Integration and Synthesis Summary: Fishes

We conducted an analysis for each fish species and present our results, as well as our conclusion and supporting rationales for each species, in the following pages. This section of the appendix is divided into two subsections. The first subsection includes an expanded version of the analysis for a large subset of species, with the organization of the analysis similar to that found in most of the other animal taxa groups in Appendix K. For this subset, the account for each species in the set includes multiple tables of information that detail the analysis of vulnerability, risk, and usage related to anticipated overlap and usage. The second subset of species, while still relying on the same types of data and consideration, addresses the remaining species, all with low anticipated usage. Subset 2 is presented in a more summarized format, which serves as a more streamlined, abbreviated account for those species.

We found that this approach provides context for the reader by providing numerous examples that offer an in-depth explanation of our analysis and the factors that were taken into account for each fish species considered in the Opinion, while also providing a more streamlined presentation of the material (i.e., in subset 2) where similar types of assumptions are appropriate across all the species in the subset. Additional information on the analyses is provided in each subsection.

SUBSET 1. Detailed Presentation of Analysis.

The following species section includes a detailed presentation of our analysis of risk related to overlap and usage. In addition to the species vulnerability assessments and summarized Environmental Baseline and Cumulative Effects information relevant to the analyis, we present results from the R-Plot analyis (see Appendix M for R-Plots), use and usage data, and our determination as to whether the proposed action is likely to jeopardize the continued existence of the listed entity in question.

Summary of changes to risk analysis for aquatic species inhabiting bins 3 and 4 since the draft Biological Opinion

Between the draft 2021 Biological Opinion (Opinion) and this final Opinion, the Service reconsidered some of our assumptions and methods related to flowing waterbodies[1] based on additional information from EPA and the registrants. Previous methods used by EPA in their biological evaluation (BE) for malathion to model bin 3 and 4 EECs greatly overestimated the concentrations anticipated to be in these larger waterbodies, and therefore, we did not rely on the numbers generated for aquatic EECs for these bins. As an interim approach for the draft Opinion, we used the modeled EECs EPA had already provided in their BE, in an effort to avoid

[1] This issue was only applicable to flowing water bodies (bins 2, 3, and 4). No such concerns were warranted for ponds, lakes, or other static water bodies (i.e., bins 5, 6, and 7) or other aquatic habitat bins.

underestimating the EECs. Using this approach, which had been previously agreed-upon by EPA and the Service, we used bin 2 modeled EECs (i.e., for small, flowing waterbodies) to estimate bin 3 and 4 EECs (for medium and larger flowing waterbodies), with the understanding that using such a value would likely overestimate concentrations found in these larger volume streams and rivers. Thus, we used bin 2 as an upper bound estimate of EECs for bins 3 and 4 in our analysis for the draft Opinion; for species found in bin 3 and 4 habitats, this method usually resulted in a risk ranking of “high” in that document.

After we issued the draft Opinion, we had additional conversations with EPA and reconsidered our approach to this issue. We determined the approach we took in the draft Opinion was overly conservative. In general, we expect that bin 3 and 4 EECs are up to an order of magnitude lower than bin 2 EECs, and the EECs in these habitats would not be expected to cause toxic effects to listed species.

Therefore, in order to more accurately reflect the level of risk from exposure in our analysis from EECs in bins 3 and 4, we adjusted the level of risk for listed species (and other species and habitat features on which they depend) in flowing waterbodies in this Opinion as follows:

- If the aquatic species inhabits only large water bodies, including larger rivers and streams assigned to bins 3 and 4, but not bin 2 (small flowing waterbodies), we changed the risk level in the final Opinion to ‘low’. This is based on our assumption that the new EEC levels are below the level where we would expect toxic effects to the species, if exposed. This same approach applies if the species inhabits larger static waterbodies (i.e., bins 6 and 7) in addition to larger flowing waterbodies, provided the species does not occur in smaller habitat (i.e., bin 2 or bin 5).

- If the aquatic species inhabits bin 3 and 4 waterbodies, and also smaller flowing or static water bodies assigned to bin 2 or 5 (which have higher EECs), respectively, we adjusted the risk level from either ‘high’ to ‘medium’ or ‘medium’ to ‘low’ - in this final Opinion. Thus, we no longer anticipate toxic effects to the species based on exposure to malathion in bins 3 and 4; however, exposure to malathion in bin 2 or 5 habitats would be at levels where we anticipate toxic effects to the listed species or other species on which it depends.

Integration and Synthesis Summary: Fishes (Acipenseridae)

Scientific Name:	Common Name:	Entity ID:
Scaphirhynchus albus	Pallid sturgeon	303

Family: Acipenseridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
In 1995, a preliminary estimate found about 45 wild pallid sturgeon existed in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996). More recent data suggest that substantially fewer wild fish remain today. For example only three wild pallid sturgeon were collected during 2007 – 2013, indicating wild pallid sturgeon numbers in the Missouri River upstream of Fort Peck Reservoir are too low for a reliable population estimate (Tews in litt., 2013). An estimated 125 wild pallid sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River (Jaeger et al. 2009). While current abundance estimates are lacking for the entire Missouri River downstream of Gavins Point Dam, Steffensen et al. (2012) generated annual population estimates for both wild and hatchery-reared pallid sturgeon for the reach of the Missouri River extending from the Platte River confluence downstream 80.5 river-kilometers (Rkm) (50 river-miles, Rmi). Their results estimated wild pallid sturgeon at 5.4 to 8.9 fish/Rkm (8.7 to 14.3fish/Rmi) and hatchery produced pallid sturgeon at 28.6 to 32.3 fish/Rkm (46.1 to 52.0 fish/Rmi). Extrapolating these estimates to the entire lower Missouri River suggests that the wild population may consist of as many as 5,991 mature individuals (Steffensen et al. 2013). This population may be stabilizing as a result of the Pallid Sturgeon Conservation Augmentation Program, but remains neither self-sustaining nor viable (Steffensen 2012; Steffensen et al. 2013). Garvey et al. (2009) generated an estimate of 1,600 (5 fish/Rkm, 0.8 fish/Rmi) to 4,900 (15.2 fish/Rkm, 24.5 fish/Rmi) pallid sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River Downstream to the Ohio River confluence). In 2009, a sturgeon survey in the Upper Mississippi River captured a single pallid sturgeon below lock and dam 25 near Winfield, Missouri (Herzog in litt., 2009). No estimates are available for the remainder of the Mississippi River.

Pallid sturgeon can be long-lived, with females reaching sexual maturity later than males (Keenlyne and Jenkins 1993). Based on wild fish, estimated age at first reproduction was 15 to 20 years for females and approximately 5 years for males (Keenlyne and Jenkins 1993). Females do not spawn each year (Kallemeyn 1983). Observations of wild pallid sturgeon collected as part of the Pallid Sturgeon Conservation Augmentation Program in the northern part of the range indicates that female spawning periodicity is 2-3 years (Rob Holm, USFWS Garrison Dam Hatchery, unpublished data). Fecundity is related to body size. The largest upper Missouri River fish can produce as many as 150,000-170,000 eggs (Keenlyne et al. 1992; Rob Holm, USFWS Garrison Dam Hatchery, unpublished data), whereas smaller bodied females in the southern extent of the range may only produce 43,000-58,000 eggs (George et al. 2012). Spawning appears to occur between March and July, with lower latitude fish spawning earlier than those in the northern portion of the range. Adult pallid sturgeon can move long distances upstream prior to spawning; a behavior that can be associated with spawning migrations (U.S. Geological Survey 2007; DeLonay et al. 2009).

The present or threatened destruction, modification or curtailment of its habitat or range remains a threat to pallid sturgeon. However, the magnitude of this threat varies across the species' range, due in part to on-going efforts to mitigate anthropogenic effects and the proportion of perturbations relative to the volume of habitat available. For example, the effects from dams (i.e., altered hydrographs and temperature profiles, altered ecologic processes, habitat fragmentation, and conversion of riverine reaches to reservoir) may be the single greatest factor affecting the species in the upper Missouri River basin. While in the middle and lower Missouri River and the middle Mississippi River, water quality, entrainment, and maintenance of the channel for navigation purposes and the associated impacts are significant threats.

Additionally, the effects from other threats may be more limiting to the species in these areas. Currently, main-stem riverine habitat is not fragmented by dams and many natural ecological processes can still create a diversity of physical habitats believed important for the species. However, data are limited related to overall water quality. Current State regulations and protections afforded under the Endangered Species Act, including the similarity of appearance rule, coupled with adequate enforcement, appear sufficient to manage, to the maximum extent practicable, the threat from overutilization for commercial, recreational, scientific, or educational purposes. New data have highlighted disease and predation as issues of potential concern that should be considered as likely threats. As of the time the 2014 Recovery Plan was written, data were inadequate to quantify the magnitude of the threat either may pose. Federal, State, and local regulatory protections have been developed to minimize and mitigate known and potential threats to fish and other aquatic species and their habitats from anthropogenic activities. There is a lack of specific information on population size, habitat use, and sensitivity or vulnerability to contaminants, entrainment, and other threats or a lack of easy access to these data where available. Energy development and invasive species are two threats that may have substantial deleterious effects on pallid sturgeon populations. Strict adherence to existing environmental laws will be necessary to minimize effects from these threats and more data will be needed to adequately evaluate the extent and magnitude of these effects. Numerous planning and conservation measures have been implemented range-wide to reduce localized effects from identified threats, including but not limited to, (1) restoration planning and implementation efforts and (2) augmentation and monitoring efforts.

EB/CE Source:
U.S. Fish and Wildlife Service. 2014. Revised Recovery Plan for the Pallid Sturgeon (*Scaphirhynchus albus*). Billings, Montana. pp. 126.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the pallid sturgeon will experience direct mortality or sublethal effects for most malathion uses at maximum rates for all bin (2, 3, and 4). We expect individuals are at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey is high and the risk to prey fish is low to high depending on use type and bin.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 23.71%: Estimated mortality among exposed individuals: 2/3/4 (M&H).
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 23.71%: Estimated sublethal effects among exposed individuals: G:2/3/4(L&M); R:2/3/4(L&M; B:2/3/4(L&M&H)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 23.71%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H); Estimated mortality among exposed prey fish: 2/3/4(L&M&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 34.76%; Estimated mortality among exposed individuals: 2/3/4(H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 34.76%: Estimated sublethal

	effects among exposed individuals: G:2/3/4(M); R:2/3/4(L); B:2/3/4(M)
Indirect	Mosquito control overlap 34.76%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H); Estimated mortality among exposed prey fish: 2/3/4(M)

Risk modifiers: Adults and immatures are piscivorous and invertivorous. They feed opportunistically on aquatic insects, crustaceans, mollusks, annelids, eggs of other fishes, and sometimes other fishes. Adult pallid sturgeon can move long distances upstream prior to spawning; a behavior that can be associated with spawning migrations. Newly hatched larvae are predominantly pelagic, drifting in the currents for 11 to 13 days and likely dispersing several hundred km downstream from spawn and hatch locations.

Indirect effects to prey fish and invertebrates:
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Because fish species exhibit a range of sensitivities to malathion, exposure is expected to have varying effects upon different species. For most fish species that are generalist feeders and rely on a variety of benthic macroinvertebrates, crustaceans, and mollusks and occasional fish prey, short-term indirect effects to aquatic invertebrate or fish prey base are anticipated to have a limited effect on food resources. These reductions to invertebrate and fish prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

Allowable uses driving effects/other considerations: Pallid sturgeon have an extremely large range and there are numerous use types that occur in watersheds where they are found. Uses with the highest overlap are Corn (7.39%), Wheat (6.88%), and Other Crops (2.16%). Because we are using bin 2 estimates as an upper bound of bin 3 & 4 exposures, effects may sometimes be overestimated for pallid sturgeon in the larger flowing waters (bins 3, 4). For individuals in Bin 3 or 4 waters near the confluence of a smaller streams (bin 2) or in nearshore areas where use sites are close to the river/stream edge effects estimates will be more realistic.

Mosquito Control: Mosquito control may occur over large portions of the species range (34.76% overlap). Exposed individuals could experience high mortality; however, the same considerations described above regarding Bin 3 and 4 waters apply to mosquito control activities.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we made specific considerations for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While pallid sturgeon do occupy other aquatic habitats (bin 2) where they may potentially be exposed to high levels of malathion, they are more commonly associated with medium to high volume bins 3 and 4 and therefore, are at a lower risk of exposure to malathion in these higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE

(Anticipated usage within the range based on past usage data)

Use type	Risk to species [1]	Use overlap with range		Estimated usage in range [2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		39,068,114	34.76	1,177,215	1.05	2,3,4	2H 3 4
Other Crops		2,431,925	2.16	892	0.00	2,3,4	2H 3 4
Other Row Crops		699,097	0.62	37,382	0.03	2,3,4	2H 3 4
Other Grains		1,840,903	1.64	162,256	0.14	2,3,4	2H 3 4
Corn		8,303,503	7.39	113,071	0.10	2,3,4	2H 3 4
Cotton		550,550	0.49	76,884	0.07	2,3,4	2H 3 4
Developed		1,788,428	1.59	89,421	0.08	2,3,4	2M

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							3 4
Wheat		7,738,179	6.88	499,730	0.44	2,3,4	2H 3 4
Vegetables & Ground Fruit		964,359	0.86	88,054	0.08	2,3,4	2M 3 4
Orchards & Vineyards		27,058	0.02	5,732	0.01	2,3,4	2H 3 4
Pasture		1,802,175	1.60	178,974	0.16	2,3,4	2H 3 4
Nurseries		6,716	0.01	6,716	0.01	2,3,4	2H 3 4
Christmas Trees		64	0.00	64	0.00	2,3,4	2H 3 4
Sub-TOTAL (D): *Other uses with direct effects*[3]		26,643,176	23.71	1,311,130	1.17		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		26,643,176	23.71	1,311,130	1.17		
TOTAL[4]:		65,711,291	58.47	2,488,345	2.21		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 112,391,886 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 9,966,159 acres, 8.867%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the pallid sturgeon. As discussed below, even though the vulnerability and and risk are medium for this species, we anticipate the likelihood of exposure to malathion is low. Furthermore, the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The pallid sturgeon has a high vulnerability based on its status, distribution, and trends. Although the species is wide-ranging, overall numbers are relatively low, with few individuals in some populations. While some populations may be stabilizing, augmentation efforts are needed, and some one or more populations are not considered self-sustaining or viable. Age to sexual maturity is high for females (20 years), and they may not spawn every year. Additionally, adults may migrate long distances to spawn, where presumably, they may encounter one or more exposures from malathion applications. Populations are fragmented due to dams, which also alter river hydrographs and temperature profiles, alter ecological processes and convert riverine reaches to reservoirs, all of which impact this species.

Where individuals are exposed to malathion applications, we anticipate medium to high levels of mortality, with survivors experiencing low to high levels of sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects in flowing water bodies, although we also anticipate effects to growth and reproduction in all waterbodies. Effects to prey are variable, with generally high levels of mortality of invertebrate prey and variable levels of mortality of piscine (fish) prey anticipated. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (58.47%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (2.21%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>112k acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or sturgeon would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the pallid sturgeon and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not expect species-level effects.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the pallid sturgeon in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Acipenseridae)

Scientific Name:	Common Name:	Entity ID:
Scaphirhynchus suttkusi	Alabama sturgeon	252

Family: Acipenseridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Population size/location(s) unknown
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Since 1990, all reports or collections of the Alabama sturgeon have been extremely rare, despite significant publicity and notoriety surrounding the species, and concentrated efforts to capture the species. Collections and reports have been restricted to the Alabama River and the Cahaba River. Only nine confirmed Alabama sturgeon captures have occurred, despite focused efforts to collect the species. Of these, two were released apparently unharmed, five died in captivity, one is known to have died shortly after release, and the fate of one is unknown. Additional efforts and observations have been made, although not all have been confirmed as Alabama sturgeon. The collection history of the Alabama sturgeon, supported by anecdotal reports from commercial fishermen, suggest that the species has disappeared from at least 85% of its historical range, and has experienced a significant decline in the remaining range since the 1960s. The species has been extirpated from the upper Tombigbee, lower Black Warrior, lower Tallapoosa, upper Alabama, and middle Cahaba rivers, where it was last reported in the 1960s; the Mobile-Tensaw Delta, last reported in 1985; the lower Coosa River, last reported ca. 1970; the lower Tombigbee River, last reported ca. 1975; (Clemmer et al., 1975; Burke and Ramsey 1985, 1995; Williams and Clemmer, 1991; Mayden and Kuhajda, 1996; M. Mettee, GSA, pers comm., 2005). The species continues to be only rarely collected from the lower portion of the Cahaba River and in the Alabama River from R.F. Henry Lock and Dam downstream to its confluence with the Tombigbee River (Burke and Ramsey 1985, 1995; N. Nichols, ADCNR, pers comm. 2005; Rider and Hartfield 2007; Rider et al. 2009; Rider and Powell 2009). The primary issue currently affecting the Alabama sturgeon is its small population size and its apparent inability to offset mortality rates with current recruitment rates. As noted previously, incidental captures of the Alabama sturgeon have steadily diminished over the last two decades. Although there are no population estimates available for the Alabama sturgeon, recent collection efforts demonstrate its increasing rarity. It is possible that Alabama sturgeon currently number fewer than 50 individuals

and it is unknown at this point, given the current operations at the Alabama River dams, the amount of suitable riverine habitat available.

It is likely that Alabama sturgeon migrate upstream during late winter and spring to spawn. Post-spawning downstream movements of shovelnose sturgeon have also been documented (Delonay, 2005). The capture of 12 individuals (including several gravid females) during a single collection trip near the mouth of the Cahaba River on 21 March 1969 suggests directional movements during the spawning season (Williams and Clemmer, 1991). Sexual maturity of the Alabama Sturgeon is believed to occur between 5 to 7 years of age. Spawning frequency of both sexes is likely influenced by food supply and fish condition, and presumably like other shovelnose sturgeon, may only occur at 2-3 year intervals (Mayden and Kuhajda 1996). Life span of the Alabama sturgeon is unknown. Although few individuals probably exceed 12 to 15 years of age (Mayden and Kuhajda 1996), it is possible the species may live longer. Adult Alabama sturgeon may exhibit seasonal downstream migrations in search of feeding and summer refugia.

The historical decline of the Alabama sturgeon was presumably triggered by unrestricted commercial harvesting between the end of the 19th century and the early 20th century (CAS 2000). Although there are no reports of commercial harvests of Alabama sturgeon after the U.S. Comm. Fish & Fisheries 1898 report, it is likely that the sturgeon continued to be affected by commercial fishing, even if there was no market. Although commercial harvesting may have significantly reduced sturgeon numbers initially, the more recent decline in the Alabama Sturgeon's range and numbers, since 1960, is more likely the result of cumulative impacts as the rivers of the Mobile River basin were developed for navigation, hydropower production, flood control, recreation, waste assimilation and other human uses (65 FR 26438). While these existing structures and activities appear to be permanent in the Mobile Basin, the present effects of their operations, such as flow regulation and navigation maintenance activities, on the Alabama sturgeon are poorly understood. The majority of rivers in the Mobile River basin are now controlled by more than 25 locks and/or dams forming a series of impoundments that are interspersed with short, free-flowing reaches. Prior to the construction of locks and dams (L&Ds) in the Mobile Basin, Alabama sturgeon could move freely between feeding areas, and from feeding areas to sites that were suitable for spawning and development of eggs and larvae. Additionally, the sturgeon may have also used large tributary streams or deep mainstem pools as thermal refugia during the summer months. Sturgeon movements were likely extensive and covered long distances. Other Scaphirhynchus species like the pallid (*S. albus*) and shovelnose (*S. platorynchus*) have been reported to migrate greater than 250 km (155 mi) (Moos 1978, Bramblet 1996, Delonay in litt. 2005). With their migration routes impeded by dams, isolated subpopulations of Alabama sturgeon were unable to successfully recruit adequate numbers to replenish the population. Reduced numbers of recruited sturgeon and surviving adult fish became more vulnerable to localized declines in water and habitat quality caused by hydropower releases, local riverine and land management practices, or by polluted discharges. Dams also reduced the possibility that sturgeon could re-colonize certain areas when subpopulations became extirpated (CAS 2000). Several conservation efforts, including those by State and Federal agencies, universities, and private organizations, have been implemented since about

1990 in an attempt to prevent further population declines and extinction of the Alabama sturgeon. These include (1) a report jointly prepared by the U.S. Army Corps of Engineers (Corps) and Service to address Corps activities in the Alabama River, (2) a conservation plan developed by the Alabama Department of Conservation and Natural Resources (DNR), (3) a voluntary conservation agreement and strategy prepared by the Corps, Alabama DNR, Alabama-Tombigbee Rivers Coalition, and the Service, (4) a multi-species recovery plan for the Mobile Basin, (5) a sturgeon sound detection study, (6) creation of a national repository for tissues and specimens, and (7) a habitat and feeding investigation.

EB/CE Source:
U.S. Fish and Wildlife Service. 2013. Recovery Plan for the Alabama Sturgeon (*Scaphirhynchus suttkusi*). Jackson, Mississppi. pp. 62.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Alabama sturgeon will experience direct mortality or sublethal effects for most malathion uses at maximum rates for all bins (2 and 4). We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey and prey fish is high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 2.37%: Estimated mortality among exposed individuals: 2/4(M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 2.37%: Estimated sublethal effects among exposed individuals: G:2/4(L&M); R:2/4(L&M); B:2/4(L&M&H)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 2.37%: Estimated mortality among exposed aquatic invertebrate prey: 2/4(H); Estimated mortality among exposed prey fish: 2/4(L&H)
MOSQUITO CONTROL	

Direct (mortality)	Mosquito control overlap 55.90%; Estimated mortality among exposed individuals: 2/4(H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 55.90%: Estimated sublethal effects among exposed individuals: G:2/4(M); R:2/4(L); B:2(M)
Indirect	Mosquito control overlap 55.90%: Estimated mortality among exposed aquatic invertebrate prey: 2/4(H); Estimated mortality among exposed prey fish: 2/4(M)

Risk modifiers: The Alabama sturgeons diet includes larval aquatic insects, oligochaetes, mollusks, fish eggs, and fishes; may scavenge. A diet that includes odonates and ephemeroptera suggests foraging in sandy depositional areas with very little silt and slow to moderate flow, but other insects in the diet suggest both rocky and soft substrates, as well as mid-water column.

Indirect effects to benthic macroinvertebrate and fish prey
Results of higher tier studies, such as outdoor mesocosms and field studies described in EPA's BE, suggest that malathion's toxicity to benthic macroinvertebrate and fish communities may be modulated through a variety of means. In contrast to laboratory toxicity studies on individual aquatic invertebrate or fish species, stream studies often show variable effects to these biotic communities that predators such as fish rely upon. Many stream studies suggest that recovery of impacted benthic macroinvertebrates is likely if there is sufficient time for recolonization between applications. Recovery of aquatic invertebrates is often rapid following disturbance, whether from flood or pulsed exposure to contaminants. Recovery of benthic macroinvertebrate communities post-exposure occurs via drift, aerial recolonization of adult aquatic insects (such as midges, dragonflies, caddisflies), and persistence of benthic macroinvertebrates in exposed areas from in-stream refugia or resistant life stages, such as diapausing eggs or nymphs. Because aquatic invertebrates and fish communities exhibit a range of sensitivities to malathion, abundance of invertebrates or fish may bebe reduced where exposure occurs, but not completely eliminated. Since the Alabama sturgeon only inhabits higher-volume and flow rivers (bin 4) and is a generalist feeder that relies on a variety of benthic aquatic invertebrate and fish prey, short-term indirect effects to some species within aquatic invertebrate and fish community prey base are anticipated to have a limited effect on the Alabama sturgeon food resources.

Allowable uses driving effects/other considerations: Alabama sturgeon only inhabit bin 4 waters. Because we are using bin 2 (small stream) estimates as an upper bound of bin 4 exposures, effects may sometimes be overestimated for sturgeon in the larger flowing waters (bin 4). For individuals in bin 4 waters near the confluence of a smaller bin 2 stream or in nearshore areas where use sites are close to the river/stream edge effects estimates will be more realistic.

Mosquito Control: Mosquito control may occur over large portions of the species range (55.90% overlap). Exposed individuals could experience high mortality; however, the same considerations described above regarding bin 4 waters apply to mosquito control activities.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we made specific considerations for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)`
		Acres	%	Acres	%		
Mosquito Control		1,949,225	55.90	73,361	2.10	4	2H 4
Other Crops		9,952	0.29	233	0.01	4	2H 4
Other Row Crops		10,845	0.31	4,784	0.14	4	2H 4
Other Grains		2,100	0.06	1,411	0.04	4	2H 4
Corn		9,855	0.28	585	0.02	4	2H 4
Cotton		41,699	1.20	9,720	0.28	4	2H 4
Developed		18,214	0.52	911	0.03	4	2M

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)`
		Acres	%	Acres	%		
							4
Wheat		1,297	0.04	330	0.01	4	2H 4
Vegetables & Ground Fruit		135	0.00	94	0.00	4	2H 4
Orchards & Vineyards		822	0.02	334	0.01	4	2H 4
Pasture		0	0.00	0	0.00	4	2H 4
Nurseries		127	0.00	127	0.00	4	2H 4
Sub-TOTAL (D): *Other uses with direct effects*[3]		95,045	2.73	18,529	0.53		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		95,045	2.73	18,529	0.53		
TOTAL[4]:		2,044,271	58.62	91,890	2.64		

^Alabama sturgeon inhabit bin 4 waters. We consider bin 2 estimates as an upper bound of bin 4 exposures.

 # acres in species range: 3,487,145 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 296,757 acres, 8.510%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Alabama sturgeon. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low. <u>While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.</u>

The Alabama sturgeon has a high vulnerability based on its status, distribution, and trends. Although the species is wide-ranging (>3 million acres), overall numbers are estimated to be very low. Additionally, adults may migrate to spawn, where presumably, they may encounter one or more exposures from malathion applications. Populations are fragmented due to dams, which also alter river hydrographs and temperature profiles, alter ecological processes and convert riverine reaches to reservoirs, all of which impact this species.

Where individuals are exposed to malathion applications, we do not anticipate exposure at levels that result in mortality based upon EPA's further investigation into bin 3 and 4 estimated environmental concentrations indicating flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species. Effects to prey are variable, with generally high levels of mortality of invertebrate prey and variable levels of mortality of piscine (fish) prey anticipated. However, as discussed above, we anticipate any reductions in prey resources would be spatially and temporally limited so as not to result in measurable reductions in prey base. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (58.47%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (2.64%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is large (>3 acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although very small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or sturgeon would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops

(e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Alabama sturgeon and its prey resources and therefore minimizes overall risk and adverse effects to the species.
Thus, while we anticipate very small numbers of individuals would be affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Alabama sturgeon in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Acipenser transmontanus	White Sturgeon (Kootenai River Pop.)	314

Family: Acipenseridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Kootenai sturgeon is a landlocked population/DPS of the White sturgeon. It is considered a single population that may travel throughout the connected portions of the DPS range. (The 6-20 populations listed from NatureServe, as shown on our ECOS website, appears to refer to all the populations of the larger White Sturgeon species. For the purposes of this consultation, we are considering the DPS as a single population.) The species' 5-Year Review (2011) references various studies estimating the population from approximately 800 to 1,500 individuals and possibly in a long-term decline from approximately 7,000 white sturgeon in the late 1970s. In 2019, an interim progress report from Idaho Department of Fish and Game estimated that the wild adult Kootenai sturgeon population abundance had declined from approximately 2,072 individuals in 2011 to 1,744 individuals (confidence interval 1,232 to 2,182) in 2017 (Hardy and McDonnell 2019). Annual survival rates (estimated by mark-recapture analysis) are estimated to be approximately 96 percent. These latest estimates are the most current information available and constitute the best available science on the abundance and survival of wild adult Kootenai sturgeon. (The NatureServe data indicates 10,000 to 1,000,000 individuals, which appears to relate to the White Sturgeon as a species and not this DPS.)

Although this long-lived species travels widely throughout its landlocked range, it has a low reproduction rate and juvenile recruitment appears to be extremely low. The significant change to the natural flows in the Kootenai River caused by flow regulation at Libby Dam is considered to be a primary reason for the Kootenai River white sturgeon's continued lack of recruitment and declining numbers. Beginning with the partial operation of Libby Dam in 1972 (though not fully operational until 1974), average spring peak flows in the Kootenai River have been reduced by more than 50%, and winter flows have increased by 300% compared to pre-dam values. As a result of original Libby Dam operations until the initiation of experimental flows in 1992, the natural high spring flows thought to be required by white sturgeon for reproduction rarely occurred during the May to July spawning season when suitable temperature, water velocity, and photoperiod conditions would normally exist. In addition, cessation of periodic flushing flows allowed fine sediments to build up in the Kootenai River bottom substrates. This sediment fills the spaces between riverbed cobbles, reducing fish egg survival, larval and juvenile fish security cover, and insect production.

Much of the Kootenai River has been channelized and stabilized from Bonners Ferry downstream to Kootenay Lake, resulting in reduced aquatic habitat diversity, altered flow conditions at potential spawning and nursery areas, and altered substrates in incubation and rearing habitats necessary for survival (Partridge 1983, Apperson and Anders, 1991). Poor water quality and excessive nutrients in the upper Kootenai River were considered to be major problems for the white sturgeon and other native fishes prior to the construction and operation of Libby Dam. Graham (1981) believed that poor water quality conditions in the 1950s and 1960s, from industrial and mine development, most likely affected white sturgeon reproduction and recruitment prior to 1974. Significant improvements in Kootenai River water quality were noted by 1977, due in part to wastewater control and effluent recycling measures initiated in the late 1960s. Although fertilizer processing, sewage, lead-zinc mine, and vermiculite discharges have been eliminated, many of these pollutants and contaminants persist, primarily bound in sediments.

At present, there are several State, Federal, Tribal, and Canadian programs and conservation efforts that may help achieve recovery objectives for the Kootenai River population of white sturgeon. These include measures to better manage flows and associated stressors related to water temperature, sediment, and other factors; regional planning efforts; augmentation; and research and monitoring. For example, in 2009, the Kootenai Tribe of Idaho (Kootenai Tribe or KTOI) completed the Kootenai River Habitat Restoration Program Master Plan, which developed a framework for implementing a large-scale, ecosystem-based habitat restoration program in the Idaho portion of the Kootenai River (KTOI 2009). This habitat restoration program focuses on addressing threats to Kootenai sturgeon including changes to river morphology and reductions in floodplain interaction, riparian habitat, and nutrients. Between 2011 and 2016, the Kootenai Tribe completed construction of nine habitat restoration projects under this program, including eight projects in the braided reach of the Kootenai River and one project in the meander reach.

EB/CE Source:

U.S. Fish and Wildlife Service. 2019. Revised Recovery Plan for the Kootenai River Distinct Population Segment of the White Sturgeon (*Acipenser transmontanus*). Portland, Oregon. pp. 44

U.S. Fish and Wildlife Service. 2011Kootenai River Distinct Population Segment of the White Sturgeon (*Acipenser transmontanus*) 5-Year Review: Summary and Evaluation. Portland, Oregon. pp. 30

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the white sturgeon will experience direct mortality or sublethal effects for most malathion uses at maximum rates for all bins (2, 4, and 7). We expect the risk of mortality will be high in bins 2 and 4 and medium in bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk of mortality to aquatic invertebrate prey to be high and the risk to prey fish to be low to medium for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 18.87%: Estimated mortality among exposed individuals: 2/4(M&H), 7(L &M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 18.87%: Estimated sublethal effects among exposed individuals: G:2/4(L&M),7(L): R:2/4(L),7(L); B:2/4(L&M&H),7(L)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 18.87%: Estimated mortality among exposed aquatic invertebrate prey: 2/4(H), 7(M&H); Estimated mortality among exposed prey fish: 2/4(L&H), 7(L&M)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 0.95%; Estimated mortality among exposed individuals: 2/4(H),7(L)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 0.95%: Estimated sublethal effects among exposed individuals: G:2/4(M),7(L); R:2/4(L),7(L); B:2/4(M),7(L)
Indirect	Mosquito control overlap 0.95%: Estimated mortality among

	exposed aquatic invertebrate prey: 2/4(H), 7(H); Estimated mortality among exposed prey fish: 2/4(H),7(L)

Risk modifiers: White sturgeon in the Kootenai River system and elsewhere are considered opportunistic feeders. White sturgeon more than 70 centimeters (28 inches) in length feed on a variety of prey items including clams, snails, aquatic insects, and fish. Young feed mostly on the larvae of aquatic insects, crustaceans, and molluscs. A significant portion of the diet of larger sturgeon consists of fish. White sturgeon are broadcast spawners, releasing their eggs and sperm in fast water. Based upon recent studies, Kootenai River white sturgeon spawn during the period of historical peak flows from May through July. Following fertilization, eggs adhere to the river substrate and hatch after a relatively brief incubation period of 8 to 15 days, depending on water temperature. Recently hatched yolk-sac larvae swim or drift in the current for a period of several hours and then settle back into interstitial spaces in the substrate. Larval white sturgeon require an additional 20 to 30 days to metamorphose into juveniles with a full complement of fin rays and scutes. Males may reach sexual maturity in about 9 years, females in 13-16 years. They may live over 100 years. Kootenai River White sturgeon are land-locked but move throughout their range to spawn.

Indirect effects to benthic macroinvertebrate and fish prey: Results of higher tier studies, such as outdoor mesocosms and field studies described in EPA's BE, suggest that malathion's toxicity to benthic macroinvertebrate and fish communities may be modulated through a variety of means. In contrast to laboratory toxicity studies on individual aquatic invertebrate or fish species, stream studies often show variable effects to these biotic communities that predators such as fish rely upon. Many stream and mesocosm studies suggest that recovery of impacted benthic macroinvertebrates is likely if there is sufficient time for recolonization between applications. Recovery of benthic macroinvertebrate communities post-exposure occurs via drift, aerial recolonization of adult aquatic insects (such as midges, dragonflies, caddisflies), and persistence of benthic macroinvertebrates in exposed areas from in-stream refugia or resistant life stages, such as diapausing eggs or nymphs. Because aquatic invertebrates and fish communities exhibit a range of sensitivities to malathion, abundance of invertebrates or fish is expected to be reduced where exposure occurs, but not completely eliminated. Since the white sturgeon is a generalist feeder that relies on a variety of benthic aquatic invertebrate and fish prey, short-term indirect effects to some prey species within aquatic invertebrate and fish communities are anticipated to have a limited effect on the Alabama sturgeon food resources.

Allowable uses driving effects/other considerations: The use type that accounts for most of the overlap is Wheat (13.61%). Lethal effects from this use could be high in streams/rivers (bin 2 and 4) where Wheat usage occurs, but low in larger ponds/lakes (bin 7). Because we are using bin 2 estimates as an upper bound of Bin 4 exposures, effects may sometimes be overestimated for White sturgeon in the larger flowing waters (bin 4). For individuals in Bin 4 waters near the confluence of a smaller streams (bin 2) or in nearshore areas where use sites are close to the river/stream edge effects, estimates will be more realistic.

Mosquito Control: Mosquito control may occur over a small portion of the species range (0.95% overlap). Exposed individuals could experience high mortality in Bin 2/4 and low mortality in bin 7; however, the same considerations described above regarding Bin 4 waters apply to mosquito control activities.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the White sturgeon does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, they can mitigate their potential risk of exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	3,351	0.95	NA	NA	2,4,7	2H 4 7L
Other Crops	D,I	729	0.21	0	0.00	2,4,7	2H 4 7M
Other Row Crops	D,I	0	0.00	0	0.00	2,4,7	2H 4 7M
Other Grains	D,I	7,271	2.06	6,940	1.96	2,4,7	2H 4 7M
Corn	D,I	4	0.00	0	0.00	2,4,7	2H 4 7M
Developed	D,I	2,488	0.70	124	0.04	2,4,7	2M

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							4 7L
Wheat	D,I	48,146	13.61	48,146	13.61	2,4,7	2H 4 7M
Vegetables & Ground Fruit	D,I	1,035	0.29	1,111	0.31	2,4,7	2H 4 7M
Pasture	D,I	6,999	1.98	6,999	1.98	2,4,7	2H 4 7M
Nurseries	D,I	59	0.02	59	0.02	2,4,7	2H 4 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		66,732	18.87	63,380	17.96		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		66,732	18.87	63,380	17.96		
TOTAL[4]:		70,083	19.81	63,380	17.96		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 353,713 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 247,235 acres, 69.897%

Overall Usage: ☒ **High** ☐ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the white sturgeon (Kootenai River Pop.). As discussed below, even though vulnerability and usage are high for this species, risk is medium, and we anticipate the likelihood of exposure of large numbers of individuals of this this DPS to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Kootenai River population of the white sturgeon has a high vulnerability based on its status, distribution, and trends. Although the white sturgeon species is wide-ranging, the listed entity

(Kootenai River population) has a smaller range (>300,000 acres). This population had experienced a decline over a number of decades and has relatively small numbers (approximately 1,700 individuals), exacerbated by a low reproduction rate and likely low juvenile recruitment, although annual survival rates are estimated to be high (96%). While water quality issues were initially identified as concerns for the species prior to the construction of Libby Dam; much of the impact to continued lack of recruitment and declining numbers appear to be related to operation of the dam, and other activities such as elimination of side-channel habitat, and diking and bank stabilization, among other factors.

Where individuals are exposed to malathion applications, we anticipate medium to high levels of mortality and variable levels of sublethal effects, with higher degrees effects more likely to occur in the riverine portions of the species' habitats. We expect survivors would experience low to high levels of sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects in flowing water bodies, although we also anticipate effects to growth and reproduction in all waterbodies. Effects to prey are variable, with generally high levels of mortality of invertebrate prey and variable levels of mortality of piscine (fish) prey anticipated. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (19.81% of individuals of the species potentially exposed), as described above.

We estimate that approximately 70% of the species range overlaps with Federal lands, where usage is anticipated to be low. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Opinion. Thus, for the majority of the species range, we anticipate the likelihood of exposure of the individuals and their prey is likely to be extremely low.

For the remaining portion of the species range, which occurs on non-Federal lands (approximately 30% of the range), we anticipate usage will be high (17.96%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above; this high usage value is driven primarily by high usage estimates for wheat (13.61%). Where individual fish travel through the stretches of riverine habitat that extend through agricultural lands, and particularly where malathion is applied to wheat (where most of the usage is anticipated to occur), we anticipate a greater likelihood of exposure. In these areas, we anticipate small numbers of individuals would be exposed to malathion applications, especially in narrow or near-shore reaches that are characterized as small flowing habitats. In those areas, we anticipate localized effects (e.g., reductions in prey) would occur as a result of applications of malathion. However, we anticipate additional food resources from upstream sources would quickly recolonize, or sturgeon would seek out other areas of available prey. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the white sturgeon (Kootenai River population) and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be affected by mortality, sublethal, or prey base effects, particularly downstream of, or in the vicinity of these agricultural areas on non-Federal lands, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the white sturgeon (Kootenai River population) in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Acipenser oxyrinchus (=oxyrhynchus) desotoi	Atlantic sturgeon (Gulf subspecies)	286

Family: Acipenseridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Gulf subspecies of the Altlantic sturgeon has populations that occur in several river basins within the Gulf of Mexico. Some populations of this species number in the thousands, others in the hundreds, with populations ranging from Alabama to Florida.

The 1991 listing rule cited the following impacts and threats: dams on the Pearl, Alabama, and Apalachicola rivers and the North Bay arm of St. Andrews Bay; channel improvement and maintenance activities; dredging and de-snagging; water quality degradation; and contaminants. All of the dams noted in the listing rule continue to block passage of Gulf sturgeon to historical spawning habitats and thus either reduce the amount of available spawning habitat or entirely impede access to it. Since Gulf sturgeon were listed, several new dams have been proposed on rivers that support Gulf sturgeon. Effects of these dams on Gulf sturgeon and their habitat and potential mitigating factors continue to be investigated, including the effects of dam operations on downstream habitats (i.e., both spawning and foraging areas). Dredging to maintain navigation channels and removal of sediments for beach renourishment occur frequently throughout the range of the Gulf sturgeon and within designated Gulf sturgeon habitat. These activities have and continue to threaten the species and affect its designated critical habitat. Potential threats to Gulf sturgeon critical habitat were documented in the upper Choctawhatchee and lower Pea Rivers (Popp and Parauka 2004, Newberry and Parauka in press). Potential habitat threats were identified based on degraded habitat characteristics, such as erosion, riparian condition, presence of unpaved roads, and presence of agriculture.

Evaluations of water and sediment quality in Gulf sturgeon habitat on the northern Gulf of Mexico coast have consistently shown elevated pollutant loading in types of tidal coastal rivers that the sturgeon use in the spring and summer (Hemming et al. 2006, 2008). Perhaps better understood is the widespread contamination throughout the overwintering feeding habitat of the

Gulf sturgeon (Brim 1998, 2000, NWFWMD 1997, 1998, 2000, 2002, Hemming 2002, 2003a, 2003b, 2004, 2007). Although the specific effects of these widely varied pollutants on sturgeon in their various life stages is not clearly understood, there is ample evidence to show potential deleterious effects to Gulf sturgeon and their habitat. Sulak et al. (2004) suggest that successful egg fertilization for Gulf sturgeon may+ require a relatively narrow range of pH and calcium ion concentration. These parameters vary substantially along the length of the Suwannee River. Egg and larval development are also vulnerable to various forms of pollution and other water quality parameters (e.g., temperature, dissolved oxygen). Pollution from industrial, agricultural, and municipal activities is believed responsible for a suite of physical, behavioral, and physiological impacts to sturgeon worldwide (Karpinsky 1992, Barannikova 1995, Barannikova et al. 1995, Khodorevskaya et al. 1997, Bickham et al. 1998, Khodorevskaya and Krasikov 1999, Billard and Lecointre 2001, Kajiwara et al. 2003, Agusa et al. 2004). Although little is known about contaminant effects on Gulf Sturgeon, a review estimating potential reactions has been performed (Berg 2006). Loss of habitat associated with pollution and contamination has been documented for sturgeon species (Verina and Peseridi 1979, Shagaeva et al. 1993, Barannikova et al. 1995). Specific impacts of pollution and contamination on sturgeon include muscle atrophy, abnormality of gonad, sperm and egg development, morphogenesis of organs, tumors, and disruption of hormone production (Graham 1981, Altuf'yev et al. 1992, Dovel et al. 1992, Georgi 1993; Romanov and Sheveleva 1993, Heath 1995, Khodorevskaya et al. 1997, Kruse and Scarnecchia 2002). More recently, pharmaceuticals and other endocrinologically active chemicals have been found in fresh and marine waters at effective concentrations (reviewed in Fent et al. 2006). These compounds enter the aquatic environment via wastewater treatment plants, agricultural facilities, and farm runoff (Folmar et al. 1996, Culp et al. 2000, Wildhaber et al. 2000, Wallin et al. 2002). These products are the source of both natural and synthetic substances including, but not limited to, polychlorinated biphenyls, phthalates, pesticides, heavy metals, alkylphenols, polycyclic aromatic hydrocarbons, 17β-estradiol, 17α-ethinylestradiol, and bisphenol A (Pait and Nelson 2002, Aguayo et al. 2004, Nakada et al. 2004, Iwanowicz et al. 2009, Björkblom et al. 2009). The impact of these exposures on Gulf sturgeon is unknown, but other species of fish are affected in rivers and streams. For example, one major class of endocrine disrupting chemicals, estrogenic compounds, have been shown to affect the male to female sex ratio in fish in streams and rivers via decreased gonad development, physical feminization, and sex reversal (Folmar et al. 1996). Settlement of these contaminants to the benthos may affect benthic foragers to a greater extent than pelagic foragers due to foraging strategies (Geldreich and Clarke 1966).

The majority of published data regarding contaminants and sturgeon health are limited to reports of tissue concentration levels. While these data are useful and allow for comparison between individuals, species, and regions, they do not allow researchers to understand the impacts of the concentrations. There is expectation that Gulf sturgeon are being negatively impacted by organic and inorganic pollutants given high concentration levels (Berg 2006). Gulf sturgeon collected from a number of rivers between 1985 and 1991 were analyzed for pesticides and heavy metals (Bateman and Brim 1994); concentrations of arsenic, mercury, DDT metabolites, toxaphene, polycyclic aromatic hydrocarbons, and aliphatic hydrocarbons were sufficiently high to warrant concern. More recently, 20 juvenile Gulf sturgeon from the Suwannee River, Florida exhibited an increase in metals concentrations with an increase in individual length (Alam et al. 2000). Federal and state water quality standards are protective of most taxa in many habitats. However, impacts of reduced water quality continue to be realized at species-specific and habitat-specific scales, and magnification through the trophic levels continues to be assessed. Current water quality standards are not always protective of federally listed species (Augsburger et al. 2003, Augsburger et al. 2007). To compound the issue, many previously identified water quality problems realized through violation of state water quality standards are addressed through the necessarily slow and deliberate process of regulated point and non-point source pollutant load reductions (Total Maximum Daily Loads, TMDLs) for chemicals that have specific quality criteria. Because there are thousands of chemicals interacting in our natural environment, many of them of human design, many do not have Federal or state water quality standards associated with them. Further, effects of most of these chemicals on the Gulf sturgeon or other protected species are poorly understood. For these reasons, point and non-point discharges to the Gulf sturgeon's habitat continue to be a threat.

Climate change has potential implications for the status of the Gulf sturgeon through alteration of its habitat. The Intergovernmental Panel on Climate Change concluded that it is very likely that heat waves, heat extremes, and heavy precipitation events over land will increase during this century (IPCC 2007). Warmer water, sea level rise, and higher salinity levels could lead to accelerated changes in habitats utilized by Gulf sturgeon. Saltwater intrusion into freshwater systems could negatively impact freshwater fish and wildlife habitat, resulting in more saline inland waters that may eventually lead to major changes in inland water ecosystems and a reduction in the amount of available freshwater. Changes in water temperature may alter the growth and life history of fishes, and even moderate changes can make a difference in distribution and number. Freshwater habitats can be stressed by changes in water quality and water levels because of anticipated extreme weather periods as mean precipitation is expected to decrease along with an increase in precipitation intensity. Both droughts and floods could become more frequent and more severe, which would affect river flow, water temperature, water quality, channel morphology, estuarine salinity regimes, and many other habitat features important to the conservation of Gulf sturgeon. A rise in water temperature may create conditions suitable for invasive and exotic species. Higher water temperatures combined with increased nutrients from storm runoff may also result in increased invasive submerged and emergent water plants and phytoplankton, which are the foundation of the food chain. New species of freshwater fishes may become established with warmer water temperatures (FWC 2009). The rate that climate change and corollary impacts are occurring may outpace the ability of the Gulf sturgeon to adapt, given its limited geographic distribution and low dispersal rate. Additional past and ongoing threats may include bycatch, red tide, collision with boats, and potential hybridization due accidental release of non-native sturgeon.

EB/CE Source:

U.S. Fish and Wildlife Service. 2009. Gulf Sturgeon (*Acipenser oxyrhinchus desotoi*) 5-Year Review: Summary and Evaluation. Panama City, Florida. pp. 49.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Atlantic sturgeon will experience direct mortality or sublethal effects for most uses of malathion at maximum rates for all bins (2, 3, 4, 6, and 7). The risk of mortality is anticipated to be high in bins 2, 3, 4, and 6 and low to medium for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey will be high in all bins and the risk to prey fish to be low to medium depending on the bin.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 6.52%: Estimated mortality among exposed individuals: 2/3/4(M&H), 6(L&M&H), 7(L&M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 8.54%: Estimated sublethal effects among exposed individuals: G:2/3/4(L&M),6(L&M),7(L&M); R:2/3/4(L&M),6(L&M),7(L); B:2/3/4(L&M&H),6(L&M&H),7(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 8.54%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 6(L&H), 7(L&H); Estimated mortality among exposed prey fish: 2/3/4(L&H), 6(L&M&H), 7(L&M)
MOSQUITO CONTROL	
Direct (mortality)	Total overlap 58.52%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 6(M), 7(L)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 58.52%: Estimated sublethal effects among exposed individuals: G:2/3/4(M),6(L),7(L);

	R:2/3/4(L),6(L),7(L); B:2/3/4(M),6(M),7(L)
Indirect	Total overlap 58.52%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 6H), 7(H); Estimated mortality among exposed prey fish: 2/3/4(M), 6(L), 7(L)

Risk modifiers: Gulf sturgeon are piscivores and invertivores. They feed primarily on benthic invertebrates and small fishes as available (e.g., worms, crustaceans, aquatic insects, snails, sand lances). Feeding evidently occurs only during the winter and spring in offshore or estuarine waters. Upon hatching from their eggs, gulf sturgeon larvae spend the first few days of life sheltered in interstitial spaces at the spawning site. Young-of-the-year spend 6-10 months slowing working their way downstream feeding on aquatic insects (e.g., mayflies and caddisflies), worms (oligochaetes), and bivalve molluscs, and arrive in estuaries and river mouths by mid-winter where they will spend their next 6 years developing. After spawning, adult gulf sturgeon migrate downstream to summer resting and holding areas in the mid to lower reaches of the rivers where they may hold until November. While in freshwater adults lose a substantial amount of their weight but regain it upon entering the estuaries. Sub adult and non-spawning adults also spend late spring through fall in these holding areas. By early December all adult and sub-adult gulf sturgeon return to the marine environment to forage on benthic (bottom dwelling) invertebrates along the shallow nearshore (2–4-meter depth), barrier island passes, and in unknown off-shore locations in the gulf. Juvenile gulf sturgeon overwinter in estuaries, river mouths, and bays; juveniles do not enter the nearshore/offshore marine environments until around age 6. Gulf sturgeon show a high degree of river-specific fidelity. Adult and sub-adult gulf sturgeon fast while in freshwater environments and are almost entirely dependent on the estuarine/marine environment for food. Some juveniles (ages 1-6) will also fast in the freshwater summer holding areas, but the majority feed year-round in the estuaries, river mouths, and bays.

Indirect effects to aquatic invertebrate and fish prey

Because aquatic invertebrates and fishes exhibit a range of sensitivities to malathion, abundance of gulf sturgeon prey items is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of prey, short-term indirect effects to aquatic invertebrate and fish prey are anticipated to have a limited effect on gulf sturgeon food resources. These reductions are likely temporary (based on application frequency), and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations: Gulf sturgeon have a very large range and there are numerous use types that occur in watersheds where they are found. Uses with the highest overlap are Developed (2.98%), Pine seed orchard (2.02%), and Other row crops (0.77%). Because we are using bin 2 estimates as an upper bound of bin 3 & 4 exposures, effects may sometimes be overestimated for Gulf sturgeon in the larger flowing waters (bins 3 and 4). For individuals in bin 3 or 4 waters near the confluence of a smaller streams (bin 2) or in nearshore areas where use sites are close to the river/stream edge effects estimates will be more realistic.
Mosquito Control: Mosquito control may occur over large portions of the species range (58.52% overlap). Exposed individuals could experience high mortality; however, the same considerations described above regarding bin 3 and 4 waters apply to mosquito control activities.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Atlantic sturgeon (Gulf subspecies) does occupy other aquatic habitats with potentially high levels of malathion exposure, their potential exposure risk is partially mitigated by their reliance upon higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☐ High ☒ Medium ☐ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		25,925,056	58.52	2,186,160	4.94	2,3,4,6,7	2H 3 4 6M 7L
Other Crops		315,569	0.71	33	0.00	2,3,4,6,7	2H 3 4 6H 7M
Other Row Crops		343,198	0.77	24,887	0.06	2,3,4,6,7	2H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							3 4 6H 7M
Other Grains		238,436	0.54	35,788	0.08	2,3,4,6,7	2H 3 4 6H 7M
Corn		128,021	0.29	4,967	0.01	2,3,4,6,7	2H 3 4 6H 7M
Cotton		289,578	0.65	41,619	0.09	2,3,4,6,7	2H 3 4 6H 7M
Developed		1,319,439	2.98	65,972	0.15	2,3,4,6,7	2M 3 4 6L 7L
Rice		382	0.00	75	0.00		
Wheat		12,359	0.03	2,016	0.00	2,3,4,6,7	2H 3 4 6H 7M
Vegetables & Ground Fruit		17,481	0.04	4,251	0.01	2,3,4,6,7	2H 3 4 6H 7M
Orchards & Vineyards		217,027	0.49	205,408	0.46	2,3,4,6,7	2H 3 4 6H 7M
Pasture		93	0.00	29	0.00	2,3,4,6,7	2H

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							3 4 6H 7M
Nurseries		7,030	0.02	7,030	0.02	2,3,4,6,7	2H 3 4 6H 7M
Christmas Trees		8	0.00	7	0.00	2,3,4,6,7	2H 3 4 6H 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		3,784,598	6.52	437,036	0.99		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		3,784,598	6.52	437,036	0.99		
TOTAL[4]:		29,709,654	65.05	2,623,195	5.92		

 # acres in species range: 44,298,385 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 5,211,432 acres, 11.764%

Overall Usage: ☐ **High** ☒ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Atlantic sturgeon (Gulf subspecies). As discussed below, even though the vulnerability and risk aremedium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Atlantic (Gulf) sturgeon has a medium vulnerability based on its status, distribution, and trends. Although the species is wide-ranging (>44 million acres), overall numbers among populations range from in the hundreds to thousands of individuals. The Atlantic (Gulf) sturgeon falls under the purview of both the National Marine Fisheries Service (NMFS) (in marine waters) and FWS (in inland waters), and encompasses the species' freshwater range covering the watersheds draining to the Gulf of Mexico, from Louisiana to Florida. The species is anadromous, with adults migrating between freshwater spawning areas and nonspawning areas in marine waters. The NMFS' Opinion will (or has) address(ed) the species in its marine habitats, while this analysis addresses only the freshwater phases of the species. Juveniles spend their first two years in freshwater habitats, while adults are generally found in freshwater habitats from spring through fall, although some individuals may remain near their freshwater spawning habitat for longer periods of time. The species is long-lived and has high fecundity, although lower reproductive rates suggest juvenile recruitment may not be as high. The species is vulnerable to a variety of threats due to its small number of remaining populations and degraded habitats. Both juveniles and adults prey on aquatic invertebrates and other fish. However, with perhaps the exception of young- of-the-year juveniles (i.e., <1 year), individuals feed in the estuaries and marine waters and are not known to feed in freshwater habitats (FWS 2009 5-Year Review).

We anticipate both juveniles and adults may be exposed to malathion while in their freshwater habitats, with adult exposure primarily occurring from spring through fall during spawning migrations. Where individuals are exposed to malathion applications, we anticipate medium to high levels of mortality, with survivors experiencing low to high levels of sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. Effects to prey are variable, with generally high levels of mortality of invertebrate prey and variable levels of mortality of piscine (fish) prey anticipated. Additionally, we anticipate reductions in prey abundance and related effects in freshwater habitats would apply primarily to young-of-the-year juveniles.

The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (58.47%), as described above. However, we anticipate actual usage within the non-Federal portion of the species' range will be medium (5.92%), based on the usage data we acquired, as described in the Opinion and summarized for this species above. Most of this usage relates to mosquito adulticide. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is large (>44 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although very small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. We anticipate most exposure, resulting in mortality, sublethal, and prey base effects, would occur in smaller flowing streams, where young-of-the-year juveniles may be rearing or foraging. We anticipate exposure of individual juveniles based on this level of usage would be localized, with small numbers of juveniles across the range exposed to runoff from pesticide applications. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or sturgeon would seek out other areas of available prey. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Atlantic sturgeon (Gulf subspecies) and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate very small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Atlantic sturgeon (Gulf subspecies) in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Amblyopsidae)

Scientific Name:	Common Name:	Entity ID:
Speoplatyrhinus poulsoni	Alabama cavefish	236

Family: Amblyopsidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Alabama cavefish is known only from Key Cave (formerly known as Coffee Cave) (Aley 1990)) in Key Cave NWR, a satellite unit of the Wheeler NWR complex situated on Tennessee Valley Authority (TVA) land in Lauderdale County, northwest Alabama. This species is considered extremely rare with a total population estimate of less than 100 individuals (Kuhajda 2004a). Surveys of caves for additional populations of the species were last conducted between 1992 and 1997 by Kuhajda and Mayden (2001) and were unsuccessful. It is unknown whether this species has ever had a wider range, as troglobytic (cave) fish generally occur at restricted localities with small population sizes (Romero *et al.* 2010). However, this species' single occurrence in Key Cave represents one of the most restricted ranges when compared to other Amblyopsids (fish commonly referred to as cavefish) and may represent a relict population of a once more widely distributed species (Niemiller and Poulson 2010).

Kuhajda and Mayden (2001) considered the Alabama cavefish population within Key Cave to be relatively stable between 1967 through 1997. The most recent survey of Key Cave was in 2009 where Kuhajda and Fluker noted a total of 19 specimens in five visits from October 2008 through February 2009. During these surveys, Kuhajda and Fluker (2010) considered the population stable based on the representation of different size/age classes. They found the species in three pools: Pool A-4 individuals; Pool B-12 individuals; and, Pool D-3 individuals. None were found in Pools C, E-J and Lynnys Pool.

Key Cave is in the recharge area of the Mississippian-aged Tuscumbia Limestone aquifer that approximately lies along the ancient Cretaceous shoreline of the Mississippi Embayment (Cooper and Kuehne 1974). The cave has a mapped groundwater recharge area of approximately 26 square km (16 square mi). Groundwater flowing through the cave is likely discharged into the Tennessee River via Collier Spring, which is submerged under Pickwick Reservoir, and Woodland Spring. There is only one above-ground stream in the recharge area (Kuhajda 2004b, U.S. Fish and Wildlife Service 2007). Therefore, most of the surface water enters the Key Cave karst system through sinkholes or seeps (U.S. Fish and Wildlife Service 2007). Aley (1987) estimated the mean annual discharge from the Key Cave aquifer as 0.42 to 0.57 cubic meters per second (15 to 20 cubic feet per second). In general, water levels tend to vary within the cave (U.S. Fish and Wildlife Service 1990) and may correspond to above-ground conditions, along with water elevations in Pickwick Lake (Aley 1990), suggesting that droughts may negatively impact the Key Cave aquifer. The Alabama cavefish does not reproduce every year and has low fecundity. Due to a longer life, and fewer spawning events, decreased recruitment within a population will not be immediately realized (Kuhajda 2004b). Cavefish in general and the Alabama cavefish specifically show an increase in longevity and a decrease in population growth rate as habitat availability is reduced (Poulson 1961, Hobbs 1992, Poulson 2001, Kuhajda 2004b).

Since little is known about this species, we must infer aspects of its biology from knowledge of other related species. Cavefish adults quickly respond and move toward a water surface that is disturbed by falling water droplets or bat guano, but they also scavenge for food, perhaps relying on chemosensory organs, originally adapted for bottom feeding, that allow the fish to perceive chemicals in the water that are related to food sources. In contrast, relatively small, younger fish scavenge for food exclusively at the bottom, again possibly using chemosensation (Yoshizawa 2015). Bats in general and the gray bat (*Myotis grisescens*) in particular, are important in the conservation and management of the Alabama cavefish (Tuttle 1979). In Key Cave, the gray bat colony is likely the primary source of organic matter through the deposition of guano (U.S. Fish and Wildlife Service 1990). Additional nutrient sources for cavefish, other than the guano dropped by bats living at the cave ceiling, is the organic matter brought into the cave system through sinkholes, sinking streams, and cave entrances by seasonal flooding (Yoshizawa 2015). In another cavefish, optimum Ozark cavefish (*Amblyopsis rosae*) habitat also occurs in caves with large colonies of gray bats (Brown and Todd 1987) or comparatively large sources of allochthonous (outside surface runoff) matter (U.S. Fish and Wildlife Service 1989). Diminished organic matter input adversely impacts the aquatic food base in caves. This disruption of food resources triggers hormonal and other changes in aquatic organisms (Poulson 1961).

The Key Cave entrance and 429 ha (1060 ac) of surface property above the cave (about 10% of the total known recharge area) is partially protected due to its ownership by the U.S. Fish and Wildlife Service. However, full protection is not afforded to habitat on private lands, including portions of the aquifer and especially the sinkholes throughout the recharge area. This species exists in a fragile ecosystem and continues to face threats from groundwater degradation, lower groundwater levels, in addition to a diminished organic matter input by bats. Survey reports of caves in the area showed large populations of gray bats in the late 1990s (Hudson 1997). However, during the last 15 years, the reduction of bat populations and guano deposits in Key Cave (Gates 2015, 2014, pers. comm.) may have reduced the nutrient cycling in cave waters (Kuhada 2004b). White-nose syndrome is causing increased bat mortality and population losses due to impacts on the species during hibernation and emergence (Reeder et al. 2012, Verant et al. 2014). Thus, the amount of nutrients in the form of bat guano may be decreasing and the overall carbon exchange in the groundwater declining. This species' small population size also contributes to its vulnerability. Though progress has been made towards the conservation of this species' and its habitat, to date none of the recovery criteria have been met.

Samples of gray bats from Cave Springs Cave on Wheeler NWR proper, 88 km (55 mi) east of Key Cave have shown that bats are a sensitive indicator of both the level and geographic extent of Tennessee River contamination from the former DDT plant near Huntsville, Alabama (Clark *et al.* 1988). Pesticide residue in guano of gray bats has been well documented in caves throughout the Southeast (Clark *et al.* 1983a, 1983b, 1980) and has been attributed to bats feeding on arthropods exposed to pesticides following agricultural application (Clark *et al.* 1978; Clawson 1991, Clawson and Clark 1989). Direct leaching of pesticides from guano into the cave water may threaten the physiology and behavior of the Alabama cavefish (Kuhajda 2016, pers. comm.), and it may reduce food resources such as arthropods.

The NWR consists of rolling hills and crop land, including a 15-ha (38 ac) sinkhole pond. The sinkhole and associated waterways are buffered by at least 10 m (32 ft) of standing vegetation and are protected by at least a 30 m (100 ft) buffer from pesticide spraying. Past farming practices have led to severe soil erosion problems; however, current management efforts by the NWR include erosion control to enhance the water quality for the endangered species inhabiting Key Cave. Aley (1987) mapped and characterized the sinkholes and sinking streams of the Key Cave aquifer and noted that many of the sinkholes are broad and shallow, thus conducive to row crop farming and they also may demonstrate a ponding effect after runoff from significant rain events. The gradual shape of these sinkholes may allow pesticides to enter the aquifer at a greater rate in contrast to pesticides entering the groundwater through non-sinkhole areas. Aley (1987) states that sinkholes pose significant high hazards (entry) for pesticides to enter groundwater. Aley (1987) also designated as *High Hazard* areas (where there is a high probability of pesticides entering the aquifer) within 3084 m (10000 ft) of Key Cave and all sinkholes within the Key Cave Aquifer recharge area. Because monitoring or testing of groundwater has not occurred, specific information regarding the effects of this change are unknown (Hurt 2016, pers. comm.). Prior to 2013, the Cooperative Farming Program at Key Cave NWR allowed planting of Genetically Modified Organism (GMO) crops in 12 managed and rotated agricultural fields. The change of pesticide type and application rate when converting from GMO to non-GMO agriculture has been shown to increase pesticide accumulation in bat guano (Clark *et al.* 1988, 1983a, 1983b, 1980; Clawson 1991, Clawson and Clark 1989), possibly increase pesticide runoff into the aquifer, and correspondingly increase pesticide concentrations in groundwater, fish, and fish prey sources (Hurt 2015, pers. comm.). Currently, approximately 119 ha (295 ac) of Key Cave NWR are seasonally managed for row crop production and 127 ha (315 ac) are managed and rotated as early successional fields or for native warm season grasses.

Due to increasing urban development in the Florence area within the recharge area for Key Cave, the species is likely to be subjected to developmental impacts in the future (Kuhajda 2004b). Planned industrial development of the Key Cave recharge area could alter drainage and hydrological patterns within the recharge area for Key Cave (U.S. Fish and Wildlife Service1990) through increases in groundwater pumping, stormwater runoff, urbanization and ancillary construction projects such as houses, small businesses, roads, utilities and easements (KPS Group 2007).

This highly endemic species with an extremely localized range makes Alabama cavefish vulnerable to extirpation from catastrophic events, such as toxic spills, or changes in flow regime, and changes in aquifer recharge due to pumping for public water supply or irrigation. Loss of connectivity between pools occupied by Alabama cavefish, due to decreased water recharge or increased water removal, could limit recovery of the species (George *et al.*2008).

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Amendment to the Alabama Cavefish Recovery Plan. Atlanta, Georgia. pp. 5

U.S. Fish and Wildlife Service. 2017. Alabama Cavefish (*Speoplatyrhinus poulsoni*) 5-Year Review: Summary and Evaluation. Jackson, Mississppi. pp. 29.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Alabama cavefish will experience direct mortality and sublethal effects for most uses of malathion for all bin 6. The risk of direct mortality is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and high for prey fish for a few uses.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 17.92%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 17.92%: medium levels of effect on behavior and growth
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 17.92%: high levels of mortality to aquatic invertebrate prey and prey fish (for a few uses)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 57.17%: high levels of effect on aquatic invertebrate prey
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 57.17%: low levels of effect

Indirect	Mosquito control overlap 57.17%: high levels of mortality to aquatic invertebrate prey and low mortality among prey fish

Risk modifiers:

Due to the subterranean nature of the Alabama cavefish and existing protections of the cave and a portion of the related recharge area, we do not anticipate direct exposure to underground invertebrate prey that the cavefish relies upon. Key Cave National Wildlife Refuge was formed in 1997 through the purchase of land that provides protection to the cave entrance where the only known population of Alabama cavefish is known to occur and approximately 10% of the surrounding recharge area (429 ha or 1060 ac) (USFWS 2017 5 year review). The 1,060 acre federally owned and protected recharge area was designated as a high hazard potential area in recognition of the high transmissivity and number of sinkholes connected to Alabama cavefish occupied areas. If exposure to invertebrate prey were to occur, it is anticipated that the most likely scenario given the relatively short half-life of malathion and the subterranean habitat, would be from runoff or potential rapid infiltration into areas such as sinkholes in medium to lower hazard potential recharge areas immediately after a large area application of malathion. Because aquatic invertebrates exhibit a range of sensitivities to malathion, abundance of sub-surface invertebrates is expected to be reduced and localized within different formations within the aquifer where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness would likely be of short duration with recovery of invertebrate density anticipated to occur within a short period of time. Food resources that the Alabama cavefish are thought to rely upon include a variety of aquatic invertebrates (copepods, isopods, amphipods, small crayfish and shrimp) (USFWS 2017 5 year review). Since Alabama cavefish rely on a variety of aquatic invertebrate prey, and other cave fish, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey and prey fish suggest.

Since the overlap analysis for the Alabama cavefish was completed, a new range map was developed for this species. The original range map encompassed two counties (Cobert and Lauderdale counties, Alabama). The new range map excludes Colbert County and therefore the mosquito adulticide usage associated with that county. Currently, based on the new range map, we have no data to suggest that malathion is being used within the range of the Alabama cavefish (i.e., within Lauderdale County) for mosquito adulticide applications, and we do not anticipate increase usage in the future at this time.

Allowable uses driving effects/other considerations:

Due to fate and transport properties of malathion, the subterranean nature of the Alabama cavefish, low volume of pesticide applied for mosquito control, and existing protections for recharge areas near Key Cave, we do not anticipate mosquito adulticide applications, if they were to occur outside of the Key Cave National Wildlife Refuge, would result in exposure to the species.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	37,881	24.44	3,300	2.13	6	6M
Other Crops	D,I	205	0.13	0	0	6	6H
Other Row Crops	D,I	10	0.01	10	0.01	6	6H
Other Grains	D,I	63	0.04	63	0.04	6	6H
Corn	D,I	12,896	8.3	585	0.38	6	6H
Cotton	D,I	10,402	6.71	7,589	4.9	6	6H
Developed	D,I	11,645	7.51	582	0.38	6	6L
Open Space Developed	D,I	11,234	7.25	562	0.36	6	6L
Wheat	D,I	95	0.05	95	0.06	6	6H
Vegetables & Ground Fruit	D,I	1	<0.01	1	<0.01	6	6H
Orchards & Vineyards	D,I	2	<0.01	0.74	<0.01	6	6H
Pasture	D,I	0	<0.01	0	<0.01	6	6H
Nurseries	D,I	14	0.01	14	0.01	6	6H
Sub-TOTAL (D): *Other uses with direct effects*[3]		46,568	30.04	9,503	6.13		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		46,568	30.04	9,503	6.13		
TOTAL[4]:		84,450	54.48	12,803	8.26		

 # acres in species range: 224,194 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 17,539 acres, 7.823%

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☒ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

The following species-specific measure is now part of the Action and will be included in *BulletinsLive! Two*:

Species specific measures: In addition to the general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, the registrants have also agreed to additional conservation measures, such as pesticide use limitation areas in BulletingsLive! Within the range of the Alabama cavefish, including areas within the Key Cave National Wildlife Refuge, applicators will be prohibited from applying malathion for agricultural uses within 50 ft (ground application) or 100 ft (aerial application) from the edge of sinkholes or springs to avoid introducing malathion into the habitats in which the species occurs. Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to species. While the exact amount of spray drift reduction will vary depending on traits of the ecosystem (e.g. flow rate, volume, etc.) as well as the application method, based on AgDRIFT modeling we expect spray drift reductions ranging from 82 to 90%. The Service evaluated these additional measures and concluded that, in addition to changes to the general labels, will provide the necessary levels of protection for the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Alabama cavefish. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general and species-specific conservation measure described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Alabama cave fish is known from a single cave and is one of the rarest cavefish in the United States. Due to its subterranean habitats, the species has an extremely limited distribution. The subterranean habitat occupied by the species is susceptible to ground water contamination from surface runoff because of the rapid penetration of contaminants through pervious substrate with little natural filtration. Additionally, we anticipate its food source is based in part on nutrients from bat guano, which also provides a pathway for malathion and other contaminants to both enter the species' habitat and be available via its food source. The species may be exposed from terrestrial use sites or via contaminated bat guano from bats foraging in nearby areas (e.g., agricultural), and any substantial loss of individuals would be catastrophic for this highly vulnerable species.

Overlap with the species range is high (~75%), primarily related to mosquito control (57%), corn (6%), developed (7%), and cotton (7%) uses. Usage is moderate on the non-Federal portion of the species range, primarily related to cotton usage, although other categories also contribute to this level of usage. As discussed above in the "Risk Modifier" section, the species current range was recently updated (to exclude Colbert County, Alabama) and no longer overlaps with areas where we anticipate mosquito adulticide usage would occur, based on the available usage data.

Therefore, we anticpate mosquito adulticide use within the species range to be zero based on current usage data. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion.

As discussed previously, the Key Cave entrance and 429 ha (1,060 ac) of surface property above the cave (about 10% of the total known recharge area) inhabited by the Alabama cavefish is partially protected due to its ownership by the U.S. Fish and Wildlife Service. We anticipate that malathion use on the refuge in areas that would reach the species either through exposure of individuals or their food source would be reduced given the protective measures (e.g., buffers) that would be implemented over the duration of the action. On the refuge, vegetative buffers around the sinkhole pond of 10 m and restricted pesticide spraying within a minimum 30 m buffer distance from the cave entrance will remain in place over the duration of the action. While the cave entrance and the pools in which the species lives is on a National Wildlife Refuge, the Federal lands component of the species range is relatively low (~7.8%), and much of the recharge area that provides water and other inputs to the species within its habitat is located off of Federal lands. As noted above, full protection for the species is not afforded to its habitat on the surrounding private lands, including portions of the aquifer and especially the sinkholes throughout the recharge area. Thus, we anticipate that usage on non-Federal lands would be the most likely source of malathion that entered the cave habitat and result in exposure to individuals in their pool habitat or their forage base originating inside the cave. The majority of the recharge areas (90%) is on non-Federal lands, and we estimate malathion usage to be medium (6% usage) in these areas, based on standard usage data. While we do not necessary assume that all usage from non-Federal areas would reach the pools the species inhabits, we do anticipate that this level of usage would result in exposure of at least small numbers of individual cavefish. Based on the 2019 Recovery Plan Amendment, the drivers for concern presently for diminished groundwater quality are related to reductions in aquifer levels due to groundwater pumping, stormwater runoff, and adjacent urbanization. We expect some direct leaching of pesticides from guano into the cave water could reduce food resources such as arthropods, however we do not expect them to be completely eliminated and will likely rebound in population numbers with recovery of invertebrate density anticipated to occur within a short period of time. Thus, while we do not anticipate exposure from activities that occur on the refuge, the usage expected to occur on the surrounding non-Federal lands may impact small numbers of individuals over the duration of the proposed action. However, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, reduced application number and rates for certain uses, and a species-specific measure (avoiding applications within 50 feet (ground applications)/100 feet (aerial applications) from the edge of sinkholes or springs, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, subterranean caves). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats (e.g., subterranean environmentsts) and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Alabama cavesfish and its prey resources and therefore minimizes overall risk and adverse effects to the species.

In addition, the species-specific measure (i.e., application buffers around sinkholes and springs) will minimize any accidental applications directly to this species habitat. The application buffer, in addition to the rain restrictions, will allow the chemical breakdown of malathion prior to any potential runoff into these environments. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects, we do not anticipate species-level effects.
Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Alabama cavefish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Catostomidae)

Scientific Name:	Common Name:	Entity ID:
Catostomus discobolus yarrowi	Zuni bluehead Sucker	3280

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Population abundance has not been estimated because of the difficulty of detecting and sampling all habitats. However, results from numerous survey efforts confirm that Zuni bluehead sucker populations in New Mexico are fragmented and low in numbers. Fish surveys have been conducted within the Zuni River watershed over multiple years since 1977. Based on available maps and survey information, we estimate the present range of the Zuni bluehead sucker in New Mexico to be approximately 5% or less of its historical range. The extent of potential range reduction in Arizona is not known. Zuni bluehead sucker populations are highly fragmented within small, isolated springs and stream segments, causing them to be vulnerable to stochastic events, such as wildfire and episodic drought, and to deleterious genetic effects (USFWS 2013).

The Zuni bluehead sucker faces a variety of threats throughout its range in Arizona and New Mexico, including water withdrawals, logging, livestock grazing, water impoundments, road construction, subdivision development, and long-term drought. In New Mexico, water withdrawals, subdivision development, livestock grazing, road construction, logging, and drought threaten Zuni bluehead suckers and their habitat. In Arizona, water withdrawals, livestock grazing, road construction, and drought have affected the Zuni bluehead sucker. These activities, alone and in combination, contribute to the substantial loss and degradation of habitat in Arizona and New Mexico. The changes in the flow regimes and loss of habitat from water withdrawals, sedimentation, and impoundments have reduced and eliminated populations of Zuni bluehead sucker in both New Mexico and Arizona. These conditions, in combination with the predicted worsening drought conditions due to climate change, will continue to degrade and eliminate Zuni bluehead sucker habitat. These threats are intensified by the species' small range. The Zuni bluehead sucker populations are highly fragmented within small, isolated springs and stream segments, causing them to be vulnerable to stochastic events, such as wildfire and episodic drought. All known Zuni bluehead sucker populations are small and isolated, increasing their vulnerability. Due to the reduction in their range and small population size, the remaining populations of Zuni bluehead sucker experience reduced viability.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Zuni Bluehead Sucker. Federal Register 79(142): 43131-43161.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Zuni bluehead sucker will experience direct mortality or sublethal effects for most uses of malathion in bin 2. The risk of direct mortality is expected to be high.We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk of mortality to aquatic invertebrate prey to be high.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 0.76%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 0.76%: high levels of effect on behavior for a few uses.
INDIRECT (all uses except mosquito control)	
Use areas/ - Prey item mortality	Total mortality 0.76%: high levels of mortality on aquatic invertebrate prey
MOSQUITO CONTROL	
Direct (mortality)	Mosquito Control overlap 44.05%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito Control overlap 44.05%: medium levels of effect on growth and behavior
Indirect	Mosquito Control overlap 44.05%: high levels of mortality on aquatic invertebrate prey

Risk modifiers: The Zuni Bluehead sucker is a benthic feeding omnivore. Dietary items include algae, caddisflies, mayflies, midges, and various terrestrial insects.

Indirect effects to benthic macroinvertebrate prey: Results of higher tier studies, such as outdoor mesocosms and field studies described in EPA's BE, suggest that malathion's toxicity to benthic macroinvertebrate communities may be modulated through a variety of means. In contrast to laboratory toxicity studies on individual aquatic invertebrate species, stream studies often show variable effects to benthic macroinvertebrate communities that predators such as Zuni bluehead sucker rely upon. Many stream studies suggest that recovery of impacted benthic macroinvertebrates is likely if there is sufficient time for recolonization between applications. Recovery of aquatic invertebrates is often rapid following disturbance, whether from flood or pulsed exposure to contaminants. Recovery of benthic macroinvertebrate communities post-exposure occurs via drift, aerial recolonization of adult aquatic insects (such as midges, dragonflies, caddisflies), and persistence of benthic macroinvertebrates in exposed areas from in-stream refugia or resistant life stages, such as diapausing eggs or nymphs. Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For omnivorous fish species like the Zuni bluehead sucker that are generalist feeders relying on a variety of benthic macroinvertebrates, algae and terrestrial insects, any short-term indirect effects to the aquatic invertebrate prey base are anticipated to have a limited effect on Zuni sucker's food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations:

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		8,594,428	44.05	653,400	3.35	2	2H
Other Crops		29,344	0.15	0	0.00	2	2H
Other Row Crops		0	0.00	0	0.00	2	2H
Other Grains		842	0.00	634	0.00	2	2H
Corn		15,567	0.08	165	0.00	2	2H
Cotton		2	0.00	0	0.00	2	2H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Developed		48,922	0.25	2,446	0.01	2	2L
Wheat		10,642	0.05	9,128	0.05	2	2H
Vegetables & Ground Fruit		16,230	0.08	833	0.00	2	2H
Orchards & Vineyards		128	0.00	184	0.00	2	2H
Pasture		26,425	0.14	8,137	0.04	2	2H
Nurseries		89	0.00	89	0.00	2	2H
Sub-TOTAL (D): *Other uses with direct effects*[3]		148,191	0.76	21,617	0.11		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		148,191	0.76	21,617	0.11		
TOTAL[4]:		8,742,619	44.81	675,017	3.46		

 # acres in species range: 19,509,139 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 3,605,641 acres, 18.482%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Zuni bluehead Sucker. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Zuni bluehead Sucker has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in growth and behavioral effects. Effects to prey are variable, with generally high levels of mortality anticipated for prey. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (45%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (3.46%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>19 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Zuni bluehead sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be affected by mortality, sublethal, or prey base effects, we do not anticipate species-level effects.Thus, while we anticipate small numbers of individuals would be adversely affected over the duration of the Action by mortality, sublethal, or prey base effects, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Zuni bluehead Sucker in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Catostomus santaanae	Santa Ana sucker	312

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Santa Ana sucker is one of only a few native freshwater species of fish currently extant in southern California. The listed species' range has been reduced in the three watersheds where it occurs and there is no opportunity for natural movement between watersheds. Santa Ana suckers are also patchily distributed within each watershed, with dispersal to other reaches limited by barriers that prevent or severely limit two-way (upstream and downstream) fish passage within the respective watersheds. The primary threat to Santa Ana sucker is habitat loss, degradation, and modification through hydrological modifications rangewide. Additionally, isolation by impassable barriers or unsuitable habitat limits gene flow within and between watersheds, thus increasing the vulnerability of small populations to a range of stochastic environmental and genetic factors.

Currently, the threats to Santa Ana sucker habitat are primarily attributed to past and ongoing urbanization and the continuing repercussions of human population growth in Los Angeles, Orange, Riverside, and San Bernardino Counties. Modification, fragmentation, and loss of habitat have been the primary reasons for the decline in Santa Ana sucker populations throughout its range compared to its status and distribution historically, and they continue to be significant threats to the recovery of the species in portions of its range. We classify Factor A threats (all of which are attributable to or outgrowths of urbanization) to Santa Ana sucker habitat or range into the following categories: (1) Hydrological modifications, (2) water quality, (3) nonnative vegetation, (4) wildfire, (5) off-highway vehicle (OHV) use, and (6) mining activities.

Human activities, such as construction of dams, water diversions, flood control channels, roads, and other impervious surfaces, have altered the hydrology of the watersheds throughout Santa Ana sucker's historical range. Hydrological modifications have significantly altered Santa Ana sucker habitat throughout Santa Ana sucker's historical range, which has impacted the species distribution and has resulted in a reduction in the species' range (that is, the current range is smaller compared to its historical range). The water in which the Santa Ana sucker lives is now distributed differently on the landscape and, in some locations for much of the year, originates from anthropogenic sources. Dams and other structures prevent fish passage, changing habitat conditions, reducing I-17 gene flow, and limiting or preventing population replenishment. These structures also disrupt the distribution of sediment, impacting the quality of foraging and spawning habitat available to Santa Ana suckers. Additionally, levees and other methods of channelization, and their maintenance further reduce the quantity and quality of habitat available for the species.

Water quality and related environmental conditions vary across and within the rivers occupied by Santa Ana suckers. Natural, unregulated stream flows support the Santa Ana sucker in the East Fork of the San Gabriel River, whereas, regulated, wastewater discharges support the Santa Ana sucker in the Santa Ana River. While wastewater-dominated rivers, like the Santa Ana River, are subject to increased inputs of regulated and unregulated contaminants (Kolpin et al. 2002, pp. 1202–1211; Jenkins et al. 2009, p. 39), more research is needed to determine if the water quality conditions prescribed by existing regulatory mechanisms are protective of the Santa Ana sucker and its habitat. For example, wastewater discharges are often warmer than natural groundwater sources (Swift 2015, in litt.). Elevated water temperatures may degrade Santa Ana sucker habitat and may promote productivity of nonnative species (Aspen 2015, p. 3). It is also unclear whether or to what extent organic wastewater compounds and endocrine disrupting compounds are affecting the species and its habitat. Other factors that may reduce water quality and in turn impact habitat for the Santa Ana sucker include unregulated discharges (for example, cross-connected sewers and illegal encampments), although efforts are underway in some areas to reduce these sources (Riverside County Flood Control and Water Conservation District 2015, in litt.). Trash and illegal dumping along watercourses can also be sources of contaminants. Because Santa Ana suckers are aquatic, the species' habitat quality is closely tied to water quality; however, more research is needed to identify which variables and at what levels (quantitative measurements) are most important.

Aquatic habitat may be modified by the presence of nonnative vegetation in a variety of ways. There are two nonnative, invasive species in particular that substantially modify or curtail Santa Ana sucker habitat or have the potential to do so: *Arundo donax* and *Compsopogon caeruleus*. Additionally, nonnative wild pigs have been observed in the Santa Ana River watershed.

Santa Ana sucker habitat continues to be degraded and modified through ongoing activities within each of the three watersheds. Hydrological modifications have limited the amount of available water and, in the Santa Ana River in particular, such activities continue to reduce sediment transport. A reduction in the distribution of sediments further reduces and degrades the quality of available habitat for the Santa Ana sucker. Changes in the quality of the water I-21 available are also affected by manmade alterations to the three watersheds, especially the Santa Ana River. Additionally, nonnative, invasive vegetation impacts the Santa Ana sucker by reducing habitat quality throughout much of the species' range. More information is needed on the impact of feral pigs. Although OHV use and recreational mining are currently not considered substantial threats to the species' habitat, they have the potential to impact Santa Ana sucker habitat in absence of specific management actions and enforcement.

EB/CE Source:
U.S. Fish and Wildlife Service. 2017. Recovery Plan for the Santa Ana Sucker (*Catostomus santaanae*). pp. 105.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Santa Ana sucker will experience direct mortality or sublethal effects for all uses of malathion in all bins (2 and 3). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 18.02%: high levels of mortality in bins 2/3
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 18.02%: high levels of effect on behavior for a few uses.
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 18.02%: high levels of mortality on aquatic invertebrate prey
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 45.02%: high levels of mortality in bins 2/3
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 45.02%: medium level of effect on behavior and growth
Indirect	Mosquito control overlap 45.02%: high levels of mortality on aquatic invertebrate prey

Risk modifiers: Santa Ana suckers are specialized invertivores and herbivores that feed principally on algae, diatoms, detritus, and small invertebrates. Adult suckers also eat the occasional insect larva.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species. While the Santa Ana sucker does occupy other aquatic habitats with potentially higher estimated environmental concentrations of malathion exposure, their potential exposure risk is partially mitigated by their reliance upon higher flowing aquatic habitats (i.e., bin 3), reducing their overall risk.

Indirect effects to aquatic invertebrate prey

Results of higher tier studies, such as outdoor mesocosms and field studies described in EPA's BE, suggest that malathion's toxicity to benthic macroinvertebrate communities may be modulated through a variety of means. In contrast to laboratory toxicity studies on individual aquatic invertebrate species, stream studies often show variable effects to benthic macroinvertebrate communities that predators such as fish rely upon. Many stream studies suggest that recovery of impacted benthic macroinvertebrates is likely if there is sufficient time for recolonization between applications. Recovery of aquatic invertebrates is often rapid following disturbance, whether from flood or pulsed exposure to contaminants. Recovery of benthic macroinvertebrate communities post-exposure occurs via drift, aerial recolonization of adult aquatic insects (such as midges, dragonflies, caddisflies), and persistence of benthic macroinvertebrates in exposed areas from in-stream refugia or resistant life stages, such as diapausing eggs or nymphs. Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since Santa Ana sucker is a generalist feeder that relies on a variety of benthic macroinvertebrate prey, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations:

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE

Agricultural usage based on CalPUR data: (Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		1,809,975	45.02	NA	NA	2,3	2H 3
Other Crops		6,479	0.16	0		2,3	2H 3
Other Row Crops		22	0.00	6	.00015	2,3	2H 3
Other Grains		683	0.02	0		2,3	2H 3
Corn		69	0.00	506	0.0125	2,3	2H 3
Cotton		199	0.00	0		2,3	2H 3
Developed		700,064	17.41	35,003	0.87	2,3	2M 3
Wheat		1,224	0.03	0		2,3	2H 3
Vegetables & Ground Fruit		6,843	0.17	13,832	0.344	2,3	2H 3
Orchards & Vineyards		5,718	0.14	16	0.0004	2,3	2H 3
Pasture		895	0.02	0		2,3	2H 3
Nurseries		2,421	0.06	377	0.0093	2,3	2H 3
Sub-TOTAL (D): *Other uses with direct effects*[3]		724,616	18.02	49,739	1.24		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		724,616	18.02	49,739	1.24		
TOTAL[4]:		2,534,592	63.04	49,739	1.24		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 4,020,649 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 2,110,429 acres, 52.490%

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Santa Ana sucker. As discussed below, even though the vulnerability is high and the risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Santa Ana sucker has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. We anticipate high levels of mortality of invertebrate prey. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (63%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (1.24%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>4 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes, , will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Combined, these conservation measures substantially reduce exposure to the Santa Ana sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be affected by mortality, sublethal, or prey base effects, we do not anticipate species-level effects. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects overe the duration of the Acton, we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Santa Ana sucker in the wild.

Conclusion: Not likely to jeopardize

Scientific Name:	Common Name:	Entity ID:
Chasmistes liorus	June sucker	287

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)
This
Status: Endangered; Proposal to reclassify as threatened (November 2019)
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple Populations (few) based on proposed rule to reclassify as threatened
Species Trends: Stable or some populations increaseing, based on proposed rule to reclassify as threatened
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The June sucker is native and endemic to Utah Lake and its tributaries, which are the primary spawning habitat for the species. The June sucker is not found outside of its native range except in two populations established for conservation purposes. A refuge population was created as part of the June Sucker Recovery Implementation Plan stocking program to enhance and secure the species' population in Utah Lake at the Fisheries Experiment Station hatchery in Logan, Utah (Service 2015). An additional population was established in Red Butte Reservoir, Salt Lake County, Utah, in 2004 and is now self-sustaining (Utah Division of Wildlife Resources 2010). These additional populations have aided in retaining ecologic and genetic diversity in June sucker, which in turn aids the species in adapting to changing environmental conditions (i.e., increases representation) (JSRIP 2018)

Human actions have profoundly changed the Utah Lake drainage and have affected the entire ecosystem. Anthropogenic changes include habitat alteration and the introduction of non-native fishes. Habitat alterations include: (1) water development that has altered natural flow events, reduced annual lake-level stability, and blocked migration corridors; (2) changes in water quality that have resulted in higher monthly river and lake temperatures, reduced dissolved oxygen levels, increased sedimentation rates and levels of dissolved solids, and increased turbidity; and (3) urbanization that has resulted in development of the Provo River flood plain, channelization of the river, and a reduction in available nursery habitat. The introduction of non-native fishes has resulted in competition, predation, and water quality changes such as increased turbidity. Loss of recruitment has resulted from a combination of the above factors.

According to the reclassification rule for June sucker (USFWS 2021), resiliency of June sucker has improved since the time of listing, with an increase in the wild spawning population of at least ten-fold, a positive population trend, and increases in both the quality and quantity of habitat. We project that these conditions will continue to improve based on plans to continue successful management actions and implement new projects, such as the Provo River Delta Restoration Project and the Utah Water Quality Study. Redundancy in June sucker is assured by the existence of two new populations, including the refuge population maintained at Fisheries Experimental Station hatchery and an additional naturally selfsustaining population in Red Butte Reservoir, as well as the presence of water flows in at least two spawning tributaries each year (Provo River and Hobble Creek), with up to five spawning tributaries available in good water years. Prior to the June sucker's listing, there were no refuge populations, and in low water years, there might be no available spawning tributaries with water throughout the summer. Representation for the June sucker exists in the form of genetic diversity in the breeding and stocking program, which has preserved a high degree of genetic variation in the fish stocked in Utah Lake since listing. Based on these elements, we find that overall viability for the June sucker has improved since the time of listing.

The first downlisting criterion requires that Provo River flows essential for June sucker spawning and recruitment are protected (Service 2011). We consider this criterion to have been met. The second downlisting criterion for June sucker requires that spawning and brood-rearing habitat in the Provo River and Utah Lake be enhanced or established to provide for the continued existence of all life stages (Service 1999). We consider this criterion to have been met. Habitat restoration projects occurred on the Provo River and Hobble Creek, and habitat quality was enhanced in Utah Lake as a result of nonnative species removal (e.g, carp). The third downlisting criterion requires that nonnative species that present a threat to the continued existence of June sucker are reduced or eliminated from Utah Lake. We consider this criterion met, but ongoing. The common carp was identified as the nonnative species having the greatest adverse impact on June sucker habitat and resiliency, due to the large-scale changes in water quality and macrophytic vegetation caused by these fish. The fourth and final downlisting criterion in the June sucker recovery plan is that an increasing, selfsustaining spawning run of wild June sucker resulting in significant recruitment over 10 years has been reestablished in the Provo River. We consider this criterion to be ongoing. This criterion does not define ‘‘significant’’ recruitment. Although the spawning population of June sucker is increasing, annual stocking continues in order to maintain the population. An augmentation plan for the June sucker set a goal, for the purposes of meeting the recovery criterion of a selfsustaining population, of stocking 2.8 million individuals into Utah Lake (Service and URMCC 1998). The goal was based on early studies of June sucker survival and the production capabilities of the facilities. As of 2017, more than 800,000 captive-bred June sucker have been stocked in Utah Lake from the various rearing locations, and a long-term, continued stocking strategy based on the most up-to-date research on stocking success and survival rates is under development (JSRIP 2008; UDWR 2017b).

EB/CE Source:

USFWS 2021. Endangered and Threatened Wildlife and Plants; Reclassification of the Endangered June Sucker to Threatened With a Section 4(d) Rule; Final Rule. 86 Federal Register 01 (January 4, 2021): 192-212.
1999 Recovery Plan

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the June sucker will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, 6, and 7). The risk of mortality is expected to be high for bins 2, 3, and 6 and medium for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 10.34%: Estimated mortality among exposed individuals: 2/3(M&H), 6(M &H), 7(L&M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 10.34%: Estimated sublethal effects among exposed individuals: G:2/3(L&M),6(L&M),7(L&M); R:2/3(L&M),6(L),7(L); B:2/3(L&M&H),6(L&M),7(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 10.34%: Estimated mortality among exposed aquatic invertebrate prey: 2/3(H), 6(H), 7(M&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 63.76%; Estimated mortality among exposed individuals: 2/3(H),6(M),7(M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 63.76%: Estimated sublethal effects among exposed individuals: G:2/3(M),6(L),7(L); R:2/3(L),6(L),7(L); B:2/3(M),6(L),7(L)

Indirect	Mosquito control overlap 63.76%: Estimated mortality among exposed aquatic invertebrate prey: 2/3(H), 6(H), 7(H)

Risk modifiers: June suckers are opportunistic planktivores. Adults, juveniles, and larvae all feed on zooplankton. They spawn in large tributary streams mainly in June and most spawning is completed within a span of five to eight days. Otolith analysis suggests that sexual maturity may be attained as early as age 5 but at least by age 10. The life span of June suckers may exceed forty years.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species. While the June sucker does occupy bin 2 aquatic habitats with potentially higher estimated environmental concentrations if exposed to malathion, their potential exposure risk is largely mitigated by their reliance upon larger flowing and larger static aquatic habitats (bins 3, 6, and 7), reducing their overall risk.

Allowable uses driving effects/other considerations: June suckers likely spend most of their time in lakes/reservoirs so effects estimated by bins 6 and 7 are probably most representative. They do spawn in tributaries therefore short-term exposures/effects estimated by bins 2/3 would be applicable. Because we are using bin 2 estimates as an upper bound of bin 3 exposures, effects may sometimes be overestimated for June suckers in the larger flowing waters (bins 3). For individuals in bin 3 waters near the confluence of a smaller streams (bin 2) or in nearshore areas where use sites are close to the river/stream edge effects estimates will be more realistic. The use types with the highest overlap are Developed (5.80%), Wheat (1.52%), and Pasture (1.37%) Mosquito Control: Mosquito control may occur over large portions of the species range (63.76% overlap). Exposed individuals could experience medium mortality in lakes/reservoirs (bins 6 and 7) and high mortality in flowing waters (bins 2 and 3). The same considerations described above regarding bin 3 waters apply to mosquito control activities.

Since the overlap analysis for the June sucker was completed, a new range map was developed for this species. The original range map encompassed multliple counties (Box Elder Carbon, Davis, Juab, Morgan, Salt Lake, San Pete, Summit, Wasatch, and Weber Counties, Utah) that are no longer considered part of the current range. The new range map only includes Utah County. Currently, based on the new range map, we have no data to suggest that malathion is being used within the range of the June sucker (i.e., within Utah County) for mosquito adulticide applications, and we do not anticipate increase usage in the future at this time.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	NA	NA	NA	NA	2,3,6,7	2H 3 6M 7M
Other Crops	D,I	46,183	1.17	0	0.00	2,3,6,7	2H 3 6H 7M
Other Grains	D,I	4,582	0.12	1,994	0.05	2,3,6,7	2H 3 6M 7M
Corn	D,I	8,173	0.21	157	0.00	2,3,6,7	2H 3 6H 7M
Developed	D,I	228,555	5.80	11,428	0.29	2,3,6,7	2M 3 6L 7L
Wheat	D,I	59,869	1.52	6,813	0.17	2,3,6,7	2H 3 6H 7M
Vegetables & Ground Fruit	D,I	311	0.01	220	0.01	2,3,6,7	2H 3 6H 7M
Orchards & Vineyards	D,I	5,255	0.13	2,071	0.05	2,3,6,7	2H 3 6H 7M

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Pasture	D,I	53,917	1.37	21,890	0.56	2,3,6,7	2H 3 6H 7M
Nurseries	D,I	560	0.01	560	0.01	2,3,6,7	2H 3 6H 7M
Christmas Trees	D,I	8	0.00	8	0.00	2,3,6,7	2H 3 6H 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		407,413	10.34	45,140	1.15		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		407,413	10.34	45,140	1.15		
TOTAL[4]:		407,413	10.34	45,140	1.15		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 3,941,671 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,257,406 acres, 31.900%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

The following species-specific measure for June sucker's Critical Habitat is now part of the Action and will be included in *BulletinsLive! Two*:

Critical Habitat conservation measure: In addition to the general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, the registrants have also agreed to additional conservation measures, such as use limitation areas.

Mosquito Control: Where feasible, avoid application in designated critical habitat from May to July. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, coordinate with the local FWS Ecological Services field offices to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects to the species (FWS points of contact are available through the Information, Planning, and Consultation (IPaC) website https://ecos.fws.cov/ipac/). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

Avoidance and use limitation areas such as the species' range, critical habitat, or key habitat types and areas and providing additional space for spray drift to dissipate before depositing in off-target sites, thus reducing the likelihood the species will come into contact with malathion.

The Service evaluated these additional measures and concluded that, in addition to changes to the general labels, will provide the necessary levels of protection for the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the June sucker. As discussed below, even though the vulnerability and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. Additionally, the species has been proposed for reclassification from endangered to threatened, due to a ten-fold increase in spawning populations, a positive population trend, increases in the quality and quantity of habitat, and the creation of refuge populations to guard against stochastic events. Thus, while we anticipate that moderate small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The June sucker was recently reclassified from endangered to threatened (86 FR 192-212), due to substantial improvements in the species' overall status since its original listing as endangered in 1986. Although populations numbers have increased in recent years and habitat quantity and quality has improved, we still consider the June sucker as having a moderate vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate medium to high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, although low to moderate levels of impacts to growth and reproduction are also expected. We generally anticipate high levels of effects to invertebrate prey where exposure occurs. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (74%), as described above.

The June sucker is native to Utah Lake and its tributaries, which are the primary spawning habitat for the species, and is not found outside of its native range except in man-made refuge populations. A refuge population was established in Red Butte Reservoir, Salt Lake County, Utah, and has been maintained there since 2004 (Utah Division of Wildlife Resources (UDWR) 2010). The only other population of June sucker is maintained at Utah Division of Wildlife Resources's Fisheries Experiment Station in Logan, Utah, as part of the June Sucker Recovery Implementation Plan stocking program to enhance the species' population in Utah Lake. Based on the species updated current range, there are very limited acres of Federal lands that overlap with the species range. The vast majority of the species range (Lake Utah) is owned by the State of Utah. Tributaries to the lake generally include private lands. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Opinion. The majority of the species range overlaps with non-Federal lands (state and private lands), and we expect individuals would be exposed to low levels of usage (<1.15%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. This value is based soley on agriculutural and non-agricultural uses (1.15%), since the species range no longer overlaps with areas where we anticipate mosquito adulticide usage would occur as discussed in the "Risk Modifier" section above. We expect the effects of exposure would be higher in the smaller water bodies (e.g., spawning areas in small tributaries, smaller standing waterbodies) or in shallow areas where runoff from upland applications may reach the waterbodies.

However, the resilience of the June sucker has improved since listing, with population increases and improved habitat conditions, as described above. The species has been reclassified from endangered to threatened. The reclassificiation rule indicates many of their threats remain; however, it also notes that other threats have been abated, and refuge populations exist to guard against the effects of stochastic events. The threats identified for this species do not specifically include use of malathion. Based on the species updated current range, we anticipate medium overlap with the species range and low estimated usage based on the available usage data., In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the June sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the June sucker in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Deltistes luxatus	Lost River sucker	288

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Historically, Lost River suckers were extremely abundant throughout the Klamath Basin. However, as habitats were made unavailable or unsuitable through destruction, obstruction, modification, and introduction of non-native species, the Lost River sucker declined to relatively low numbers. Prior to listing, significant amounts of suitable habitat were lost or modified and distribution was restricted due to conversion of wetlands to agricultural uses and development. For example, approximately 150,700 ac (61,000 ha) of habitat were lost by lowering Tule and Lower Klamath Lakes (National Research Council 2004). In addition, several migration barriers were constructed throughout the range of the species, including the Link River Dam (1921), Clear Lake Dam (1910), Wilson Diversion Dam (1912), Malone Diversion Dam (1921), Anderson-Rose Dam (1921), Chiloquin Dam (1914), the railroad (1909), and many smaller structures (BOR 2000). The 2007 5-year status review for the Lost River sucker recommended that the species be downlisted to threatened status based on (1) data indicating higher numbers of Lost River sucker in Upper Klamath Lake than estimated at the time of listing, and (2) indications that the population in Clear Lake Reservoir was experiencing recruitment. The 2007 status review also discussed the detection of individuals in Tule Lake and the benefits to the species from restoration activities, but acknowledged that significant threats still remained.

In the 2013 5-Year Review for this species, new data indicated that the reasons provided in the 2007 5-year review for recommending downlisting the Lost River sucker to threatened are no longer supported. Between 2004 and 2012, some substantial threats were reduced through construction of the A canal screen and Link River Dam ladder, restoration of the Williamson River Delta, and removal of the Chiloquin Dam. Nevertheless, significant threats to the Lost River sucker remain, including extremely poor water quality in Upper Klamath Lake and other areas, fluctuations in available water quantity and drought, fragmentation of populations, entrainment, non-native species, and climate change. These threats increase mortality rates, reduce reproduction, and inhibit natural metapopulation dynamics. Although, the individual impacts of each of these threats on the status of the species are poorly understood, the extinction of this species remains a credible possibility. Only two populations exhibit any appreciable larval production, but neither of these experiences sufficient recruitment to the adult population to replace individuals lost at normal mortality rates. The largest and most important population, Upper Klamath Lake, has declined by approximately 45% since 2002. This is a general estimate given that there are slight differences between males and females, and between subpopulations in the lake. The population in Clear Lake Reservoir also appears to be aging without new individuals joining the adult population. All other areas support extremely small numbers of individuals due to unsuitable habitat and/or a complete lack of larval production.

In the 2019 5-Year Review, we found that the status of the Lost River sucker has not markedly changed since the previous 5-year Status Review. Overall resiliency for this species is low and is declining with time. Redundancy is also critically low. There are only three distinct spawning populations: Upper Klamath Lake-springs, Upper Klamath Lake-river, and Clear Lake Reservoir. Two of these spawning populations (Clear Lake Reservoir and Upper Klamath Lake-springs) have very low numbers and are extremely vulnerable to localized catastrophic events, such as fish kills due to poor water quality. The Clear Lake Reservoir population is isolated from the others. Lost River sucker that spawn at the eastern shoreline springs of Upper Klamath Lake are unique. It is the only known spawning congregation outside of a river environment. This ecological redundancy is an important aspect of diversity because it could provide resilience to future localized disturbances. However, juveniles produced from both spawning populations are subject to similar conditions in Upper Klamath Lake, and both experience recruitment failure due to high juvenile mortality. As a species, Lost River sucker appear to be relatively genetically distinct. Mitochondrial DNA suggests only about 2 percent of Lost River sucker introgress with other species. This is the lowest of all the sucker species within the basin (Dowling et al. 2016 pp. 12 & 13). Nevertheless, the known genetic distinction from shortnose sucker is still relatively low (Hoy and Ostberg 2015 p. 675).

Prevailing degraded quality of remaining areas exacerbates the effects of pervasive habitat loss. Most water bodies currently occupied by Lost River sucker do not meet water quality standards for nutrients, dissolved oxygen, temperature, and pH set by the States of Oregon and California. These conditions, which manifest primarily in summer, have caused several incidents of widespread adult mortality. The occurrence of mass mortality of fish in Upper Klamath Lake is 5 not new; however, the modern dominance of the cyanobacterium *Aphanizomenon flosaquae* in the system has led to increased regularity of extreme events. Although conditions are most severe in Upper Klamath Lake and Keno Reservoir, individuals throughout the basin are vulnerable to water-quality-related mortality. Degraded water quality conditions may also weaken fish and increase their susceptibility to disease, parasites, and predation. Water quality remains one of the most important factors threatening Lost River sucker existence.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Lost River Sucker (*Deltistes luxatus*) 5-Year Review: Summary and Evaluation. Klamath Falls, Oregon. pp. 10.

U.S. Fish and Wildlife Service. 2013. Lost River Sucker (*Deltistes luxatus*) 5-Year Review: Summary and Evaluation. Klamath Falls, Oregon. pp. 45.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Lost River sucker will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, 4, 5, 6, and 7). The risk of mortality is expected to be high for bins 2, 3, 4, 5, and 6 and medium for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 4.03%: Estimated mortality among exposed individuals: 2/3/4(M&H), 5(M&H), 6(L&H), 7(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 4.03%: Estimated sublethal effects among exposed individuals: G:2/3/4(L&M),5(L&M),6(L&M),7(L&M); R:2/3/4(L&M),5(L&M),6(L),7(L); B:2/3/4(L&M&H),5(L&M&H),6(L&M),7(L)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 4.03%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 5(H), 6(H),7(M&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 6.03%; Estimated mortality among exposed individuals: 2/3/4(H),5(H),6(M),7(M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 6.03%: Estimated sublethal effects among exposed individuals: G:2/3/4(M),5(M),6(L),7(L); R:2/3/4(L),5(L),6(L),7(L); B:2/3/4(M),5(M),6(L),7(L)
Indirect	Mosquito control overlap 6.03%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 5(H), 6(H),7(H)

Risk modifiers: The Lost River sucker is an invertivore that predominantly feeds on zooplankton and macroinvertebrates. The species will also ingest detritus and algae. Habitat includes deep-water lakes and impoundments (bins 5, 6, and 7), and swift water and deep pools of small to medium rivers (bins 2, 3, and 4). The species occurs in riverine and palustrine habitats, in both marsh and shoreline regions. Suckers can be found throughout the reservoirs they inhabit, but they appear to prefer shorelines with emergent vegetation that can provide cover from predators and invertebrate food. The species is uniformly arranged. Suckers move from lakes into tributary streams to spawn in riffles or runs with gravel or cobble substrate, moderate flows, and depths of 21 to 128 centimeters (8.3 to 50.4 inches) in the benthic zone of river and lake systems. Lake suckers such as Lost River sucker are relatively tolerant of water quality conditions unfavorable for many other fishes, tolerating higher pH (more basic conditions), temperatures, and unionized ammonia concentrations; and lower dissolved oxygen concentrations. Wetlands are likely to play a major role in survival and growth of larval suckers in the upstream reaches of the Sprague River.

Indirect effects to prey invertebrates:

Because aquatic invertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. The Lost River sucker's diet includes detritus, filamentous algae, and relies upon a variety of invertebrate prey, including larval dipeterans and amphipods, and zooplankton. Therefore, short-term indirect effects to aquatic invertebrate preys are anticipated to have a limited effect on food resources. These reductions to invertebrate prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species. While the Lost River sucker does occupy bin 2 aquatic habitats with potentially higher estimated environmental concentrations if exposed to malathion, their potential exposure risk is partially mitigated by their reliance upon larger flowing and static aquatic habitats (bins 3, 4, 6, and 7), reducing their overall risk.

Allowable uses driving effects/other considerations: The total overlap for all use types (not including mosquito control) is relatively low (4.02%). Use types with the highest overlap are Pasture (2.05%), Wheat (0.90%), and Other Grains (0.34%). Because we are using bin 2 estimates as an upper bound of bin 3 and 4 exposures, effects may sometimes be overestimated for Lost River suckers in the larger flowing waters (bins 3 and 4). For individuals in bin 3 or 4 waters near the confluence of a smaller streams (bin 2) or in nearshore areas where use sites are close to the river/stream edge effects estimates will be more realistic.

Mosquito Control: Mosquito control may occur over relatively small portions of the species range (6.03% overlap). Exposed individuals could experience medium to high mortality; however, the same considerations described above regarding bin 3 and 4 waters apply to mosquito control activities.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE

Usage data for the whole range based on data from EPA's SUUM (Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	580,459	6.03	NA	NA	2,3,4,5,6,7	2H 3 4 5H 6M 7M
Other Crops	D,I	25,455	0.26	0	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Other Row Crops	D,I	81	0.00	81	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Other Grains	D,I	32,595	0.34	15,335	0.16	2,3,4,5,6,7	2H 3

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							4 5H 6H 7M
Corn	D,I	27	0.00	1	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Cotton	D,I	6	0.00	0	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Developed	D,I	30,924	0.32	1,546	0.02	2,3,4,5,6,7	2M 3 4 5M 6L 7L
Wheat	D,I	87,092	0.90	94,502	0.98	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Vegetables & Ground Fruit	D,I	14,402	0.15	14,486	0.15	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Orchards & Vineyards	D,I	83	0.00	8	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7H

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Pasture	D,I	197,001	2.05	131,159	1.36	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Nurseries	D,I	80	0.00	80	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		387,762	4.03	257,215	2.67		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		387,762	4.03	257,215	2.67		
TOTAL[4]:		968,221	10.06	257,215	2.67		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

Agricultural usage in California only based on CalPUR data:

UDL	Mean Annual UDL Acres Treated within species CA range (minus Fed Lands) (2012-17)	Mean Annual Percent of Species Entire Range (including Fed Lands) Treated (2012-2017, excluding other states)
Other Grains	67.3	0.001
Pasture	285.5	0.003
Vegetables and Ground Fruit	340.2	0.004
Wheat	39.3	0.000
Total	732.4	0.008

 # acres in species range: 9,627,007 acres
% of range in California (i.e., where CalPUR data is available): 44%
Range overlap with Federal lands: 6,947,703 acres, 72.169%

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Lost River sucker. As discussed below, even though the vulnerability is high and the risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Lost River sucker has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, particularly in smaller waterbodies or near their edges where we anticipate individuals may frequently occur. We anticipate survivors would experience sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. Effects to prey are variable, with generally high levels of mortality anticipated for prey. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (10%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (2.7%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. We anticipate small numbers of individuals may exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Lost River sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adveresely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Lost River sucker in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Xyrauchen texanus	Razorback sucker	290

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (9/25/2018): Downlist to Threatened
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Stable
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

According to the 2018 5-Year Review, over the last 30 years, management actions in the upper basin have improved the resiliency of populations, created the redundancy of multiple and well-distributed populations, and maintained representation, largely through genetic diversity. Program partners in both upper basin recovery programs have demonstrated a commitment to recovery over the last 30 years. Current population estimates indicate a population of approximately 36,000 adults in the Green River subbasin (Zelasko et al. 2018), 5,000-8,000 adults in the Colorado River subbasin (Elverud in prep) and approximately 3,000 in the San Juan River basin (San Juan River Basin Recovery Implementation Program 2017). Substantial razorback sucker populations (500-2000 adults) have been found residing in Lake Powell (Francis et al. 2015; Albrecht et al. 2017). Spawning and larval production are occurring across the upper basin in mainstem, tributary and reservoir environments. In the lower basin, Lake Mead has the highest level of resiliency out of all eight populations, because it supports the only naturally recruiting population on the landscape (Albrecht et al. 2010). The Lake Mohave population remains a genetic refuge, from which larvae are harvested annually (Leavitt et al. 2017). The largest lower basin population has been reestablished in the Colorado River between Davis and Parker dams (Lake Havasu) at approximately 5,000 individuals (Kesner et al. 2017). With the exception of Lake Mead, where management is limited to research and monitoring, the lower basin populations are heavily managed.

Primarily due to ongoing management actions, the razorback sucker currently has sufficient individual and population-level resiliency, and species-level redundancy and representation across eight populations distributed between the upper and lower basins, such that the potential loss of one or more populations is not likely to occur now or in the short term. The current resiliency of the naturally reproducing Lake Mead population, in conjunction with the resiliency and redundancy afforded by management-based populations across both basins decreases the risk to the species from stochastic and catastrophic events, such that the species currently has a low risk of extinction, as long as management actions continue at their current rate and effectiveness.

From the 2012 5-Year review: Historically, the species occupied the mainstem Colorado River and many of its tributaries from northern Mexico, through Arizon and Utah into Wyoming, Colorado and New Mexico. They are currently found in the Green River, upper Colorado River, and San Juan River Sub-basins; the lower Colorado River between Lake Havasu and Davis Dam; reservoirs of Lakes Mead and Mohave, and in small tributatries of the Gila River Sub-basin. At the time of listing, habitat losses were documented, but the threats to the species were poorly understood and distribution and abundance of the species were not well known. The decline of the species was probably due to a combination of threats, including direct loss of haibtat, changes in flow and temperature, and blockage of migration routes by the construction of large reservoirs. Habitat loss, modification, fragmentation, and blocked fish passage are associated with dam construction and operation. The species was once abundant throughout most of the Colorado River System. A major cause of decline has been loss of a contiguous complement of habitats used by the various life history phases. Twelve barriers to fish passage within occupied habitat have been identified in the upper basin upstream of Glen Canyon. Some passage facilities have been installed to address this threat in part. In addition, interaction with non-native fish may have decimated the species in many areas, including waters not affected by dams. Imminent threats of habitat modification, predation by non-native fish, and potential spills or leaching of environmental contaminants still remain high for the species. Many potential contaminants (e.g., petroleum products, radionuclides, selenium, pesticides, and heavy metals such as mercury) enter the Colorado River System from a variety of sources, but their role in suppressing populations is not always well understood.

EB/CE Source:
U.S. Fish and Wildlife Service. 2018. Razorback Sucker (*Xyrauchen texanus*) 5-Year Review: Summary and Evaluation. Lakewood, Colorado. pp. 25.

U.S. Fish and Wildlife Service. 2012. Razorback Sucker (*Xyrauchen texanus*) 5-Year Review: Summary and Evaluation. Denver, Colorado. pp. 38.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the razorback sucker will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, 4, and 7). The risk of mortality is expected to be high for bins 2, 3, and 4 and low to high for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 3.37%: Estimated mortality among exposed individuals: 2/3/4(L&H), 7(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 3.37%: Estimated sublethal effects among exposed individuals: G:2/3/4(L&M),7(L&M); R:2/3/4(L&M),7(L); B:2/3/4(L&M&H),7(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 3.37%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 7(M&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 28.96%: Estimated mortality among exposed individuals: 2/3/4(H), 7(L);
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 28.96%: Estimated sublethal effects among exposed individuals: G:2/3/4(M),7(L); R:2/3/4(L),7(L); B:2/3/4(M),7(L)
Indirect	Mosquito control overlap 28.96%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 7(H)

Risk modifiers: Razorback suckers are omnivores, feeding on plankton, crustaceans, diatoms, filamentous algae, and detritus.

Indirect effects to aquatic invertebrate prey

Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration and spatially limited with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of benthic macroinvertebrate and micro crustacean prey, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on razorback sucker's food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species. While the razorbacker sucker does occupy bin 2 aquatic habitats with potentially higher estimated environmental concentrations if exposed to malathion, their potential exposure risk is largely mitigated by their reliance upon larger flowing and static aquatic habitats (bins 3, 4, and 7), reducing their overall risk.

Allowable uses driving effects/other considerations:

Overall Risk: ☐ High ☒ Medium ☐ Low

USAGE

Usage data for the whole range based on data from EPA's SUUM: (Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		14,450,692	28.96	951,311	1.91	2,3,4,7	2H 3 4 7L
Other Crops	D,I	149,776	0.30	0	0.00	2,3,4,7	2H 3 4

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							7M
Other Row Crops	D,I	222	0.00	232	0.00	2,3,4,7	2H 3 4 7M
Other Grains	D,I	65,293	0.13	25,399	0.05	2,3,4,7	2H 3 4 7M
Corn	D,I	49,280	0.10	3,168	0.01	2,3,4,7	2H 3 4 7M
Cotton	D,I	40,591	0.08	8,339	0.02	2,3,4,7	2H 3 4 7H
Developed	D,I	430,723	0.86	21,536	0.04	2,3,4,7	2L 3 4 7L
Wheat	D,I	199,582	0.40	126,265	0.25	2,3,4,7	2H 3 4 7M
Vegetables & Ground Fruit	D,I	137,279	0.28	10,572	0.02	2,3,4,7	2H 3 4 7M
Orchards & Vineyards	D,I	27,566	0.06	7,363	0.01	2,3,4,7	2H 3 4 7H
Pasture	D,I	580,944	1.16	166,659	0.33	2,3,4,7	2H 3 4 7M
Nurseries	D,I	795	0.00	795	0.00	2,3,4,7	2H 3 4

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							7H
Sub-TOTAL (D): *Other uses with direct effects*[3]		1,682,051	3.37	370,327	0.74		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		1,682,051	3.37	370,327	0.74		
TOTAL[4]:		16,132,742	32.33	1,321,638	2.65		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

Agricultural usage in California only based on CalPUR data

UDL	Mean Annual UDL Acres Treated within species CA range (minus Fed Lands) (2012-17)	Mean Annual Percent of Species Entire Range (including Fed Lands) Treated (2012-2017, excluding other states)
Nurseries	1.7	0.00000
Other Crops	10.3	0.00002
Pasture	590.7	0.00118
Vegetables and Ground Fruit	51.2	0.00010
Total	653.8	0.00131

 # acres in species range: 49,895,380 acres
% of range in California (i.e., where CalPUR data is available): 1%
Range overlap with Federal lands: 31,394,348 acres, 62.920%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the razorback sucker. As discussed below, even though the vulnerability and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The razorback sucker has a moderate vulnerability based on its status, distribution, and trends. Management actions in the upper basin have improved the resiliency of populations, created the redundancy of multiple and well-distributed populations, and maintained representation, largely through genetic diversity. FWS is currently considering downlisting of the species to threatened (although this has not yet been finalized). Where individuals are exposed to malathion applications, we anticipate variable levels of mortality, with higher levels of effects occurring in small waterbodies, or near shoreline areas of larger waterbodies. We anticipate survivors would experience sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, although low to moderate levels of impacts to growth and reproduction are also expected. We generally anticipate high levels of effects to invertebrate prey where exposure occurs. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (32%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (2.7%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. We anticipate small numbers of individuals may exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the razorback sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the razorback sucker in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Chasmistes brevirostris	Shortnose sucker	291

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The shortnose suckers are endemic to the upper Klamath River basin, including the Lost River and Lower Klamath Lake sub-basins. It is difficult to know precisely which tributaries and bodies of water this species historically occupied because records are sparse, but shortnose suckers occur in Upper Klamath Lake, Lower Klamath Lake, Tule Lake, Clear Lake Reservoir, and the major tributaries to these water bodies including the Sprague River, Wood River, Lost River, Willow Creek, and the Klamath River above Lower Klamath Lake. Loss of habitat was a major factor leading to the listing of the shortnose sucker (53 FR 27130). Historic habitat loss was especially pronounced in the Lost River–Tule Lake and Lower Klamath sub-basins. Loss of these areas has restricted the species to only three populations that are able to achieve even marginal reproduction (Upper Klamath Lake, Gerber Reservoir and Clear Lake Reservoir). The species is at significant risk from catastrophic events (i.e., die-offs), given the lack of population redundancy that could be used to replenish affected populations. Access to important habitat areas for spawning, rearing, and other needs has also been greatly curtailed.

Lake suckers such as shortnose suckers are relatively tolerant of water quality conditions unfavorable for many other fishes, including higher pH (more basic conditions), temperature, un-ionized ammonia concentrations, and lower dissolved oxygen concentrations (Saiki et al. 1999). Many of the water bodies currently occupied by shortnose suckers periodically exhibit conditions that are potentially harmful or fatal to the species. Significant threats to the shortnose sucker remain, including extremely poor water quality in Upper Klamath Lake and other areas, fluctuations in available water quantity and drought, fragmentation of populations, and entrainment. These threats increase mortality rates, reduce reproduction, and inhibit natural metapopulation dynamics. Predation by overly-abundant fathead minnows may be an important threat to larval shortnose suckers survival and other non-native fishes may also pose a threat to shortnose suckers; however, little quantitative information exists to indicate their influence on sucker abundance and distribution. Further, climate change and drought are potential threats to shortnose sucker throughout their range and new regional climatic patterns may pose a threat to shortnose sucker.

From the 2019 5-Year Review:
The FWS, together with many other entities and partners, have accomplished much to reduce threats to shortnose sucker since their listing, much of which is discussed in the Revised Recovery Plan and the previous 5-year Status Review (both from 2013) Since the last 5-year Status Review, notable conservation efforts include a Habitat Conservation Plan (HCP) by PacifiCorp that identifies actions that the company will implement for the protection of shortnose sucker habitat to support recovery of the species. The inception of a captive rearing program for the shortnose sucker is another major conservation effort since the previous Status Review. In partnership with Gone Fishing LLC, we began bringing larvae from the Williamson River into captivity for rearing. Individuals are in captivity for 2-3 years. Each year, we return thousands of these reared individuals to Upper Klamath Lake to bolster wild population numbers. Approximately, 2,500 suckers (comprised of all three species from the upper Klamath Basin) were released into Upper Klamath Lake in 2018. An additional 3,200 suckers were released in 2019.

However, the status of shortnose sucker has not substantially changed since the previous 5-year Status Review. Shortnose suckers suffer from low resiliency as a species. The low resiliency is due to the extremely low numbers in most populations, inadequate access to suitable spawning habitat for most populations, and genetic impurity in most populations (i.e., impaired representation). Shortnose suckers have more populations across a broader area compared to Lost River sucker, but overall, the species' redundancy remains quite low. There are currently only three known spawning populations (Upper Klamath Lake, Clear Lake Reservoir, and Gerber Reservoir). There may be an additional two populations (Lake Ewauna and Topsy Reservoir – a Klamath main stem reservoir) where spawning could potentially occur, albeit in very small numbers. In Upper Klamath Lake there are fewer shortnose suckers than Lost River suckers, by nearly an order of magnitude, but shortnose sucker is more abundant than Lost River sucker in the Lost River sub-basin overall. However, the number of populations and effective abundance is, in reality, diminished given the high levels of genetic introgression with Klamath largescale sucker

EB/CE Source:
U.S. Fish and Wildlife Service. 2013. Shortnose Sucker (*Chasmistes brevirostris*) 5-Year Review: Summary and Evaluation. Klamath Falls, Oregon. pp. 42.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the shortnose sucker will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, 4, 5, 6, and 7). The risk of mortality is expected to be high for bins 2, 3, 4, 5, and 6 and medium for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 3.28%: high mortality in bins 2/3/4, 5, and 6
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 3.28%: high level effect on behavior for a few use types.
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 3.28%: high mortality to aquatic invertebrate prey in all bins for nearly all uses
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 11.15%: high mortality in bins 2/3/4, 5, 6
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 11.15%: medium level effects on growth and behavior
Indirect	Mosquito control overlap 11.15%: high mortality to aquatic invertebrate prey

Risk modifiers: Shortnose sucker juveniles feed primarily along stream and lake margins on aquatic invertebrates and aquatic insects, and adults generally inhabit lakes although they may occasionally be found in streams and feed predominantly on zooplankton.

Indirect effects to aquatic invertebrate prey
Because aquatic invertebrates, including aquatic insects, exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration and spatially-limited with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that rely on a variety of aquatic invertebrate and zooplankton prey, short-term indirect effects to aquatic

invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the “Approach to the Effects Analysis” section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species. While the shortnose sucker does occupy bins 2 and 5 aquatic habitats with potentially higher estimated environmental concentrations if exposed to malathion, their potential exposure risk is largely mitigated by their reliance upon higher volume aquatic habitats (bins 3, 4, and 6), reducing their overall risk.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE

Usage data for the whole range based on data from EPA’s SUUM: (Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		1,738,164	11.15	NA	NA	2,3,4,5,6,7	2H 3 4 5H 6M 7L
Other Crops		29,074	0.19	0	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Other Row Crops		81	0.00	81	0.00	2,3,4,5,6,7	2H 3 4

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							5H 6H 7M
Other Grains		40,640	0.26	15,445	0.10	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Corn		53	0.00	1	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Cotton		6	0.00	0	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Developed		37,036	0.24	1,852	0.01	2,3,4,5,6,7	2M 3 4 5L 6L 7L
Wheat		98,378	0.63	104,759	0.67	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Vegetables & Ground Fruit		14,433	0.09	14,515	0.09	2,3,4,5,6,7	2H 3 4 5H 6H 7M

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Orchards & Vineyards		87	0.00	11	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Pasture		275,976	1.77	131,617	0.84		2H 3 4 5H 6H 7M
Nurseries		95	0.00	95	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		495,875	3.18	268,392	1.72		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		495,875	3.18	268,392	1.72		
TOTAL[4]:		2,234,039	14.32	268,392	1.72		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

Agricultural usage in California only based on CalPUR data:

UDL	Mean Annual UDL Acres Treated within species CA range (minus Fed Lands) (2012-17)	Mean Annual Percent of Species Entire Range (including Fed Lands) Treated (2012-2017, excluding other states)
Other Grains	67.3	0.00043
Pasture	285.5	0.00183
Vegetables and Ground Fruit	340.2	0.00218

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Wheat	39.3	0.00025
Total	732.4	0.00470

 # acres in species range: 15,595,659 acres
% of range in California (i.e., where CalPUR data is available): 32%
Range overlap with Federal lands: 11,672,858 acres, 74.847%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Shortnose sucker. As discussed below, even though the vulnerability is high and the risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Shortnose sucker has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. Effects to prey are variable, with generally high levels of mortality anticipated for prey; however, as discussed above these reductions to prey where they occur are not anticipated to appreciably reduce the prey base for the species. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range, as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (1.72%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>15 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the shortnose sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species.Thus, while we anticipate small numbers of individuals over the duration of the Action would be adversely affected by mortality, sublethal, or prey base effects, we do not expect species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the shortnose sucker in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Catostomus warnerensis	Warner sucker	292

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
From the 2010 5-Year Review:

The Warner sucker is endemic to the Warner Basin in southeastern Oregon, northeastern California, and northwestern Nevada. The historic range of Warner sucker includes the basin's three permanent lakes, Hart, Crump, and Pelican; the ephemeral Anderson, Swamp, Mugwump, Flagstaff, Upper Campbell, Campbell, Stone Coral, and Bluejoint Lakes; and all the sloughs and canals connecting these lakes. Warner sucker also reside in the three major stream basins that are tributaries to these lakes (Deep Creek, Twentymile Creek, and Honey Creek). The southernmost known distribution of Warner sucker is in the upper reaches of West Barrel Creek in California.

The Warner sucker remains vulnerable to predation by exotic fish and is affected by habitat modification through the continued operation of water diversions and barriers that restrict movement and migration of Warner sucker. Prolonged drought, particularly desiccation of lakes from drought and irrigation use and the drying or reduced stream flow of stream channels from irrigation water removal, greatly impact Warner suckers' viability and recovery.

The species likely consists of a metapopulation containing at least several thousand individuals with connectivity between the basin habitats. The trends are unclear, but appear to be depressed, possibly declining. Some recruitment between stream and lake habitat appears to occur. Estimates are at least several thousand for the total metapopulations, although population is described as seriously depressed and successful recruitment limited.

(The 2019 5-Year Review indicated the evaluation of threats affecting the species under the factors and the status in our 2010 5-Year review remains accurate.)

EB/CE Source:

U.S. Fish and Wildlife Service. 2019. Warner Sucker (*Catostomus warnerensis*) 5-Year Review: Summary and Evaluation. Portland, Oregon. pp. 98.

U.S. Fish and Wildlife Service. 2010. Warner Sucker (*Catostomus warnerensis*) 5-Year Review: Summary and Evaluation. Portland, Oregon. pp. 35.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Warner sucker will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, 5, 6, and 7). The risk of mortality is expected to be high for bins 2, 3, 5, and 6 and medium for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all use/bin combinations.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 0.81%: high mortality in bins 2/3, 5, and 6
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 0.81%: high level of effect on behavior for a few use types
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 0.81%: high level of mortality to aquatic invertebrate for all bins and nearly all uses
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 20.76%: High level of mortality in bins 2/3 and 5
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 20.76%: medium level effects on behavior and growth
Indirect	Mosquito control overlap 20.26%: high level of mortality to aquatic invertebrate prey in all bins

Risk modifiers: Warner suckers are opportunistic omnivores. Juveniles feed on invertebrates, particularly planktonic crustaceans. Adults are benthic feeders and eat diatoms, algae, and detritus.

Indirect effects to aquatic invertebrate prey
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since the Warner sucker is a generalist feeder that relies on a variety of aquatic invertebrate and micro crustacean prey and diatoms and algae, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food availablity.Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Warner sucker does occupy other aquatic habitats that may be exposed to potentially high levels of malathion, they can mitigate their potential risk of exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Allowable uses driving effects/other considerations:

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	524,128	20.76	NA	NA	2,3,5,6,7	2H 3 5H 6M 7L
Other Crops	D,I	1,658	0.07	0	0.00	2,3,5,6,7	2H 3

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							5H 6H 7M
Other Grains	D,I	3,127	0.12	3,113	0.12	2,3,5,6,7	2H 3 5H 6H 7M
Corn	D,I	1	0.00	0	0.00	2,3,5,6,7	2H 3 5H 6H 7M
Cotton	D,I	0	0.00	0	0.00	2,3,5,6,7	2H 3 5H 6H 7M
Developed	D,I	1,963	0.08	98	0.00	2,3,5,6,7	2L 3 5L 6L 7L
Wheat	D,I	1,904	0.08	1,315	0.05	2,3,5,6,7	2H 3 5H 6H 7M
Vegetables & Ground Fruit	D,I	13	0.00	13	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Orchards & Vineyards	D,I	2	0.00	3	0.00	2,3,5,6,7	2H 3 5H 6H 7M
Pasture	D,I	11,776	0.47	11,517	0.46	2,3,5,6,7	2H 3

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							5H 6H 7M
Nurseries	D,I	15	0.00	15	0.00	2,3,5,6,7	2H 3 5H 6H 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		20,460	0.81	16,074	0.64		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		20,460	0.81	16,074	0.64		
TOTAL[4]:		544,588	21.57	16,074	0.64		

 # acres in species range: 2,524,215 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,989,133 acres, 78.802%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Warner sucker. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Warner Sucker has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. Effects to prey are variable, with generally high levels of mortality anticipated for prey. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (22%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (0.04%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>2 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Aquatic habitat buffers also minimize the amount of malathion that can potentially drift or runoff into aquatic environments. Combined, these conservation measures substantially reduce exposure to the Warner sucker and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adveresely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Warner sucker in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Chasmistes cujus	Cui-ui	210

Family: Catostomidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
At the beginning of the 20th century, Cui-ui inhabited Pyramid Lake and Winnemucca lakes. Obligate stream spawners, cui-ui congregated near the mouth of the Truckee River in spring and migrated as far as 40 km (25 miles) upstream (to the vicinity of Wadsworth, Nevada) to spawn (Snyder 1917). The species was eliminated from Winnemucca Lake when it dried in the 1930s following unrestricted diversion of water from the Truckee River and a severe drought. Cui-ui is now restricted to Pyramid Lake and the lower Truckee River (downstream from Derby Dam). Pyramid Lake elevation is nearly 24 meters (80 feet) lower than at the turn of the century, and there are now structural impediments (e.g., Marble Bluff and Numana dams) to fish passage. Populations may fluctuate depending on flow and other habitat conditions.

Adult and juvenile Cui-ui inhabits Pyramid Lake year-round. Adults utilize the lower 19 km (12 mi) of the Truckee River only during the spawning season (ranging from as early as April to as late as June) and only in years in which there is sufficient attraction flow and passage above or around the delta (Scoppettone et al. 1986). Most spawners utilize the 16-km (10-mi) reach between Marble Bluff and Numana dams; the fish ladder at Numana Dam is not conducive to passage of Cui-ui. Fecundity is relatively high, reproductive success may vary based on habitat conditions. Population may have a relatively large number of individuals (100,000 to >1,000,000, existence of recent surveys unclear), but the single population appears to be limited to one general area (Pyramid Lake and lower Truckee River).

Cui-ui was listed as endangered due to human activities that impacted the natural hydrologic dynamics of the Truckee River/Pyramid Lake system by extensive storage, diversion and use of river water (loss or degradation of habitat). Loss of habitat, degradation of water quality, and disruption of hydrological flows are the prominent threats of the species.

EB/CE Source: U.S. Fish and Wildlife Service. 1992. Recovery Plan. Cui-ui (Chasmistes cujus) Second Revision. Portland, Oregon. 140 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Cui-ui will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 3, 4, and 7). The risk of mortality is expected to be high for bins 2, 3, and 4 and low to medium for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high in bins 2, 3, and 4 and medium to high bin 7.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 2.40%: Estimated mortality among exposed individuals: 2/3/4(L&H), 7(L&M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 2.40%: Estimated sublethal effects among exposed individuals: G:2/3/4(L&M),7(L&M); R:2/3/4(L&M),7(L); B:2/3/4(L&M&H),7(L&M&H)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 2.4%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 7(M&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 36.73%; Estimated mortality among exposed individuals: 2/3/4(H),7(M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 36.73%: Estimated sublethal effects among exposed individuals:

	G:2/3/4(M),7(L); R:2/3/4(L),7(L); B:2/3/4(M),7(L)
Indirect	Mosquito control overlap 36.73%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 7(H)

Risk modifiers: The Cui-ui [kwee-wee] is an opportunistic invertivore, feeding on zooplankton, phytoplankton, and invertebrates such as small crustaceans and insect larvae or pupae. It feeds mainly in shallow to medium-depth water 10 to 30 m (30 to 100 ft.) deep, although it has been observed to feed in schools near the surface over deeper waters. It has a slow growth rate, with no known competitors or dependencies for feeding.

Indirect effects to aquatic invertebrate prey:
Because aquatic invertebrate prey exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since Cui-ui rely on a variety of benthic macroinvertebrate and micro crustacean prey, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations: Total overlap for all uses is relatively low (2.40%). The use type with the highest overlap, Developed (2.24%), is anticipated to cause low levels of lethal and sublethal effects among exposed individuals. Indirect effects to exposed aquatic invertebrate prey are anticipated to be medium in bin 7 and high in bin 2. Adult and juvenile cui-cui inhabit Pyramid Lake year-round and effects (estimated using bin 7) are anticipated to be low for the highest use, Developed and medium to high for the minor uses. Adults utilize the lower 19 km (12 mi) of the Truckee River only during the spawning. Because we are using bin 2 estimates as an upper bound of bin 3 and 4 exposures, effects may sometimes be overestimated for cui-ui in the larger flowing waters (bins 3 and 4). For individuals in bin 3 or 4 waters near the confluence of a smaller streams (bin 2) or in nearshore areas where use sites are close to the river/stream edge effects estimates will be more realistic.

Mosquito Control: Mosquito control may occur over large portions of the species range (36.73% overlap). Exposed individuals could experience medium mortality in the lake (bin 7) and high mortality in the streams/river (bins 2, 3, and 4). However, the same considerations described above regarding bin 3 and 4 waters apply to mosquito control activities.

In the “Approach to the Effects Analysis” section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Cui-ui does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats (bin 2), they can mitigate their potential risk of exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	1,124,290	36.73	114,645	3.75	2,3,4,7	2H 3 4 7M
Other Crops	D,I	256	0.01	0	0.00	2,3,4,7	2H 3 4 7M
Other Grains	D,I	34	0.00	31	0.00	2,3,4,7	2H 3 4 7M
Corn	D,I	7	0.00	8	0.00	2,3,4,7	2H 3 4 7M
Developed	D,I	68,527	2.24	3,426	0.11	2,3,4,7	2L 3 4 7L
Wheat	D,I	87	0.00	6	0.00	2,3,4,7	2H 3 4 7L

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Vegetables & Ground Fruit	D,I	242	0.01	326	0.01	2,3,4,7	2H 3 4 7M
Orchards & Vineyards	D,I	0	0.00	0	0.00	2,3,4,7	2H 3 4 7H
Pasture	D,I	4,120	0.13	4,258	0.14	2,3,4,7	2H 3 4 7M
Nurseries	D,I	76	0.00	76	0.00	2,3,4,7	2H 3 4 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		73,350	2.40	8,133	0.27		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		73,350	2.40	8,133	0.27		
TOTAL[4]:		1,197,639	39.13	122,778	4.01		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 3,060,598 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,732,650 acres, 56.611%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Cui-ui. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Cui-ui has a high vulnerability based on its status, distribution, and trends, although the single population likely has a relatively high number of individuals, as noted above. Where individuals are exposed to malathion applications, we anticipate low to high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. Effects to prey are variable, with generally high levels of mortality anticipated for prey. We anticipate the highest levels of effects to individuals would be related to mosquito adulticide; developed uses also have higher (but still relatively low) overlap, but the degree of effects is anticipated to be low from this use layer. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (39%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>3 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Combined, these conservation measures substantially reduce exposure to the Cui-ui and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Cui-ui in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Centrarchidae)

Scientific Name:	Common Name:	Entity ID:
Elassoma alabamae	Spring pygmy sunfish	7332

Family: Centrarchidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining. (One metapopulation is declining; however, the status of other metapopulations are stable or unknown. A new population to the east on Wheeler NWR was discovered in 2015.)
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The spring pygmy sunfish and its habitat are currently facing the threats of both declining water quality and quantity. Excessive groundwater usage, and the resultant reduction of the water levels in the aquifer/recharge areas and decreased spring outflow in the Beaverdam Spring/Creek system, is believed to have negatively impacted the spring pygmy sunfish and its habitat.

Contamination of the recharge area and aquifer from the intensive use of chemicals (i.e., herbicides, pesticides, and fertilizers) within the spring pygmy sunfish's habitat poses a threat to the species' survival.

Contaminant transport occurring with sediment in surface stormwater runoff, or resulting from agricultural runoff, can enter the spring pool and spring run directly without first entering the groundwater. During 1999–2001, 35 pesticides and volatile organic compounds such as tetrachloroethylene and trichloroethylene were detected in wells and springs within the Lower Tennessee River Valley (Woodside et al. 2004. pp. 1–2). Increased toxic concentrations of herbicides coupled with increased desiccation of aquatic vegetation due to drought (Jandebeur 2012c, pp. 1–6, 13) may have contributed to the demise of the Pryor Spring/Branch population of the spring pygmy sunfish. The ongoing, intensive agricultural practices and proposed urbanization and industrialization plans (Bostick and Davis 2013, pers. comm.; Hill in litt. 2013) within the immediate area of the watershed threaten to contaminate the groundwater in the aquifer supplying the Beaverdam Spring/Creek system (Healy 2010, p. 70). (While the species listing document mentions application of herbicides as an example of pesticide use, we assume the broader use of the term "pesticides" also includes other types of pest control in addition to herbicides, based on context from the listing document.)

Ongoing stormwater discharge from agricultural lands and urban sites compounds the water quality degradation by increasing sediment load and depositing contaminants into surface and groundwater sources. However, between 2012 and 2013, two Candidate Conservation Agreements with Assurances (CCAAs) were established on over 3,900 acres of occupied habitat that encompassed aquatic habitats, riparian and recharge areas. The CCAAs established vegetative buffers, restricted livestock access to aquatic habitats, limited groundwater removal, and prohibited pesticide and herbicide use. In 2015, a new population of spring pygmy sunfish was discovered to the east on Wheeler NWR. In 2019, when Critical Habitat was designated for the species, a large-scale residential and industrial development was being planned adjacent to the Beaverdam Spring/Creek system that was anticipated to exacerbate the decreasing water quantity and quality issues within occupied habitat. Since the establishment of critical habitat in 2019, two additional tracts of land totaling 1,200 acres of occupied habitat were placed in long-term conservation[1] for the species to mitigate environmental effects from the development of a manufacturing facility in the Beaverdam Creek area, and protect water quantity and quality, including prohibition of pesticide use.

EB/CE Source:

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Threatened Species Status for Spring Pygmy Sunfish. Federal Registr 78(191):60766-60783.

U.S. Fish and Wildlife Service. 2019. Designation of Final Critical Habitat for the Spring Pygmy Sunfish. Federal Register 84: 24987-25009.

Manson, M. 2020. Partnership Preserves 700 Acres for Habitat Protection. Alabama Land Trust Website: https://www.landtrustnal.org/2020/06/22/beaverdam-swamp-protected. *Accessed on 1/25/2020*

U.S. Fish and Wildlife Service. June 7, 2012. Candidate Conservation Agreement with Assurances for the Spring Pygmy Sunfish between Bella Mina Farm, Ltd and the U.S. Fish and Wildlife Service (TE40219-A-0). 18 pp.: 20 years duration and 3,200 acres, and 5 river miles of the Beaverdam-Moss Creek/Spring Complex covered.

U.S. Fish and Wildlife Service. November 27, 2013. Candidate Conservation Agreement with Assurances for the Spring Pygmy Sunfish between Greenbrier Enterprises, LLC, et. al. (Horton Farm) and the U.S. Fish and Wildlife Service (TE15501B-0). 31 pp: 25 years duration and 440 acres, and 6 linear miles of Beaverdam Spring/Creek covered.

[1] These activities are separate conservation activities from the CCAAs described previously.

U.S. Fish and Wildlife Service. November 27, 2013. Candidate Conservation Agreement with Assurances for the Spring Pygmy Sunfish between Greenbrier Enterprises, LLC, et. al. (McDonald Farm) and the U.S. Fish and Wildlife Service (TE15501B-0). 31 pp: 25 years duration and 272 acres covered.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)
Risk to individuals if exposed: We anticipate the spring pygmy sunfish will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 5, and 6). The risk of mortality is expected to be high for all bins for most uses. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 7.06%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 7.06%: high levels of effect on behavior for a few uses.
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 7.06%: high levels of mortality on aquatic invertebrate prey.
MOSQUITO CONTROL	
Direct (mortality)	Mosquito Control overlap 9.25%: high levels of mortality in bins 2, 5 and medium levels of mortality in bin 6.
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito Control overlap 9.25 %: medium levels of effect on growth and behavior in bins 2, 5 and low levels of effect on growth and behavior in bin 6.
Indirect	Mosquito Control overlap 9.25%: high levels of mortality on aquatic invertebrate prey

Species occurs in Bins 2, 5, and 6. See Risk Assumptions (above) for Risk to individuals and Species.

Overlap with species range (Total uses without mosquito control/Mosquito Control): 6.04%/71.55%

Risk Modifiers:

However, these values do not take into account: the additional acreage (3,900 acres) covered under the three CCAAs; the conservation tracts acquired by the North Alabama Land Trust; and the newly discovered population on the National Wildlife Refuge. Due to the protections offered at these locations, we anticipate the risk will be lower.

Indirect effects to prey fish and invertebrates:
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Because fish species exhibit a range of sensitivities to malathion, exposure is expected to have varying effects upon different species. For most fish species that are generalist feeders and rely on a variety of benthic macroinvertebrate, crustaceans, and mollusks and occasional fish prey, short-term indirect effects to aquatic invertebrate or fish prey base are anticipated to have a limited effect on food resources. These reductions to invertebrate and fish prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**

USAGE

Use type	Risk to species[2]	Use overlap with range		Estimated usage in range[3]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	36,970.3	71.55	4,781	9.25	2,5,6	2H 5H 6M
Cotton	D,I	2689.5	5.2	2,689.5	5.2	2,5,6	2H 5H

[2] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[3] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[2]	Use overlap with range		Estimated usage in range[3]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							6H
Developed	D,I	2104.5	0.20	2104.5	0.2	2,5,6	2M 5L 6L
Open Space Developed	D, I	2103	0.2	2103	0.19	2,5,6	2M 5L 6L
Wheat	D,I	107.60	0.21	107.6	0.21	2,5,6	2H 5H 6H
Other Crops	D,I	65.5	0.13	65.5	<0.01	2,5,6	2H 5H 6H
Other Grains	D,I	19.5	0.04	19.5	.04	2,5,6	2H 5H 6H
Nurseries	D,I	13.6	0.03	13.6	0.03	2,5,6	2H 5H 6H
Vegetables & Ground Fruit	D,I	7.5	0.01	7.5	0.01	2,5,6	2H 5H 6H
Other Row Crops	D,I	2.9	<0.01	2.9	<0.01	2,5,6	2H 5H 6H
Pasture	D,I	0.4	<0.01	0	<0.01	2,5,6	2H 5H 6H
Sub-TOTAL (D): *Other uses with direct effects*[4]		5,011	6.04		7.06		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		5,011	6.04		7.06		
TOTAL[5]:					16.31		

[4] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[5] TOTAL includes usage on all use sites with effects, including mosquito control.

PCT totals

- **All R-Plot layers except mosquito control: 7.06%**
- **Mosquito control: 9.25%**

 # acres in species range: 51,672 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 15,284 acres, 29.625%

As with the Risk discussion above, we anticipate overall usage will be lower, based on location surrounding land uses, and high degree of occupied habitat being actively managed for the benefit of the species.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

The following specific measures for Spring pygmy sunfish's designated critical habitat (which are not included within the areas included in the CCAAs discussed above) are now part of the Action and will be included in *BulletinsLive! Two.* While the measure is intended to reduce effects to critical habitat, it will also further reduce effects to the species:

Critical Habitat conservation measure: In addition to the general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, the registrants have also agreed to additional conservation measures, such as use limitation areas.

Cotton use BulletinsLive protection measure language:

For non-ULV aerial applications to cotton, use a 100-foot buffer from aquatic habitats in the species' designated critical habitat or use a full swath displacement in addition to the 50-foot buffer from aquatic habitats listed on the label.

Mosquito Control: Where feasible, avoid application in the species' designated critical habitat. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, coordinate with the local FWS Ecological Services field offices to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects to the species(FWS points of contact are available through the Information, Planning, and Consultation (IPaC) website https://ecos.fws.cov/ipac/). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

Avoidance and use limitation areas such as the species' range, critical habitat, or key habitat types and areas, are effective ways to reduce exposure to malathion by preventing use directly in these important areas and providing additional space for spray drift to dissipate before depositing in off-target sites, thus reducing the likelihood the species will come into contact with malathion.

The Service evaluated these additional measures and concluded that, in addition to changes to the general labels, will provide the necessary levels of protection for the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the spring pygmy sunfish. As discussed below, even though the vulnerability to this species is medium, the risk and likelihood of exposure to malathion are considered low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

This species has a medium vulnerability based on its status, distribution, and trends.

We anticipate that individuals exposed to malathion would experience variable levels of mortality or sublethal effects depending on use type and characteristics of their aquatic habitats, with survivors experiencing sublethal effects, and with each of these effects varying in part by use category. We anticipate high levels of mortality for exposed invertebrate prey.

Based on the usage data we acquired, we initially estimated usage within the non-Federal portion of the species' range would be greater than 10% for the species, as described in the Opinion and summarized for this species above. However, in consideration of other information, notably restrictions on pesticide use within the three established CCAAs, and two land trusts signed in 2019, we do not anticipate use or usage in or near areas of occupied habitat and therefore classified usage as low. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for these species in these areas, per the rationale related to usage on Federal lands as described in the Biological Opinion. Overall, we anticipate the likelihood of exposure of individuals of the species to malathion is low due to over 5,000 acres of occupied habitat and adjacent uplands being in long-term conservation for the benefit of the species. These conservation agreements specify water quantity and quality protections, namely prohibition of pesticide and herbicide use. For this reason, we do not anticipate mosquito adulticide usage over occupied areas. Similarly, the recently discovered population on Federal lands (Wheeler National Wildlife Refuge) and the relatively high degree of species habitat on Federal lands where we expect usage to be much lower over the duration of the proposed action further mitigate exposure risks to the species. We anticipate the majority of the individuals of the species are found in these protected areas. In addition to the low anticipated malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, reduced application number and rates for certain uses, and species-specific measures for critical habitat units, which are not protected as part of the CCAA agreements discussed above), will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. In addition, measures specific to minimize exposure to critical habitats (i.e., mosquito adulticide measures and cotton application restrictions) will also minimize exposure to the species itself. Combined, these conservation measures substantially reduce exposure to the spring pygmy sunfish and its prey resources and therefore minimizes overall risk and adverse effects to the species.

Thus, we anticipate it would be unlikely for individuals to be exposed or their food resources to be impacted either via groundwater contamination or surface runoff into occupied habitats based on conservation measures that will be implemented, and the long-term conservation agreements and land trusts being actively managed for the benefit of the species, including prohibition against pesticide use, and the relatively high overlap of the species range with federal lands. Therefore, we anticipate that the Action would not appreciably reduce survival and recovery of the spring pygmy sunfish.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Cyprinidae)

Scientific Name:	Common Name:	Entity ID:
Notropis oxyrhynchus	Sharpnose Shiner	3596

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single (sustainable) population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The sharpnose shiner was known to historically and naturally inhabit approximately 3,417 km (2,123 mi) of river segments in the Brazos, Red, and Colorado River basins, but now the only sustainable population is restricted to approximately 1,009 km (627 mi) of the upper Brazos River basin in north-central Texas, a greater than 70% reduction. The two key factors influencing the current and future status of the sharpnose shiner by affecting both individual and population-level survival and reproduction are the fragmentation of riverine habitat and alterations to flow regime.

Fragmentation of riverine habitat occurs primarily through fish barrier construction (e.g., reservoir construction, chloride control dams, impoundments, low-water crossing, falls). Impoundments, groundwater depletion, mining or dredging, salt cedar invasion, alteration of channel morphology, and drought each have the potential to alter flow regimes. Together, these factors have likely been the main reasons for the large range reduction by both sharpnose and smalleye shiners and why both species are at a heightened risk of extirpation within their remaining ranges in the upper Brazos River basin. Secondary factors affecting both species include commercial bait harvesting and sources of pollution such as concentrated animal feeding operations, industrial discharges, municipal discharges, urban runoff, and agricultural runoff. These factors may potentially reduce sharpnose shiner survival, especially when considered together and in conjunction with other threats. Although golden algae-related fish kills are of concern, the causes of golden algal blooms are not well understood. These multiple factors are not acting independently, but are acting together as different sources (or causes), which can result in cumulative effects to lower the overall viability of the species.

As remaining habitat of the shiners becomes more fragmented and drought conditions intensify, the single remaining population of sharpnose shiners will become more geographically restricted, further reducing the viability of the species into the future. Under these conditions, the severity of secondary threats, including water quality degradation from pollution and golden algal blooms and legally permitted commercial bait fish harvesting, will have a larger impact on the species. As the shiners become more geographically concentrated, a single pollutant discharge, golden algal bloom, commercial harvesting, or other local event will increase the risk of extinction of the species.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Species Status Assessment Report for the Sharpnose Shiner (*Notropis oxyrhynchus*) and Smalleye Shiner (*N. buccula*). Arlington, Texas Ecological Services Field Office.

U.S. Fish and Wildlife Service. 2020. Draft recovery plan for the sharpnose (*Notropis oxyrhynchus*) and smalleye (*N. buccula*) shiner. U.S. Fish and Wildlife Service Arlington, Texas.

U.S. Fish and Wildlife Service. 2021. 5-year review: Sharpnose Shiner and Smalleye Shiner (Notropis oxyrhynchus and N. buccula). U.S. Fish and Wildlife Service, Arlington, Texas.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the sharpnose shiner will experience direct mortality or sublethal effects for most uses of malathion in bin 3. The risk of mortality is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 30.07%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 30.07%: high levels of effect on behavior for a few uses.
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 30.07%: high levels of mortality on aquatic invertebrate prey.
MOSQUITO CONTROL	
Direct (mortality)	Mosquito Control overlap 43.17%: high levels of mortality

Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito Control overlap 43.17%: medium levels of effect on growth and behavior
Indirect	Mosquito Control overlap 43.17%: high levels of mortality on aquatic invertebrate prey

Risk modifiers: Sharpnose shiners are generalist feeders and have a maximum lifespan of less than three years. Their diet is dominated by aquatic invertebrates such as dipterans, ostracods, trichopterans, odonata, coleopterans, and hemipterans, plus various terrestrial arthropods.

Indirect effects to aquatic invertebrate prey
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since sharpnose shiners consume a variety of aquatic and terrestrial invertebrate prey, short-term indirect spatially limited effects to aquatic invertebrate prey are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

Allowable uses driving effects/other considerations:

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		2,171,382	43.17	36,300	0.72	3	2H 3
Other Crops		55,220	1.11	0	0.00	3	2H 3
Other Row Crops		152	<0.01	963	0.02	3	2H 3
Other Grains		47,030	0.93	47,030	0.93	3	2H 3
Corn		1,526	0.03	1,224	0.02	3	2H 3
Cotton		418,649	8.32	149,771	2.98	3	2H 3
Developed		86,931	1.73	1,834	0.04	3	2M 3
Open Space Developed		181,704	3.61	9,085	0.18	3	2L 3
Wheat		162,365	14.30	721,920	14.35	3	2H 3
Vegetables & Ground Fruit		1,377	0.03	1,131	0.02	3	2H 3
Orchards & Vineyards		201	<0.01	192	<0.01	3	2H 3
Pasture		314	0.01	314	0.01	3	2H 3
Nurseries		30	<0.01	30.46	<0.01	3	2H 3
Sub-TOTAL (D): *Other uses with direct effects*[3]		955,502	30.07	933,495	18.56		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		955,502	30.07	933,495	18.56		
TOTAL[4]:		3,126,884	73.23	969,795	19.28		

^We consider the bin 2 estimates as an upper bound of bin 3 exposures. This species only occurs in bin 3.

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

 # acres in species range: 5,030,054 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 4 acres, 0.000%

Overall Usage: ☒ **High** ☐ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the sharpnose shiner. Even though the vulnerability of the species is high, as is anticipated usage, we expect the risk is low for this species when exposure occurs, as described below, and implementation of general conservation measures is expected to reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

While the species range is very large (>5 million acres), the only sustainable population is restricted to approximately 1,009 km (627 mi) of the upper Brazos River basin. The sharpnose shiner has a high level of vulnerability based on its status, distribution, and trends. In our draft Opinion, we initially assumed high risk for this species, using a highly conservative modeling approach employing EECs for very small flowing waterbodies (bin 2), and anticipated low levels of mortality, particularly from wheat, other crops, and mosquito adulticide uses. However, in coordination with EPA, we were able to reassess risk using revised assumptions about exposure in bin 3; simply put, the bin 2 EECs are too conservative, and we expect substantially lower levels of mortality and sublethal effects (e.g., an order of magnitude) when exposure occurs. Where exposure occurs, effects to prey would be variable due to the sharpnose shiner feeding on a variety of terrestrial and aquatic invertebrates, with generally high levels of mortality anticipated for invertebrate prey. That said, if exposed, aquatic invertebrate prey are anticipated to experience short-term and spatially limited reductions therefore having a limited effect on the species' food resources. Thus, we anticipate that actual risk in bin 3 habitats will be lower than the modeled indirect effects to invertebrate prey suggest.

We anticipate usage within the non-Federal portion of the species' range will be high (19.28%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above, however as discussed above, we anticipate there is a low likelihood of effects such as mortality or sublethal impacts (e.g., growth, reproduction, behavior) to be observed for the sharpnose shiner based on its inhabiting bin 3 waters where malathion concentrations are not likely to reach levels where impacts to this species would be observed. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. We anticipate a few individuals may be exposed over the duration of the proposed action and experience mortality and sublethal effects. We also anticipate localized reductions in prey could occur as a result of applications of malathion. However, additional food resources from upstream sources would quickly recolonize (e.g., aquatic invertebrates would periodically drift downstream and reestablish a forage base weeks afterwards), terrestrial arthropods from the riparian zone would continue to serve as a food resource. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to the shiner and its prey. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and its prey for many uses; although this measure does not apply to one use (wheat) that had a larger overlap with the species, we nonetheless anticipate risk from this use is low, as described above. Combined, the conservation measures substantially reduce exposure to the sharpnose shiner and its prey and therefore minimize overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects, we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the sharpnose shiner in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Notropis buccula	Smalleye Shiner	7670

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The smalleye shiner has lost at least half of its historical range. It is now restricted to one population in the upper Brazos River basin. As a result, the smalleye shiner currently lacks redundancy, which reduces the viability of this species as a whole. In addition, streamflows within their current extant range are insufficient during some years to support successful reproduction, such as occurred in 2011. The two primary factors affecting the current and future conditions of this species are river fragmentation by impoundments and alterations of the natural streamflow regime (by drought, groundwater withdrawal, and saltcedar (*Tamarix* spp.) encroachment). Other secondary factors, such as water quality degradation and commercial harvesting for fish bait, likely also impact these species but to a lesser degree. These factors are not acting independently, but are acting together as different sources (or causes), which can result in cumulative effects to lower the overall viability of the species.

Of the area once occupied in the Brazos, Colorado, and Wichita Rivers, only two contiguous river segments remain with unobstructed lengths (without dams) greater than 275 km (171 mi): the upper Brazos River (where the fish are extant) and the lower Brazos River (where the fish are either extirpated or functionally extirpated). The effects of river habitat fragmentation have occurred and continue to occur throughout the range of the species and are expected to increase if proposed new reservoirs are constructed. River habitat fragmentation is affecting species at the individual, population, and species levels and puts the species at a high risk of extinction currently and increasingly so into the long-term future. In addition, future fragmentation of the remaining occupied habitat of the upper Brazos River by new impoundments would decrease the contiguous, unfragmented river habitat required by the species for successful reproduction and impact the sole remaining population. Texas does not have adequate water supplies to meet current or projected water demand in the upper Brazos River region and additional reservoir construction is likely imminent. As a result, possible new impoundments include the 2012 State Water Plan's proposed Post Reservoir in Garza County, the Double Mountain Fork Reservoir

(East and West) in Stonewall County, and the South Bend Reservoir in Young County. Species extirpation is expected to eventually occur in occupied river fragments reduced to less than 275 km (171 miles) in length, so any new structures further fragmenting stream habitats increases the likelihood of species extinction. As remaining habitat of the shiners becomes more fragmented and drought conditions intensify, the single remaining population of smalleye shiners will become more geographically restricted, further reducing the viability of the species into the future. Under these conditions, the severity of secondary threats, such as water quality degradation from pollution and golden alga blooms and legally permitted commercial bait fish harvesting, will have a larger impact on the species. As the shiners become more geographically concentrated, a single pollutant discharge, golden algal bloom, or commercial harvesting or other local event, will increase the risk of extinction of the species.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Species Status Assessment Report for the Sharpnose Shiner (*Notropis oxyrhynchus*) and Smalleye Shiner (*N. buccula*). Arlington, Texas Ecological Services Field Office.
U.S. Fish and Wildlife Service. 2020. Draft recovery plan for the sharpnose (*Notropis oxyrhynchus*) and smalleye (*N. buccula*) shiner. U.S. Fish and Wildlife Service Arlington, Texas.

U.S. Fish and Wildlife Service. 2021. 5-year review: Sharpnose Shiner and Smalleye Shiner (Notropis oxyrhynchus and N. buccula). U.S. Fish and Wildlife Service, Arlington, Texas.
Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 30.09%: high levels of mortality for most uses.
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 30.09%: high levels of effect on growth and behavior for a few uses.
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 30.09%: high levels of mortality on aquatic invertebrate prey.
MOSQUITO CONTROL	
Direct (mortality)	Mosquito Control overlap 13.55%: medium levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito Control overlap 13.55%: low levels of effect on growth and behavior

Indirect	Mosquito Control overlap 13.55%: high levels of mortality on aquatic invertebrate prey.

Species occurs in bin 3. See Risk Assumptions (above) for Risk to individuals and Species.

Overlap with species range (Total uses without mosquito control/Mosquito Control): 30.09%/13.55%

Risk modifiers:

Indirect effects to aquatic invertebrate prey

Smalleye shiner are generalist feeders, eating mostly invertebrates. Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Because smalleye shiner is a generalist feeders that relies on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to aquatic invertebrate prey suggest.

In the “Approach to the Effects Analysis” section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		681,685	13.55	36,300	0.72	3	2H 3
Other Crops		55,630	1.11	<1	0.00	3	2H 3
Other Row Crops		1103	<0.01	962	0.02	3	2H 3
Other Grains		47,030	0.93	47,030	0.93	3	2H 3
Corn***		1,526	0.03	1,224	0.02	3	2H 3
Cotton		418,649	8.32	149,771	2.98	3	2H 3
Developed		36,685	1.73	1,834	0.04	3	2L 3
Open Space Developed		181,704	3.61	9,085	0.18	3	2L 3
Wheat***		719,262	14.30	719,262	14.30	3	2H 3
Vegetables & Ground Fruit		1,377	0.03	1,130	0.02	3	2H 3
Orchards & Vineyards		201	<0.01	192	<0.01	3	2H 3
Pasture		314	0.01	314	0.01	3	2H 3
Nurseries		30	<0.01	30.46	<0.01	3	2H 3
Sub-TOTAL (D): *Other uses with direct effects*[3]		1,463,511	30.09	933,495	18.56		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		1,463,511	30.09	933,495	18.56		
TOTAL[4]:		2,145,196	43.64	969,795	19.28		

***Use acres values for corn and wheat are slightly off from R-Plot values for this species

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

 # acres in species range: 5,030,054 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 6,230 acres, 0.052%

Overall Usage: ☒ **High** ☐ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the smalleye shiner. Even though the vulnerability for the species is high, as is anticipated usage, we expect the risk is low for this species when exposure occurs, as described below, and implementation of general conservation measurs is expected to reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The smalleye shiner has a high level of vulnerability based on its status, distribution, and trends. While the species range is very large (>5 million acres), the only sustainable population is restricted to approximately 1,009 km (627 mi) of the upper Brazos River basin. In our draft Opinion, we initially assumed high risk for this species, using a highly conservative modeling approach employing EECs for very small flowing waterbodies (bin 2), and anticipated low levels of mortality, particularly from wheat, other crops, and mosquito adulticide uses. However, in coordination with EPA, we were able to reassess risk using revised assumptions about exposure in bin 3; simply put, the bin 2 EECs are too conservative, and we expect substantially lower levels of mortality and sublethal effects (e.g., an order of magnitude) when exposure occurs. Where exposure occurs, effects to prey would be variable due to the smalleye shiner feeding on a variety of terrestrial and aquatic invertebrates, with generally high levels of mortality anticipated for invertebrate prey. If exposed, aquatic invertebrate prey are anticipated to experience short-term and spatially limited reductions therefore having a limited effect on the species' food resources. Thus, we anticipate that the actual risk will be lower than the modeled indirect effects to invertebrate prey suggest.

We anticipate usage within the non-Federal portion of the species' range will be high (19.28%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above, however as discussed above we anticipate there is a low likelihood of effects such as mortality or sublethal impacts (e.g growth, reproduction, behavior) to be observed for the smalleye shiner based on their life history of inhabiting bin 3 waters where malathion concentrations are not likely to reach levels where impacts to this species would be observed. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. We anticipate a few individuals may be exposed over the duration of the proposed action and experience mortality and sublethal effects. We also anticipate localized reductions in prey could occur as a result of applications of malathion. However, additional food resources from upstream sources would quickly recolonize (e.g., aquatic invertebrates would periodically drift downstream and reestablish a forage base weeks afterwards), terrestrial arthropods from the riparian zone would continue to serve as a food resource, in addition individuals would swim to other reaches of their habitat to seek out other areas of available prey. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources; although this measure does not apply to one use (wheat) that had a larger overlap with the species, we nonetheless anticipate risk from this use is low, as described above. Combined, these conservation measures substantially reduce exposure to the smalleye shiner and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the smalleye shiner in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Chrosomus saylori	Laurel dace	9220

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The laurel dace is a small fish endemic to the Tennessee River Basin in Tennessee. The Service listed laurel dace as endangered on August 9, 2011 (76 FR 48722) and designated critical habitat on October 16, 2012 (77 FR 63604). The Tennessee Wildlife Resources Agency (TWRA) lists the laurel dace as endangered under the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 (Tennessee Code Annotated §§ 70-8-101-112).

Primary threats to the species include decreased water and habitat quality resulting from siltation and other non-point source pollution, habitat fragmentation due to the presence of artificial barriers, inadequacy of existing regulatory mechanisms, and restricted range and population size. The final rule to list laurel dace as endangered (76 FR 48722) identified siltation and other nonpoint source pollutants, removal or alteration of riparian vegetation, and presence of fish passage barriers created by culverts at road crossings across streams as factors causing the destruction or modification of the species' habitat. In addition to these stressors, conversion of native hardwood forests to residential uses, pasture, crop, and pine monocultures has likely altered hydrology in the catchments of streams where laurel dace occur. Stressors originating from residential development likely will increase, as examination of parcel data in the Piney River and Soddy and Sale Creek drainages reveals that many tracts of land in the uppermost headwaters have been subdivided into smaller parcels for residential development. While development has not yet occurred on many of these parcels, the abundance of parcels that are 1 to 10 acres in size and classified as residential (State of Tennessee 2007a, 2007b, and 2008) indicates that increasing density of residential development could become a threat to aquatic life in these drainages.

Land conversion to row crop agriculture also presents a threat to laurel dace habitat. In 2009, two large pine plantations within the Soddy Creek Watershed were harvested and converted to tomato farms. An irrigation impoundment was built on one Soddy Creek tributary, and another was under construction during 2013. These tomato fields have introduced a substantial source of sediment into the Soddy Creek headwaters. In addition to contributing sediment, irrigation and stormwater runoff from crop fields may flow directly into the creek, potentially containing fungicides, herbicides, and fertilizers (Thurman pers. comm. 2009). Biological sampling in Soddy Creek by Tennessee Department of Environment and Conservation (TDEC), on two separate dates during 2014, produced the lowest possible score, and the streambed was covered in sediment. A tomato farm is also present in the headwaters of Youngs Creek, where a sign was present in July 2013 barring human entrance due to pesticides (Figure 3; George pers. comm. 2013). Based on inspection of aerial imagery, this site on Youngs Creek has been in agricultural production since at least 2004.

Riparian buffers filter sediment and nutrients from overland runoff, allow water to soak into the ground, protect stream banks, and provide shade for streams (Waters 1995). Removal of riparian vegetation near aquatic habitat is problematic not only for its potential to increase siltation, but also for the potential thermal alteration that could result from the loss of tree canopy that shades these small headwater streams (Strange and Skelton 2005). Skelton (2001) reported that laurel dace occupy cool streams with a maximum recorded temperature of 26 °C (78.8 °F). Though the species' tolerance of elevated stream temperatures has not been investigated, removal of riparian vegetation along the shallow, headwater streams the species inhabits could potentially increase temperatures above the laurel dace's maximum tolerable limit.

An emerging threat to laurel dace is the loss of hemlocks from riparian areas due to the hemlock woolly adelgid (*Adelges tsugae*) (HWA), a nonnative insect that infests hemlocks, 20 causing damage or death to trees. HWA increases mortality rates for hemlocks in the southern Appalachians; in North Carolina, more than 85% of infested trees were dead seven years following infestation (Ford et al. 2012). HWA was documented on Walden Ridge in Rhea County in 2008 and Bledsoe County in 2013, with likely infestation of hemlock in riparian forests along laurel dace streams in the future (Johnson pers. comm. 2013). All three watersheds containing laurel dace have known HWA infestations from US Highway 27 up Walden Ridge (D. Godbee pers. comm. 2013), but only hemlocks on state lands have been mapped so far (D. Lincicome pers. comm. 2013).

According to the 2021 5-Year Review, the species has declined and now occupies only portions of three headwater streams - Bumbee Creek and Youngs Creek in the northern metapopulation and Horn Branch in the southern metapopulation (Bledsoe and Rhea Counties, Tennessee). Additionally, the population in Horn Branch, compared to capture records before 2014, is almost undetectable by current survey methods. Increased sedimentation associated with vegetable production (row-crop agriculture) and potential predation by sunfishes continue to threaten the species.

EB/CE Source:

U.S. Fish and Wildlife Service. 2016. Recovery Plan for the Laurel Dace (Chrosomus saylori). Atlanta, Georgia. pp. 62

U.S. Fish and Wildlife Service. 2021. 5-Year Review: Summary and Evaluation. Cookeville, Tennessee. pp.18

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)
Risk to individuals if exposed: We anticipate the laurel dace will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 3, and 6). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 0.55%: high levels of mortality for most uses in bins 2 and 3
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 0.55%: high levels of effect on growth and behavior for most uses, and high levels of effect on reproduction for a few uses in bins 2 and 3
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 0.55%: high levels of mortality among aquatic invertebrate prey in bins 2 and 3
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 15.55%: high levels of effect for mortality in bin 2, and medium effect level in bin 3.
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 15.55%: medium levels of effect on behavior
Indirect	Mosquito control overlap 15.55%: high levels of mortality among aquatic invertebrate prey

Species occurs in bins 2, 3. See Risk Assumptions (above) for Risk to individuals and Species.
Risk modifier:
Indirect effects to prey fish and invertebrates:
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since laurel dace are opportunistic feeders (Fix 2021) that rely on a variety of aquatic and terrestrial invertebrate prey, plant matter and algae, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the laurel dace does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats (bin 2), their potential risk of exposure to malathion is at least partially lowered due to their reliance upon these higher flowing aquatic habitats (bin 3), reducing their overall risk.

Overlap with species range (Total uses without mosquito control/Mosquito Control): 2.76%/27.01%

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortlaity Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	126,080	27.01	2,542	15.55	2,3	2H 3M
Developed	D,I	1,064	2.28	0	0.11	2,3	2M 3M
Corn	D,I	1,750	0.37	0	0.35	2,3	2H 3H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortlaity Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Wheat	D,I	279	0.06	183	0.05	2,3	2H 3H
Other Crops	D,I	58.5	0.01	0	<0.01	2,3	2H 3H
Other Grains	D,I	52.8	0.01	107	0.01	2,3	2H 3H
Vegetables and Ground Fruit	D,I	37.5	<0.01	19	<0.01	2,3	2H 3H
Nurseries	D,I	26.5	<0.01	3,126	<0.01	2,3	2H 3H
Other Row Crops	D,I	22.7	<0.01	14	<0.01	2,3	2H 3H
Pasture	D,I	2.6	<0.01	69	<0.01	2,3	2H 3H
Cotton	D,I	0.6	<0.01	0	<0.01	2,3	2H 3H
Sub-TOTAL (D): *Other uses with direct effects*[3]		7,438	4.60	3,518	0.55		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		7,438	4.60	3,518	0.55		
TOTAL[4]:		1,293,742	29.79	6,060	16.10		

PCT totals

- **All R-Plot layers except mosquito control: 0.55%**

Mosquito control: 15.55%
 # acres in species range: 466,809 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 26,557 acres, 5.689%

Overall Usage: ☒ **High** ☐ **Medium** ☐ **Low**

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*:

Species specific measures: In addition to the general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, the registrants have also agreed to additional conservation measures, such as use limitation areas. Use limitation areas were identified as low flow areas (bin 2) based on modeled EECs at levels where toxic effects to the species if exposed would occur in these habitat areas. Avoidance of applications near low flow habitats would avoid exposure to malathion and potential toxic effects to the species.

Mosquito Control: Where feasible, avoid application within low flow areas. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, coordinate with the local FWS Ecological Services field offices to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects the species (FWS points of contact are available through the Information, Planning, and Consultation (IPaC) website https://ecos.fws.cov/ipac/). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

Avoidance and use limitation areas such as the species' range, critical habitat, or key habitat types and areas, are effective ways to reduce exposure to malathion by preventing use directly in these important areas, thus reducing the likelihood the species will come into contact with malathion.

The Service evaluated these additional measures and concluded that, in addition to changes to the general labels, will provide the necessary levels of protection for the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the laurel dace. As discussed below, even though the vulnerability is high and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

Laurel dace have a high vulnerability based on their status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate medium levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. We anticipate high levels of mortality for exposed invertebrate prey in low-flow bin 2 habitats. The risk to the species posed by labeled uses across the range is anticipated to be medium based on the overlap of use layers with the species range, as described below.

We anticipate usage within the non-Federal portion of the species' range will be high (>10%) for the species, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for the species, per the rationale related to usage on Federal lands as described in the Biological Opinion. Most of the usage (15.55%) on non-Federal lands for laurel dace is related to mosquito adulticide applications, and other uses are low for the dace. While mosquito adulticide usage was determined to be high within the range of the species, that high usage is based on usage rates for Hamilton County. Since the species' current distribution is restricted to Bledsoe and Rhea Counties (2012 5-Year Review) in headwater streams, exposure to malathion through mosquito adulticide applications is likely low or non-existant. Based on the usage data, we anticipate individuals of laurel dace would be exposed to runoff from malathion applications, namely from agricultural uses,that would result in low levels of mortality; survivors would experience sublethal effects and high levels of reduction in prey resources. Where localized effects reductions in prey occur as a result of applications of malathion, we anticipate these to be relatively short-term and localized. We anticipate where these prey reductions may occur that reestablishment of aquatic invertebrate prey would occur via a variety of methods (see Risk modifier: Indirect effects to invertebrate prey discussion above). Since laurel dace is an opportunistic feeder that relies on a variety of aquatic and terrestrial invertebrate prey, plant matter and algae, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources.

We expect that the introduction of malathion at low levels via urban and agricultural runoff would reduce survival of individuals of the species over the duration of the proposed action. While mosquito adulticide usage within the mapped range is high, those applications are not occurring where the species actually exist, and therefore, we do not anticipate mortality or sublethal effects as a result of mosquito adulticide applications. In addition to the low malathion usage within currently occupied habitat of the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes, and a species-specific measure for mosquito adulticide applications, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additionally, the laurel dace has a species-specific conservation measure for mosquito adulticide applications, minimizing exposure by excluding areas from application or by working collaboratively with the Service's local field office to develop appropriate conservation measures. Combined, these conservation measures substantially reduce exposure to the laurel dace and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the laurel dace in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Moapa coriacea	Moapa dace	211

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Increasing population(s)
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Flows in the Virgin–Muddy River system were fully appropriated by the early 20th century. During those early years of settlement and as engineering practices improved, portions of the Virgin River main stem and the lower Muddy River became dewatered periodically. The majority of the present day threat to the species in terms of habitat destruction occurred in the late 1800s and early 1900s. Hoover Dam was completed in 1935, creating Lake Mead, which inundated the lower 80 km (50 mi) of the Virgin River and the lower 8 km (5 mi) of the Muddy River. Subsequent stocking of non-native species (illicit or authorized) in Lake Mead to develop a sport fishery and their unrestricted access to the lower reaches of the Virgin and Muddy Rivers introduced a new threat to the Virgin River fishes. Additional water development projects on tributaries to the Virgin River (Santa Clara, Ash Creek, and Beaver Dam Wash) continued through the latter half of the 1900s, and recent water storage projects have replaced older diversion structures in the upper river and further modified Virgin River hydrology. Reduced based flows are of concern for some populations, and habitat conditions can be exacerbated by severe and persistent drought, which is expected to continue to occur in the future. Other important threats continue with introductions of non-native species, and eradication is challenging and has not been complete. In some streams, critical and behavioral thermal maxima are exceeded for varying periods of time in most years. We anticipate these effects will continue in the future as both results of the environmental baseline and as a result of cumulative effects. Conservation efforts are also being undertaken, with several efforts identifed in the recovery plan. For example, the Virgin River Program coordinates, directs, and funds recovery actions for listed species. Other efforts in the Virgin River Basin include several existing or developing habitat conservation and watershed management plans and partnerships, some of which have the potential to benefit these species over the long term.

This species is assumed to have moderate vulnerability. While still sensitive to stochastic events and presence much reduced from the past, recent counts have shown increasing trends amidst efforts to control non-native species. This species has been extirpated from much of its historical range due to habitat modifications and destruction and introduction of non-native species such as mollies, gambusia, and tilapia. Populations of the species likely fluctuate, with surveys (2005 to 2013) showing semiannual total estimates of the species ranging from around 450 to just over 1,700 individuals (all streams/reaches combined). The most recent year counts we obtained (from 2013) showed just over 1,200 individuals in February and just over 1,700 in August. Most of the survey results (i.e., between 2008 and 2012, 9 surveys total) reported estimates ranging from 459 and 713 individuals. (Source: Nevada Fish and Wildlife Office and National USFWS websites)

While the increases during this time period are encouraging, we have not found additional survey counts post-2013 to determine whether the trend continues to be increasing, stable, or if numbers have decreased since then. Much of the habitat modification impacting the species occurred many years ago, and efforts to control/reduce non-native species that compete with or prey on this species are likely to be key in helping to recover the species. Stressors remain, including water withdrawals, non-native species, and risk of stochastic events.

EB/CE Source:
U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem. Portland, Oregon. 60 pp.
U.S. Fish and Wildlife Service. 1994. Virgin River Fishes Recovery Plan.
Salt Lake City, Utah. 45 pp.

Additional information from U.S. Fish and Wildlife Service websites, accessed 12/20/2016: https://www.fws.gov/endangered/map/ESA_success_stories/NV/NV_story2/index.html and https://www.fws.gov/nevada/protected_species/fish/species/moapa_dace.html

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Moapa dace will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, and 6). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey will be high for all bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 4.60%: high levels of mortality for most uses
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 4.60%: high levels of effect on behavior for a few uses
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 4.60%: high levels of mortality among aquatic invertebrate prey
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 9.56%: high levels of effect
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 9.56%: medium levels of effect on behavior
Indirect	Mosquito control overlap 9.56%: high levels of mortality among aquatic invertebrate prey

Risk modifiers: Moapa dace are omnivorous, feeding primarily on invertebrates, but also algae, vascular plants, and detritus.

Indirect effects to invertebrate prey:
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since moapa dace are omnivorous feeders that rely on a variety of invertebrate prey, plant matter and algae, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Moapa dace does occupy other aquatic habitats with potentially higher levels of malathion exposure, their potential exposure risk is partially mitigated by their reliance upon higher volume aquatic habitats, reducing their overall risk.

Allowable uses driving effects/other considerations:

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortlaity Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	15,460	9.56	2,542	1.57	2,3,6	2H 3 6M
Other Crops	D,I	1,081	0.67	0	0.00	2,3,6	2H 3 6H
Other Row Crops	D,I	0	0.00	0	0.00	2,3,6	2H 3 6H
Other Grains	D,I	184	0.11	183	0.11	2,3,6	2H 3 6H
Corn	D,I	1	0.00	0	0.00	2,3,6	2H 3 6H
Cotton	D,I	138	0.09	107	0.07	2,3,6	2H 3 6H
Developed	D,I	375	0.23	19	0.01	2,3,6	2L 3 6L
Wheat	D,I	2,818	1.74	3,126	1.93	2,3,6	2H 3 6H
Vegetables & Ground Fruit	D,I	15	0.01	14	0.01	2,3,6	2H 3 6H
Orchards & Vineyards	D,I	91	0.06	69	0.04	2,3,6	2H 3 6H
Pasture	D,I	2,735	1.69	2,695	1.67	2,3,6	2H 3 6H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortlaity Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Sub-TOTAL (D): *Other uses with direct effects*[3]		7,438	4.60	6,213	3.84		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		7,438	4.60	6,213	3.84		
TOTAL[4]:		22,897	14.17	8,755	5.42		

 # acres in species range: 161,632 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 146,433 acres, 90.597%

Overall Usage: ☐ **High** ☒ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Moapa dace. As discussed below, even though the risk is high for this species, we anticipate the vulnerability to be medium and the likelihood of exposure to malathion to be low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Moapa dace has a medium vulnerability based on its status, distribution, and trends. Most of its range overlaps with Federal lands or other protected areas, and some of the threats (e.g., competing or predator nonnative species) are currently being addressed. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects. Effects to prey are variable, with high levels of mortality of invertebrate prey. The risk to the species posed by labeled uses across the range is anticipated to be relatively high, based on the overlap of use layers with the species range (14%), as described above.

We anticipate usage within the non-Federal portion of the species' range will be medium (5.42%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. However, since a large portion of the species range occurs on Federal lands, which is actively being managed (at least in part) for the species, we anticipate only low numbers of individuals would be exposed over the duration of the proposed action. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Moapa dace and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Moapa dace in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Cyprinodontidae)

Scientific Name:	Common Name:	Entity ID:
Cyprinodon elegans	Comanche Springs pupfish	216

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The best available scientific information indicates that the primary threats to the Comanche Springs pupfish are: 1) habitat loss from the loss of spring flow due to a decline in groundwater levels, and 2) hybridization or competition with sheepshead minnow due to further introductions into Comanche Springs pupfish populations. The information reviewed indicates that impacts to spring flows from significant increase in groundwater use or declines in recharge are likely to occur in the upcoming decades. Many springs in the area with similar groundwater sources have failed in the past 50 years, and most of the remaining springs have shown declining trends in outflow. One spring habitat with genetically unique pupfish (Phantom Lake Spring) has gone dry since the 1981 Recovery Plan and is currently being maintained artificially with pumping. The magnitude of impact on Comanche Springs pupfish from the loss of spring flow is extremely high. Because the range of the species is limited to a few small locations, habitat modification due to a decline in spring flows could result in additional local extirpations and eventual extinction. Although there have been recent conservation efforts at Phantom Lake Spring and San Solomon Spring that have improved Comanche Springs pupfish habitat, these efforts would be all for naught if spring flow continued to decline. In addition, the established captive brood stocks are not beneficial if there is no spring habitat in which to re-establish the populations. The threats associated with hybridization and competition are due to the presence of sheepshead minnow in East Sandia Spring, Lake Balmorhea, and the hybridization zone at the mouth of the canal system. Genetic introgression appears to be limited to Lake Balmorhea thus far. However, if this species were introduced into the San Solomon or Phantom Lake ciénegas, the Comanche Springs pupfish populations there could be lost, similar to the outcome of Pecos pupfish and Leon Springs pupfish populations when they encountered sheepshead minnow introductions. Removal of sheepshead minnow is very difficult. Therefore, the magnitude of the impact of this threat on the species is considered high.

Secondary threats include habitat modification from water quality degradation, local habitat changes, lack of regulatory mechanisms, and increased susceptibility to the gill parasite. None of these concerns acting alone in otherwise robust populations are likely to result in substantial threats to the species, but together or in small populations, any of these could negatively impact the Comanche Springs pupfish.

All of these threats, both primary and secondary, have either stayed constant or increased since the listing of the Comanche Springs pupfish and development of its recovery plan in 1981. Some of the threats (specifically, increased susceptibility to the gill parasite and climate change) are novel threats that have emerged since the recovery plan. Although the creation of additional habitat has increased the abundance of pupfish in some populations, the species as a whole remains vulnerable. Besides East Sandia Spring, no other waters in the natural range of the species may be suitable for relocation or establishment. Survival of the species depends entirely on its success in the Balmorhea area, an area which is under threats of decreasing spring flows and sheepshead minnow invasion.

EB/CE Source:
U.S. Fish and Wildlife Service. 2013. Comanche Springs Pupfish (*Cyprinodon elegans*) 5-Year Review: Summary and Evaluation. Austin, Texas. pp. 39

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Comanche Springs pupfish will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 5, and 6). The risk of mortality is expected to be high for bins 2 and 5 and low to high for bin 6 depending on the use. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total percent overlap (all uses except mosquito control) 3.43%: Mortality risk: 2(L&H), 5(M&H), 6(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total percent overlap (all uses except mosquito control) 3.43%: Risk of sublethal effects G:2(L&M),5(L&M),6(L&M);

	R:2(L&M),5(L&M),6(L); B:2(L&M&H),5(L&M&H),6(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total percent overlap (all uses except mosquito control) 3.43%: Risk to aquatic invertebrate prey: 2(H), 5(H), 6(H)
Mosquito Control	
Direct (mortality)	Mosquito control percent overlap 0.08%; Mortality risk: 2(H),5(H),6(M)
Sublethal – growth (G), reproduction (R) and behavior (B)	G:2(M),5(M),6(L) R:2(L),5(L),6(L) B:2(M),5(M),6(L)
Indirect	2(H),5(H),6(H)

Risk modifiers:

Allowable uses driving effects/other considerations:

Comanche Springs pupfish are currently found in three springs and one creek: Phantom Lake Spring (located in easternmost Jeff Davis County, Texas), San Solomon Spring, Giffin Spring, and Toyah Creek near Balmorhea, Reeves County, Texas. This pupfish usually occurs over mud in current. They feed opportunistically on invertebrates and filamentous algae. This species breeds during most months of the year. Females reach sexual maturity in about five months and spawn up to 30 eggs/day in captivity. Most individuals do not live more than 1 year.

Indirect effects to prey fish and invertebrates:
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly afterFor most fish species that are generalist feeders and rely on a variety of invertebrates, and filamentous algae, short-term indirect effects to aquatic invertebrate prey are anticipated to have a limited effect on food resources. These reductions to invertebrate prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D, I	3307	0.08	0	NA	2,5,6	2H 5H 6M
Other Crops	D, I	115122	2.66	31	0.00	2,5,6	2H 5H 6M
Other Row Crops	D, I	172	0.00	171	0.00	2,5,6	2H 5H 6M
Other Grains	D, I	1528	0.04	1682	0.04	2,5,6	2H 5H 6M
Corn	D, I	24	0.00	0	0.00	2,5,6	2H 5H 6M
Cotton	D, I	10211	0.24	9753	0.23	2,5,6	2H 5H 6H
Developed	D, I	10687	0.25	534	0.01	2,5,6	2L 5M 6L
Rice		1	0.00	0	0.00	2,5,6	
Wheat	D, I	2365	0.05	2122	0.05	2,5,6	2H 5H 6M
Vegetables & Ground Fruit	D, I	141	0.00	171	0.00	2,5,6	2H 5H 6H
Orchards & Vineyards	D, I	426	0.01	311	0.01	2,5,6	2H 5H 6H
Pasture	D,I	7758	0.18	2356	0.05	2,5,6	2H 5H 6M
Sub-TOTAL (D): *Other uses with direct effects*[3]		148434	3.43	17131	0.40		

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		148434	3.43	17131	0.40		
TOTAL[4]:		151741	3.50	17131	0.40		

 # acres in species range: 4,331,681 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 10,352 acres, 0.239%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

[4] TOTAL includes usage on all use sites with effects, including mosquito control.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed is not likely to jeopardize the continued existence of the Comanche Springs pupfish. As discussed below, even though the vulnerability is high and the risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Comanche Springs pupfish has a high vulnerability based on its status, distribution, and trends. This species is short-lived, and is limited to a few populations in vulnerable spring and spring-fed habitats. Refuge population(s) (i.e., additional populations maintained elsewhere) exists to help guard against stochastic events and their effects on the populations, although poplations in natural habitats fluctuate widely from year to year, and some have low numbers. The species has declined over time due to with water withdrawals, competition with other species and other stressors. The risk to the species, should individuals be exposed to applications, is also anticipated to be high for most uses, with few exceptions (i.e., developed). We anticipate individuals found in smaller static and flowing waters from most labeled uses would experience high levels of mortality, if exposed, as would their prey. Should individuals experience exposure in larger water bodies, the risk of mortality is lower for some uses, but still high for others.

However, both the vulnerability and risk to individuals if exposed would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. Thus, while the effect of exposure, should it occur, would be problematic for the species due to its vulnerability and the toxicity of this pesticide to the species and its invertebrate prey resources, we expect exposure to occur only at very low levels over the duration of the Action. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures

substantially reduce exposure to the Comanche Springs pupfish and its prey resources and therefore minimizes overall risk and adverse effects to the species.
Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Comanche Springs pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Cyprinodon diabolis	Devils Hole pupfish	217

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining,
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Recovery Plan (1990) describes impacts to this species from past and ongoing activities. Disturbance and alteration of habitat has increased over time. Marshlands were burned, and later land was tilled, springs diverted, and crops were produced. Large-scale disturbance began in the early 1960s when approximately 2,000 acres of Carson Slough was mined for peat, eliminating one of the largest marshes in Nevada (Soltz and Naiman 1978). Athough early surveys had not defined the distribution of Ash Meadows endemic species in upper Carson Slough, comparisons of early and recent collection records show that habitats of this and other species were eliminated by this mining (Hall 1935, Miller 1948, Soltz and Naiman 1978, Knight and Clemmer 1987). Introduction of non-native plants, fish, and other species collectively reduced plant and animal populations by displacement through competion for food and space, and/or predation (Miller 1943, Beatley 1977 a, b; Reveal 1978 a, b, c; Soltz and Naiman 1978, and others). Springs were dried and diverted, eliminating several populations (Soltz and Naiman 1978, Ono et al. 1983). A number of public agencies and private organizations have been involved with conservation programs in Ash Meadows since the 1950's. For example, approval of the Ash Meadows Habitat Management Plan by the Bureau initiated a number of more recent conservation programs on public domain lands (USBLM 1980). The Bureau has withdrawn from mineral entry 2,681 acres of land within Warm Springs pupfish essential habitat and surrounding Jack Rabbit and Big Springs.

EB/CE Source: 1990 Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada (USFWS 1990)

Additional considerations for vulnerability for this species:

The Devils Hole pupfish has highly variable population cycles, ranging from less than 50 individuals to more than 100. Relatively recent (2013) counts estimated lows of 35 individuals, although counts of approximately 100 fish are typical, per the 2019 Supplemental Finding for the species. Management actions (e.g., feeding, habitat structures, etc.) have been undertaken to help sustain the natural population.

Source: 2010 Supplemental Finding for the Devil's Hole Pupfish (USFWS (2019)

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)
Risk to individuals if exposed: This species occurs entirely on Federal lands. We anticipate high levels of both direct and indirect effects to this species if exposed, as we have demonstrated elsewhere in this document; however, we did not run R-Plots for this species. We address risk qualitatively for the species below in the Conclusion section of this species summary.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

This species occurs entirely on Federal lands. We did not quantitatively evaluate usage on Federal lands, but we assume only low levels of usage for the species below in the Conclusion section of this species summary, per the rationale related to usage on Federal lands as described in the Biological Opinion.

 # acres in species range: 72,078 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 72,078 acres, 100.000%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact

amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Devils Hole pupfish. As discussed below, even though the vulnerability and risk is high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.
This short-lived species (approximately 1 year), has only a single, small population in the wild, occupying the smallest extent of habitat of any vertebrate species (2.5 m by 20 m submerged limestone cavern); some individuals are also currently in captivity to serve as a refuge population (as of 2013). Thus, the species has high vulnerability based on its status, distribution, and trend, and the risk to the species and its invertebrate prey posed by labeled uses across its range is anticipated to be high (as for other listed pupfish species), should individuals of the species be exposed. The Devils Hole pupfish is found entirely on Federal Lands, and this species is closely monitored and managed. Thus, we anticipate that any usage within the species range that would result in exposure of individuals of the species to occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur. Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Devils Hole pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Cyprinodon radiosus	Owens pupfish	218

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
As a result mainly of habitat loss from water diversion, the Owens pupfish was at one time considered extinct (U.S. Fish and Wildlife Service 1998). In 1964, a small population of Owens pupfish was discovered in Fish Slough, which was still the only existing population when the pupfish was listed as endangered in 1967. Since listing, three additional populations have been established (Warm Springs, Well 368, and Mule Springs). Presently, there are four populations of pupfish, Fish Slough, Warm Springs, Well 368, and Mule Springs. Only the Fish Slough population has persisted since listing. Progress is being made toward establishing two new pupfish populations. Management plans are being developed for each of the potential Owens pupfish populations. The plans will include requirements to manage threats. Current major threats to the Owens pupfish include habitat encroachment by aquatic vegetation, predation by non-native species, and stochastic factors. These threats are occurring at all four of the existing pupfish populations and at all locations identified in the recovery plan for future introductions. Future introductions are not likely to be successful unless these threats are eliminated or reduced from those areas.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Owens Pupfish (*Cyprinodon radiosus*) 5-Year Review: Summary and Evaluation. Ventura, California. pp. 21.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Owens pupfish will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 5, and 6). The risk of mortality is expected to be high in all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects (growth, reproduction, behavior). We anticipate risk to aquatic invertebrate prey to be medium to high depending on the use and bin.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total percent overlap (all uses except mosquito control) 0.39%: Mortality risk: 2(L,H), 5(L,H), 6(L,H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total percent overlap (all uses except mosquito control) 0.39%: Risk of sublethal effects G:2(L,M),5(L,M),6(L,M); R:2(L,M),5(L,M),6(L); B:2(L,M,H),5(L,M,H),6(L,M)
INDIRECT (all uses except mosquito control)	,
Use areas - Prey item mortality	Total percent overlap (all uses except mosquito control) 0.39%: Mortality risk to aquatic invertebrate prey: 2/3(H), 5(M,H), 6(M,H)
MOSQUITO CONTROL	
Direct (mortality)	Total percent for mosquito control 22.3%: Mortality risk: 2/3(H), 5(H), 6(M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total percent for mosquito control 22.3%: G:2/3(M),5(M),6(L); R:2/3(L),5(L),6(L); B:23(M),5(M),6(L)
Indirect	Total percent for mosquito control 22.3%: Mortality risk to aquatic invertebrate prey: 2/3(H), 5(H), 6(H)

Risk modifiers:
In July 1964, a single population of approximately 200 fish was rediscovered in Fish Slough. All extant populations have been propagated from this remnant stock. Extant populations occur only in refuges at Fish Slough (which contains the Bureau of Land Management [BLM] Spring, BLM Ponds, and Marvin's Marsh sub-populations), Mule Springs, Well 368, and Warm Springs. All of

these habitats are managed to protect Owens pupfish by isolating them from nonnative fishes. The diet of the Owens pupfish changes seasonally, typically including invertebrates and those plants most abundant in the environment. Their diet consists mainly of midge larvae and, to a lesser extent, mayfly larvae and beetle larvae and adults. Owens pupfish are effective in controlling mosquito larvae. Their diet also includes small crustaceans, terrestrial insects that fall into the water, algae, carrion, and fish eggs. Juvenile pupfish grow rapidly to sexual maturity, in 3 to 4 months. They are usually able to spawn before their first winter. Female Owens pupfish may be involved in spawning acts as many as 200 times per day, but they lay only one to two eggs at a time. Owens pupfish rarely live longer than 1 year, although some individuals have been observed living as long as 3 years in refuge habitats.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Owens pupfish does occupy other aquatic habitats with potentially higher levels of malathion exposure, their potential exposure risk is partially mitigated by their reliance upon higher volume aquatic habitats, reducing their overall risk.

Allowable uses driving effects/other considerations: While effects to exposed individuals could be high, the overall footprint for all uses is small (0.39% overlap). The use with the highest overlap is Developed (0.26%).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE
(Anticipated usage within the range based on past usage data)

Agricultural usage not based on CalPUR data – the only data are for a non-ag use (Developed-Open Space Developed):

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		^
Mosquito Control	D,I	468801	22.30	0	NA	2,3,5,6	2H 3 5H 6M
Other Crops	D,I	376	0.02	0	0	2,3,5,6	2H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		^
							3 5H 6H
Other Row Crops	D,I	0	0.00	0	0.00	2,3,5,6	2H 3 5H 6H
Other Grains	D,I	21	0.00	18	0.00	2,3,5,6	2H 3 5H 6H
Corn	D,I	26	0.00	0	0.00	2,3,5,6	2H 3 5H 6H
Cotton	D,I	5	0.00	0	0.00	2,3,5,6	2H 3 5H 6H
Developed	D,I	5503	0.26	275	0.01	2,3,5,6	2M 3 5L 6L
Pasture	D, I	2070	0.1	2031	0.01	2,3,5,6	2H 3 5H 6H
Wheat	D,I	67	0.00	0	0.00	2,3,5,6	2H 3 5H 6H
Vegetables & Ground Fruit	D,I	1	0.00	1	0.00	2,3,5,6	2H 3 5H 6H
Orchards & Vineyards	D,I	14	0.00	9	0.00	2,3,5,6	2H 3 5H 6H
Sub-TOTAL (D):		8083	0.40	2365	0.01		

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		^
Other uses with direct effects[3]							
Sub-TOTAL (I): *Other uses with indirect effects*[3]		8083	0.40	2365	0.01		
TOTAL[4]:		476914	22.70	2365	0.02		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 2,102,019 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 1,574,562 acres, 74.907%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Owens pupfish. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.
The Owens pupfish has a high vulnerability based on its status, distribution, and trends. The species experienced a rapid decline from in the early 1900s, resulting in a single population (after being presumed extinct for a number of years) by the mid-1900s. After introductions and management, the Owens pupfish is now found in additional locations within its range, and the species currently is comprised of four populations, one of which has three sub-populations. This short-lived species is still vulnerable to threats and stressors related to genetics, stochastic events, and non-native species. We anticipate the risk to the species posed by labeled uses will be high where exposure occurs, with high levels of mortality and sublethal impacts to exposed individuals, and medium to high levels of impacts to their prey items.

However, we anticipate very low levels of usage within the non-Federal portions of the species range, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. Additionally, the species occurs to a large degree on Federal lands, where we anticipate only low levels of usage (as described in the Usage section of the Opinion. In addition to the extremely low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff into those environments. Combined, these conservation measures substantially reduce exposure to the Owens pupfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual pupfish and their invertebrate prey to occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur, and we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Owens pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Cyprinodon nevadensis pectoralis	Warm Springs pupfish	231

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s),
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Recovery Plan for the species describes impacts to the species from past and ongoing activities. Disturbance and alteration of habitat has increased over time. Marshlands were burned, and later land was tilled, springs diverted, and crops were produced. Large-scale disturbance began in the early 1960s when approximately 2,000 acres of Carson Slough was mined for peat, eliminating one of the largest marshes in Nevada (Soltz and Naiman 1978). Athough early surveys had not defined the distribution of Ash Meadows endemic species in upper Carson Slough, comparisons of early and recent collection records show that habitats of this and other species were eliminated by this mining (Hall 1935, Miller 1948, Soltz and Naiman 1978, Knight and Clemmer 1987). Introduction of non-native plants, fish, and other species collectively reduced plant and animal populations by displacement through competion for food and space, and/or predation (Miller 1943, Beatley 1977 a, b; Reveal 1978 a, b, c; Soltz and Naiman 1978, and others). Springs were dried and diverted, eliminating several populations (Soltz and Naiman 1978, Ono et al. 1983). A number of public agencies and private organizations have been involved with conservation programs in Ash Meadows since the 1950's. For example, approval of the Ash Meadows Habitat Management Plan by the Bureau initiated a number of more recent conservation programs on public domain lands (USBLM 1980). The Bureau has withdrawn from mineral entry 2,681 acres of land within Warm Springs pupfish essential habitat and surrounding Jack Rabbit and Big Springs.

EB/CE Source: 1990 Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Warm Springs pupfish may experience direct mortality or sublethal effects for the single use in the species range (Developed). The risk of mortality and sublethal effects is expected to be low for all bins (2 and 5). We anticipate risk to aquatic invertebrate prey to be high in bin 2 and medium in bin 5.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total percent overlap (all uses except mosquito control) 0.05%: Mortality risk: 2(L), 5(L)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total percent overlap (all uses except mosquito control) 0.05%: G:2(L), 5(L) R:2(L), 5(L) B:2(L), 5(L)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total percent overlap (all uses except mosquito control) 0.05%: 2(H), 5(M)
MOSQUITO CONTROL	
Direct (mortality)	There is 0% overlap of this use
Sublethal – growth (G), reproduction (R) and behavior (B)	
Indirect	

Risk modifiers:
The Warm Springs pupfish occupies six small springs in an area encompassing less than 1.99 square kilometers (0.77 square mile), situated approximately 1 kilometer (0.62 mile) west of Devil's Hole in Ash Meadows, Nye County, Nevada. They are opportunistic omnivores that feed on insects and plant matter. Because their habitat is limited to springs, the distribution of their food is also limited to springs. Warm Springs pupfish can develop to reproductive maturity in as little as 2 to 3 months. These pupfish begin spawning at the end of February and continue through October, with a peak in spawning activity between April and June. The average life span of Warm Springs pupfish is 6 to 9 months, though some survive for more than 1 year.

Allowable uses driving effects/other considerations:

Developed: individuals exposed to malathion in bins 2 and 5 would be at low risk of mortality and sublethal effects (growth, reproduction, behavior). We anticipate risk to aquatic invertebrate prey to be high in bin 2 and medium in bin 5.

Overall Risk: ☐ High ☒ Medium ☐ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control			0		NA		
Other Crops			0		0		
Other Row Crops			0		0		
Other Grains			0		0		
Corn			0		0		
Cotton			0		0		
Developed		17	0.05	1	0.002	2,5	2L 5L
Rice			0		0		
Wheat			0		0		
Vegetables & Ground Fruit			0		0		
Orchards & Vineyards			0		0		
Pasture			0		0		
Sub-TOTAL (D): *Other uses with direct effects*[3]		17	0.05	1	0.02		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		17	0.05	1	0.02		
TOTAL[4]:		17	0.05	1	0.02		

 # acres in species range: 35,669 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 35,509 acres, 99.551%

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Warm Springs pupfish. As discussed below, even though the vulnerability and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Warm Springs pupfish has a medium vulnerability based on its status, distribution, and trends, although the information driving the medium (vs. high) ranking is due in part to limited information on population trends. This species is short-lived, and is limited to a few populations in vulnerable spring and spring-fed habitats. The species consists of a relatively low number of small, isolated populations, likely with small numbers. However, the species occurs almost entirely on National Wildlife Refuge lands, with only a small portion of its range estimated to overlap with non-Federal lands. We anticipate the risk to the species posed by labeled uses across the range to be medium, driven primarily by effects to the species' invertebrate prey, as described above.

However, we anticipate the medium levels of both vulnerability and risk to individuals if exposed would be mitigated by the very low degree of overlap of labeled uses on non-Federal lands with the range of the species. We expect this use will result in only low levels of mortality and sublethal impacts to individuals of the species, if exposure occurs, although there may be higher levels of impacts to their invertebrate prey base. Similarly, we anticipate usage will be low, based primarily on the usage data we acquired and the fact that the species range overlaps primarily with Federal lands, as described in the Opinion and summarized for this species above. In addition to the extremely low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Warm Springs pupfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual pupfish and their invertebrate prey to occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to forage base that are reasonably certain to occur, and we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Warm Springs pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Cyprinodon bovinus	Leon Springs pupfish	251

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
This species is restricted to two areas within Diamond Y Spring system. Accurate population numbers of Leon Springs pupfish at Diamond Y Spring are not currently known; however, Itzkowitz (2010, p. 19) indicated that although populations of pupfish during 2008, 2009, and 2010 were larger than in 2006 and nearly double that of 2007, they were a mere fraction of the numbers observed in 2001. Itzkowitz (2010, p19) estimated the total population (upper and lower watercourse) of the Diamond Y Spring system in 2010 to be less than 50 individuals, and noted that irrespective of which year's population numbers were considered, they are all too small to sufficiently maintain the species. As of August 2013, the current captive stock of pupfish at SNARRC consisted of approximately 4,000 juveniles and 2,000 adult pupfish, totaling around 6,000 individuals. The population at SNARRC is considered stable and healthy, with approximately 60-150 individuals tested annually for any diseases or pathogens of concern (Ulibarri 2013, pers. comm.). Due to previous stochastic events affecting the small population size of the pupfish in the Diamond Y system, the refugia population at SNARRC has and will continue to be used as a safeguard to repopulate or supplement the existing population when the need arises.

The the Leon Springs pupfish has been considered completely extirpated from the wild once since the original 1980 listing due to introgression with sheepshead minnows in the late 1980s and early 1990s, requiring eradication efforts and restocking with genetically pure individuals from the refugia population at the Southwestern Native Aquatic Resources and Recovery Center. Any events negatively affecting the species or its habitat could result in extinction of the Leon Springs pupfish in the wild.

The best available information indicates that the primary threats to the Leon Springs pupfish are: 1) habitat loss from the potential loss of spring flow due to a decline in groundwater levels, 2) egg predation by the Pecos gambusia, 3) habitat loss due to the encroachment of bulrush into the species' habitat, 4) hybridization with introduced species, primarily the sheepshead minnow, and 5) potential contamination of habitat from local oil and gas activities, all of which are compounded by the small size of the pupfish population in the wild. Loss of suitable habitat due to bulrush encroachment is a relatively new threat to the species that was not originally addressed in the 1985 recovery plan. The information reviewed does not indicate that impacts to spring flows from a significant increase in groundwater use or declines in recharge are imminent (defined here as likely to occur in the next 15 years). However, diminished spring flows could occur over the foreseeable future of 50 to 100 years as a result of climate change or to meet increased human needs for more water resources. If this threat were realized, the magnitude of impact on the Leon Springs pupfish is extremely high. Because the range of the species is limited to a small, isolated location, habitat modification due to a decline in spring flows could result in its extinction in the wild.

The threat of egg predation during breeding events from the Pecos gambusia is high and ongoing, and the magnitude of the impact of this threat on the species is high. Additional threats include habitat modification from water quality degradation, local habitat changes, and the introduction of a disease, parasite, or non-native species. All of the above threats must be considered in the context of a fish with an extremely small range, no opportunity for natural movement (relocation), a small population size, and a short life span. Therefore, the magnitude of impact of any potential threat or future stochastic event is exceptionally high.

EB/CE Source:
U.S. Fish and Wildlife Service. 2013. Leon Springs Pupfish (*Cyprinodon bovinus*) 5-Year Review: Summary and Evaluation. Austin, TX. pp. 29

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Leon Springs pupfish will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 5, and 6). The risk of mortality is expected to be high for bins 2 and 5 and low to high in bin 6 depending on the use. We expect individuals to be at greater risk of lethal effects than sublethal effects (growth, reproduction, behavior). We anticipate risk to aquatic invertebrate prey to be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total percent overlap (all uses except mosquito control) 1.15%:

	Mortality risk: 2(L,H), 5(M,H),6(L,M,H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total percent overlap (all uses except mosquito control) 1.15%: Risk of sublethal effects G:2(L,M),5(L,M),6(L,M); R:2(L,M),5(L,M),6(L); B:2(L,M,H),5(L,M,H),6(L,M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total percent overlap (all uses except mosquito control) 1.15%: Risk to aquatic invertebrate prey: 2(H), 5(H), 6(H)
MOSQUITO CONTROL	
Direct (mortality)	NA
Sublethal	
Indirect	

Risk modifiers:
Currently, the Leon Springs pupfish only occur in Diamond Y Draw drainage, a flood tributary of the Pecos River in western Texas north of Fort Stockton. They feed opportunistically, mainly on diatoms and algae, also amphipods, gastropods, and ostracods. This species spawns throughout the year and peaks in July. Most individuals probably participate in only 1 spawning period. Spawning events are brief, with the female laying one egg; many spawning events may occur in succession. Life span is 20-23 months.

Indirect effects to prey invertebrates:
Because aquatic invertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. For most fish species that are rely on a variety of aquatic invertebrates, such as microcrustaceans, and mollusks in addition to diatoms and algae, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. These reductions to invertebrate prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

Allowable uses driving effects/other considerations:
Malathion use sites overall occur in a relatively low proportion of the species range (1.15% overlap, 47,483 acres). Uses with the highest overlap are Other Row Crops, Developed, Wheat, and Pasture.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		0	0.00		NA	2,5,6	
Other Crops	D,I	20297	0.49	0	0.00	2,5,6	2H 5H 6M
Other Row Crops	D,I	150	0.00	144	0.00	2,5,6	2H 5H 6M
Other Grains	D,I	1093	0.03	1099	0.03	2,5,6	2H 5H 6M
Corn	D,I	186	0.00	0	0.00	2,5,6	2H 5H 6M
Cotton	D,I	5571	0.13	5586	0.14	2,5,6	2H 5H 6H
Developed	D,I	9873	0.24	494	0.01	2,5,6	2L 5M 6L
Rice		0	0.00	0	0.00	2,5,6	
Wheat	D,I	4531	0.11	3572	0.09	2,5,6	2H 5H 6M
Vegetables & Ground Fruit	D,I	327	0.01	324	0.01	2,5,6	2H 5H 6H
Orchards & Vineyards	D,I	1252	0.03	1259	0.03	2,5,6	2H 5H 6H
Pasture	D,I	4195	0.10	2356	0.06	2,5,6	2H 5H 6M
Sub-TOTAL (D):		47483	1.15	14839	0.36		

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Other uses with direct effects[3]							
Sub-TOTAL (I): *Other uses with indirect effects*[3]		47483	1.15	14839	0.36		
TOTAL[4]:		47483	1.15	14839	0.36		

 # acres in species range: 4,128,556 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 4 acres, 0.000%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Leon Springs pupfish. As discussed below, even

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

though the vulnerability and risk are high for this species, we anticipate both usage and the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Leon Springs pupfish has a high vulnerability based on its status, distribution, and trends. This species is short-lived, and is limited to a few populations in vulnerable spring and spring-fed habitats. The refuge population (i.e., an additional population maintained elsewhere) exists to help guard against stochastic events and their effects on the species. The species has declined over time and is under threat from several factors, including loss of spring flow due to decresases in groudnwater levels, predation pressure from other species, habitat loss, and other stressors. The risk to the species, should individuals be exposed to applications, is also anticipated to be high for most uses, with few exceptions (i.e., developed). We anticipate individuals found in smaller static and flowing waters from most labeled uses would experience high levels of mortality, if exposed, as would their prey. Should individuals experience exposure in larger water bodies, the risk of mortality is lower for some uses, but still high for others.

However, both the vulnerability of the species and risk to individuals (if exposed) are mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low (<1%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. While the magnitude of impact of any potential threat or future stochastic event is exceptionally high we anticipate exposure to occur only at low levels (<1%) over the duration of the Action based on the overlap and usage data. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Leon Springs pupfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual pupfish and their invertebrate prey to occur only at very low levels over the duration of the Action, and with the added protection of a refuge population to guard against stochastic events, we do not anticipate species-level effects. We anticipate that any usage within the species range that would result in exposure of individuals of the species to occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Leon Springs pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Cyprinodon nevadensis mionectes	Ash Meadows Amargosa pupfish	274

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Prior threats include local groundwater extraction in the vicinity of the Ash Meadows National Wildlife Refuge, habitat destruction by cattle and wild horses, and off-highway vehicles were addressed with the designation of the refuge, along with the purchase of land and water rights. Ongoing threats include continued habitat degradation and invasive species. Off-refuge development of groundwater has the potential for seriously limiting available habitat. Surface mining (clay) also has the potenial to degrade aquatic and riparian habitat, which in turn can affect habitat and forage base. Non-native invasive species pose a threat to listed species through direct predation, competition, exclusion, by changing ecosystem processes (i.e., fire) and simplifying allochtonous inputs. The refuge is making significant strides in addressing non-native species threats, although these activites have only recently been initiated and future benefits, efforts, and funding are uncertain.

EB/CE Source:
U.S. Fish and Wildlife Service. 2010. Ash Meadows Amargosa Pupfish (*Cyprinodon nevadensis mionectes*) 5-Year Review: Summary and Evaluation. Las Vegas, Nevada. pp. 40.

While the species exists entirely on Federal Lands, we still rank the inherent vulnerability based on the species status, distribution, and trends. Additional information related to vulnerability rationale (from 2010 5-Year Review):

Species is found in several lentic and lotic habitats within the borders of the Ash Meadows National Wildlife Refuge and adjacent lands. Populations fluctuate throughout the course of the year, but appear to be declining over all in all populations except one (Crystal Springs, per 2008 reporting). Habitat was altered by agricultural development (e.g, habitat impacts, former pesticide use, etc.) prior to the establishment of the Refuge, although most of these threats are no longer imminent due to existence of the Refuge. While stochastic events could be important to any given population, overall the 5-year review indicated a moderate level of threat from stochastic events.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed:

This species occurs almost entirely on Federal lands; the only use layer we anticipate will overlap non-Federal lands where the species occurs will be Developed, and this overlap is very low (<0.01%).

We anticipate the Ash Meadows Amargosa pupfish will be at low risk of mortality and sublethal effects for all bins (2, 5, and 6). We anticipate risk to aquatic invertebrate prey, if exposed, will be high in bin 2 and medium in bins 5 and 6.

Risk to the species from labeled uses across the range:

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap <0.01%: Estimated mortality among exposed individuals: 2(L), 5(L), 6(L)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap <0.01%: Estimated sublethal effects among exposed individuals: G:2(L),5(L),6(L); R:2(L),5(L),6(L); B:2(L),5(L),6(L)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap <0.01%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 5(M), 6(M)
MOSQUITO CONTROL	
Direct (mortality)	No overlap
Sublethal	
Indirect	

Risk modifiers: Currently, the Ash Meadows Amargosa pupfish is known primarily from the Ash Meadows National Wildlife Refuge. Most of the major spring systems in this refuge are designated as critical habitat. Ash Meadows Amargosa pupfish feed primarily on periphyton and algae, but they will also eat invertebrates, detritus, and diatoms. The entire life cycle of the Ash

Meadows Amargosa pupfish occurs in one pool. The Ash Meadows Amargosa pupfish have a lifespan that varies depending on the pool temperature. Sexual maturity is also variable in the species, depending on water temperate (2 to 4 months until sexual maturity in warm waters and up to a year in cold water). If the water is warm enough, breeding can occur year-round. Pupfish can live up to 4 years if they are found in a cooler water temperature environment, but Ash Meadows Amargosa pupfish often live only up to 1 or 2 years.

Allowable uses driving effects/other considerations: There is only one use that may occur in the species range and the overlap for that use, Developed, is extremely low (<0.01%). Direct effects from this use are expected to be low. There may be some indirect effects to invertebrate prey if exposure occurs.

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%*	Acres	%*		
Developed		0.00	0.00	0.00	0.00	2,5,6	2L 5L 6L
Sub-TOTAL (D): *Other uses with direct effects*[3]		0.00	0.00	0.00	0.00		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		0.00	0.00	0.00	0.00		
TOTAL[4]:					`		

*0.00 denotes <0.01%

 # acres in species range: 107,747 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 107,587 acres, 99.851%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Ash Meadows Amargosa pupfish. As discussed below, even though the vulnerability is high for the species, we anticipate the risk and likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Ash Meadows Amargosa pupfish has a high vulnerability based on its status, distribution, and trends. The species exists on Federal lands, with only a very small portion of its range that overlaps with non-Federal lands. While past threats have largely been eliminated or reduced as the species now occurs on National Wildlife Refuge lands, some threats and stressors remain of concern. For example, off-refuge development of groundwater has the potential for seriously limiting available habitat.

However, the vulnerability of the species is mitigated by the low degree of risk to individuals and overlap of labeled uses with the non-Federal portion of the species' range. We expect this use will result in only low levels of mortality and sublethal impacts to individuals of the species, if exposure occurs, and similarly low levels of impacts to their invertebrate prey base. Similarly, we anticipate usage will be low, based primarily on the usage data we acquired and the fact that the species range overlaps primarily with Federal lands, as described in the Opinion and summarized for this species above. In addition, where usage may occur, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Ash Meadows Armargosa pupfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we anticipate that any usage within the species range that would result in exposure of individuals of the species will occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Ash Meadows Amargosa pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Cyprinodon macularius	Desert pupfish	275

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The natural populations of desert pupfish are the same as those identified in the 1993 recovery plan (USFWS 1993), with the addition of the natural population in the wash by Hot Mineral Spa, California. The numbers of pupfish in these sites have waxed and waned, as have the populations of non-native aquatic species there. Since the 19th century, desert pupfish habitat has been impacted by streambank erosion, the construction of water impoundments that dewatered downstream habitat, excessive groundwater pumping, the application of pesticides to nearby agricultural areas, and the introduction of nonnative aquatic species as both predators and potential competitors (Matsui 1981, Hendrickson and Minckley 1984, Minckley 1985, Schoenherr 1988).

Releases of *C. m. macularius* occurred in Arizona, but we are not certain if pupfish will establish viable populations (Robinson 2009). Although the recovery criteria have not been achieved (see Section 2.2.3), progress has been made on implementation of recovery plan tasks (Desert Fishes Team 2006, USFWS 2010b). Several recovery plan tasks have been completed and many more are being implemented and are ongoing (USFWS 2010b). Significant accomplishments include creating refuges in both Mexico and the United States for *C. m. eremus*, attempting to reestablish *C. m. macularius* in Arizona, implementing the Safe Harbor Agreement in Arizona, and assessing the genetic status of all desert pupfish populations (Echelle et al. 2007, Loftis 2007, Koike et al. 2008, Loftis et al. 2009). However, the threats identified at the time of listing and in the recovery plan continue unabated. New non-native aquatic species continue to establish within the desert pupfish's range, and previously existing non-native species increase in numbers and distribution (Minckley and Marsh 2009). Human demands for water continue, with the Salton Sea, Quitobaquito Springs, and the Rio Sonoyta suffering water level declines and the associated threats to the desert pupfish from water depletion, such as habitat loss, fragmentation, and degradation of habitat quality, still ongoing. Water availability to the desert pupfish will continue to interact with predicted trends for warmer, drier, and more extreme hydrological conditions associated with climate change.

EB/CE Source:
U.S. Fish and Wildlife Service. 2010. Desert Pupfish (*Cyprinodon macularius*) 5-Year Review: Summary and Evaluation. Phoenix, Arizona. pp.43

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the desert pupfish will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 3, 4, 5, and 6). The risk of mortality is expected to be high for bins 2, 3, 4, and 5 and low to high for bin 6 depending on the use, except for developed uses, where the risk is expected to be lower for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 6.97%: Estimated mortality among exposed individuals: 2/3/4(L&H), 5(M &H), 6(L&H), 7(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 6.97%: Estimated sublethal effects among exposed individuals: G:2/3/4(L&M),5(L&M),6(L&M),7(L&M); R:2/3/4(L&M),5(L&M),6(L),7(); B:2/3/4(L&M&H),5(L&M&H),6(L&M),7(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 6.97%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 5(H), 6(H),7(M&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 14.51%; Estimated mortality among exposed individuals: 2/3/4(H),5(H),6(M),7(L)
Sublethal	Mosquito control overlap 14.51%: Estimated sublethal effects among exposed individuals:

	G:2/3/4(M),5(M),6(L),7(L); R:2/3/4(L),5(L),6(L),7(L); B:2/3/4(M),5(M),6(L),7(L)
Indirect	Mosquito control overlap 14.51%: Estimated mortality among exposed aquatic invertebrate prey: 2/3/4(H), 5(H), 6(H),7(H)

Risk modifiers: Desert pupfish feed on algae, detritus, and small invertebrates. In the Salton Sea they eat ostracods, copepods, and some insects and pile worms. In other areas, they feed on aquatic crustaceans, aquatic insect larvae, and mollusks. This species spawns spring and summer, or year-round in warm constant temperature environments. Each female may lay 50-800 eggs or more/season, depending on her size. Males defend eggs and there are up to 2-3 generations per year. Life span in the wild appears highly variable, from less than a year for some populations two years for others.

Indirect effects to prey fish and invertebrates: Because aquatic invertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs primarily in habitats with low flow or volume (bins 2 and 5), but not completely eliminated. For most fish species that are generalist feeders and rely on a variety of benthic macroinvertebrate, crustaceans, mollusks and annelids, short-term indirect effects to aquatic invertebrates are anticipated to have a limited effect on food resources. These reductions to invertebrate prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Desert pupfish does occupy other aquatic habitats with potentially higher levels of malathion exposure, their potential exposure risk is partially mitigated by their reliance upon higher volume aquatic habitats, reducing their overall risk.

Allowable uses driving effects/other considerations: The use type with the highest overlap, Developed (3.99%), also had some of the lowest malathion EECs and the corresponding effects were generally lower compared to other uses. The next highest uses were Pasture (0.92% overlap) and Other Crops (0.90% overlap).

Mosquito control: Mortality effects resulting from mosquito control activities could be high, medium, or low depending on the waterbody and this use is estimated to occur over 14.51% of the species range.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	776,144	14.51		NA	2,3,4,5,6,7	2H 3 4 5H 6M 7L
Other Crops	D,I	48,338	0.90	0	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Other Row Crops	D,I	98	0.00	12	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Other Grains	D,I	5,649	0.11	1,965	0.04	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Corn	D,I	2,920	0.05	123	0.00	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Cotton	D,I	23,387	0.44	4,082	0.08	2,3,4,5,6,7	2H 3 4

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
							5H 6H 7H
Developed	D,I	213,644	3.99	10,682	0.20	2,3,4,5,6,7	2L 3 4 5M 6L 7L
Rice		-	0.00	0	0.00		
Wheat	D,I	23,499	0.44	6,618	0.12	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Vegetables & Ground Fruit	D,I	3,357	0.06	3,654	0.07	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Orchards & Vineyards	D,I	2,326	0.04	1,613	0.03	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Pasture	D,I	49,057	0.92	48,792	0.91	2,3,4,5,6,7	2H 3 4 5H 6H 7M
Nurseries	D,I	299	0.01	299	0.01	2,3,4,5,6,7	2H 3 4 5H 6H 7M

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect^ associated with bin (H, M, L)
		Acres	%	Acres	%		
Sub-TOTAL (D): *Other uses with direct effects*[3]		372,573	6.97	77,840	1.46		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		372,573	6.97	77,840	1.46		
TOTAL[4]:		1,148,717	21.48	77,840	1.46		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

CalPUR data	Mean Annual UDL Acres Treated within species CA range (minus Fed Lands) (2012-17)	Mean Annual Percent of Mean Annual Percent of Species Entire Range (including Fed Lands) Treated (2012-2017, excluding other states)
Nurseries	1.7	0.00003
Vegetables and Ground Fruit	41.0	0.00077

 # acres in species range: 5,348,700 acres
% of range in California (i.e., where CalPUR data is available): 2%
Range overlap with Federal lands: 3,456,585 acres, 64.625%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program,which has a history of implementation of species protection measures for the species[1]), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

[1] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the Description of the Action section of the Opinion. For example, the 2018 FWS informal section 7(a)(2) consultation with APHIS includes the following conservation measure for the desert pupfish: "A 500-foot ground buffer and a ¼-mile aerial buffer will be used at the edge of aquatic habitat. Buffer zones should be used for (1) all of the habitat area and (2) at least 1 mile upstream and 300 feet downstream from the habitat area in any contributing channel, tributary, or spring run."

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the desert pupfish. As discussed below, even though the vulnerability and risk is high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The desert pupfish has a high vulnerability based on its status, distribution, and trends. This species, present in Arizona, has undergone a significant decline over the years. Four naturally occurring populations have been reinforced by numerous introduced populations. We anticipate all are likely sensitive to stochastic events, based on their distribution and habitat characteristics. Total number of individuals is relatively high for the species (>1 million), but much of this appears to be related to introductions. Populations fluctuate due to successful introductions as well as failures over time. Many occupied pupfish localities are small, fragmented, and highly threatened, which may outweigh the significance of the large total number estimated for the species. Other water quality threats, including from cattle grazing and irrigation are also of concern, as is susceptibility to genetic diversity limitations and climate change (e.g., related to water quality and quantity). The risk to the species, should individuals be exposed to applications, is also anticipated to be high for most uses, with few exceptions (i.e., developed). We anticipate individuals found in smaller static water bodies, or any type of flowing waters, from most labeled uses would experience high levels of mortality, if exposed, as would their prey. Should individuals experience exposure in larger static water bodies, the risk of mortality is lower for some uses, but still high for others.

However, both the vulnerability and risk to individuals if exposed would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. Thus, while the effect of exposure, should it occur, would be problematic for the species due to its vulnerability and the toxicity of this pesticide to the species and its invertebrate prey resources, we expect exposure to occur only at very low levels over the duration of the Action. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the desert pupfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the desert pupfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Crenichthys baileyi grandis	Hiko White River springfish	283

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Hiko White River springfish was historically restricted to the thermal pools and outflows of Hiko and Crystal Springs (Williams and Wilde 1981), two large thermal springs discharging on the valley floor of Pahranagat Valley north of the town of Alamo. The fish communities at Crystal and Hiko Springs have changed considerably from historic conditions due to habitat alterations and the introduction of non-native aquatic species. Threats are related to non-native species, water withdrawals, recreation and other impacts to habitat Today, the fish communities have shifted to predominantly non-native species, including but not limited to: mosquitofish, shortfin mollies, sailfin mollies (*P. latipinna*), convict cichlids (*A. nigrofasciatus*), carp (*Cyprinus carpio*), and tilapia species (NDOW 2012a). Interactions with these non-native species may influence life history traits of *C. baileyi* (e.g., differences in size at first maturity in *C. baileyi* populations with and without exotics). A refuge population has since been established at Blue Link Spring, Mineral County, Nevada because of threats to the Hiko and Crystal Springs populations (USFWS 1998). The current population abundance numbers provided by NDOW show the population persisting at Ash, Hiko, and Crystal Springs but at low numbers. A refuge for the species located at Blue Link Spring continues to show high population numbers. Habitat manipulation and predation/competition with non-native species continue to be the major threats. Uncertainties regarding groundwater withdrawal and climate change may pose future threats to the species. Efforts to remove non-native species are being carried out by Nevada Department of Wildlife (NDOW). These efforts have shown to only partially remove the non-native populations for a limited amount of time. A programmatic Safe Harbor Agreement (PSHA) was developed and signed by the USFWS and NDOW; to date, no landowners have participated and signed the PSHA.

EB/CE Source:

U.S. Fish and Wildlife Service. 2012. Hiko White River Springfish (*Crenichthys baileyi grandis*) and White River Springfish (*Crenichthys baileyi baileyi*) 5-Year Review: Summary and Evaluation. Reno, Nevada. pp.32

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Hiko White River springfish will experience direct mortality or sublethal effects for most uses of malathion in all bins (2 and 5). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all use/bin combinations.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 0.13%: Estimated mortality among exposed individuals: 2(L&H), 5(M &H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 0.13%: Estimated sublethal effects among exposed individuals: G:2(L&M),5(L&M); R:2(L),5(L); B:2(L&M&H),5(L&M&H)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 2.53%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 5(H)
MOSQUITO CONTROL	
Direct (mortality)	NA
Sublethal	
Indirect	

Risk modifiers: The Hiko White River springfish is an opportunistic herbivore/invertivore, consuming invertebrates, filamentous algae, vascular plants, and diatoms. Most Hiko White River springfish females appear to spawn twice annually. Spawning occurs throughout the year and is asynchronous, but there may be a peak in spawning during the warm summer months. Approximately 6 to 17 eggs are deposited per spawning event. This species is a broadcast spawner, releasing eggs and sperm into open water for external fertilization. Eggs are adhesive and attach firmly to nearby vegetation. There is no subsequent parental care.

Allowable uses driving effects/other considerations: Although some uses could result in malathion concentrations that are highly toxic to exposed individuals, the major consideration is the low occurrence of use sites in the species range (total overlap 0.03%).

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		0	0.00		NA		
Other Crops		1	0.00	0	0.00	2,5	2H 5H
Other Grains		13	0.01	7	0.01	2,5	2H 5H
Corn		4	0.00	11	0.01	2,5	2H 5H
Developed		68	0.07	3	0.00	2,5	2L 5M
Pasture		39	0.04	39	0.04	2,5	2H 5H
Sub-TOTAL (D): *Other uses with direct effects*[3]		125	0.13	60	0.06		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		125	0.13	60	0.06		
TOTAL[4]:		125	0.13	60	0.06		

 # acres in species range: 95,702 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 86,331 acres, 90.208%

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed is not likely to jeopardize the continued existence of the Hiko White River springfish. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Hiko White River springfish has a vulnerability base high vulnerability based on its status, distribution, and trends. This springfish is present in thermal pools, and has a small number of populations, ranging from approximately 60 to 400 individuals, with the exception of the newer refuge population that was established, which with visual estimates (from 2011) of approximately 4,000 individuals. We anticipate individuals in the small waterbodies in which they occur that are exposed to malathion for most uses would experience high levels of mortality, and exposed survivors would experience variable levels of sublethal effects based on use type and waterbody size. We also anticipate invertebrate prey would also experience high levels of mortality if exposed.

However, both the vulnerability and risk to individuals if exposed would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. In addition to the extremely low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Hiko River springfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of Hiko White River springfish and their invertebrate prey to occur only at very low levels over the duration of the Action, and we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of this species in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Crenichthys nevadae	Railroad Valley springfish	284

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Railroad Valley springfish (RRVS) were historically found in six spring systems distributed in two areas of Nye County, Nevada. All are currently occupied, in part due to a reintroduction effort to Big Warm Spring in 2007. However, the abundance and distribution of these six populations over time has not been well analyzed with existing survey methodologies. The primary threats to the RRVS and its habitat at the time of listing were habitat destruction and non-native fish introductions. Since the time of listing, habitat destruction has been significantly reduced or eliminated. Habitat restoration has been completed at all six historical habitats. Impacts from non-native fish introductions since the time of listing have been significantly reduced by the removal of aquaculture facilities, elimination of non-native predatory fish in Big Warm Spring and Little Warm Spring, and by implementing a Safe Harbor Agreement with the Tribe to ensure that non-native fish are not intentionally introduced into these springs. Large-scale groundwater pumping is a threat that was not considered at the time of listing. The threat of groundwater pumping for urban development should be evaluated carefully to ensure the long-term survival of RRVS. Water project negotiations must include provisions to perpetually protect and preserve RRVS within their native, historical habitats. Climate change was also not a threat considered at the time of listing and must be considered in evaluating the species' status.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Railroad Valley Springfish (*Crenichthys nevadae*) 5-Year Review: Summary and Evaluation. Reno, Nevada. pp. 36.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Railroad Valley springfish will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 5, and 6). The risk of mortality is expected to be high for bins 2 and 5 and low to high in bin 6 depending on the use. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 0.03%: Estimated mortality among exposed individuals: 2(L&H), 5(M &H), 6(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 0.03%: Estimated sublethal effects among exposed individuals: G:2(L&M),5(L&M),6(L&M); R:2(L),5(L),6(L); B:2(L&M&H),5(L&M&H),6(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 0.03%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 5(H), 6(M,H)
MOSQUITO CONTROL	
Direct (mortality)	NA
Sublethal	
Indirect	

Risk modifiers: Railroad Valley springfish were extirpated from Big Warm Spring by 2003 due to the introduction of red-bellied tilapia (*Oreochromis zillii*). They were restored to the area in 2007 and currently are found in the springhead to approximately 914 meters (m) (3,000 feet [ft.]) below in the outflow. Railroad Valley springfish persist at Little Warm Spring, but the population's distribution is fragmented due to in-stream barriers. The other four populations at Lockes Ranch continue to persist. Railroad Valley springfish are indiscriminate and opportunistic feeders and ingest a wide variety of foods based on seasonal availability. During the spring, they are primarily herbivores, consuming filamentous algae. In the summer, they eat primarily animal-based foods, with ostracods (e.g., seed shrimp) representing the bulk of their diet. Little is known about the reproductive life history of the Railroad Valley springfish. Spawning has not been observed in this species but may be similar to that of the White River springfish. White River springfish deposit one egg at a time, and eggs are fertilized by a male as they are deposited. Eggs fall to the nearest vegetation and adhere tightly. Spawning females deposit 10 to 20 eggs with each spawning. Railroad Valley springfish collected from the spring outflow within 100 m (300 ft.) of the source of Big Spring had poorly developed ovaries throughout the year. Presumably, the water temperature in this reach of the outflow exceeds the tolerance limits for reproduction of this species.

Allowable uses driving effects/other considerations: Although some uses could result in malathion concentrations that are highly toxic to exposed individuals, the major consideration is the low occurrence of use sites in the species range (total overlap 0.03%).

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		0	0.00		NA		
Other Crops	D,I	10	0.00	0	0.00	2,5,6	2H 5H 6H
Other Grains	D,I	32	0.00	18	0.00	2,5,6	2H 5H 6H
Corn	D,I	30	0.00	0	0.00	2,5,6	2H 5H 6M
Developed	D,I	128	0.00	6	0.00	2,5,6	2L 5M 6L
Wheat	D,I	6	0.00	11	0.00	2,5,6	2H 5H 6M
Pasture	D,I	1,000	0.03	648	0.02	2,5,6	2H 5H 6H
Sub-TOTAL (D): *Other uses with direct effects*[3]		1,205	0.03	683	0.02		

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		1,205	0.03	683	0.02		
TOTAL[4]:		1,205	0.03	683	0.02		

 # acres in species range: 3,906,706 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 3,875,658 acres, 99.205%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Railroad Valley springfish. As discussed below, even

[4] TOTAL includes usage on all use sites with effects, including mosquito control.

though the vulnerability is medium and the risk is high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Railroad Valley springfish has a medium vulnerability based on its status, distribution, and trends. The species has a relatively small number of populations, but some refuge populations have been established, though with unknown numbers of individuals in each population or range-wide. The last 5-Year Review (2009) indicates that threats are related to non-native species, water withdrawals, recreation and other impacts to habitat. We anticipate individuals, particularly those in small flowing or static waterbodies, that are exposed to malathion for most uses would experience high levels of mortality, and exposed survivors would experience variable levels of sublethal effects based on use type and waterbody size. We also anticipate invertebrate prey would also experience high levels of mortality if exposed.

However, we anticipate both the vulnerability and risk to individuals, if exposed, would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low, based primarily on the usage data we acquired and the fact that the species range overlaps primarily with Federal lands, as described in the Opinion and summarized for this species above. In addition, where usage may occur, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Railroad Valley springfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual Railroad Valley springfish and their invertebrate prey to occur only at very low levels over the duration of the Action, and we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of this species in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Crenichthys baileyi baileyi	White River springfish	285

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The White River springfish is endemic to thermal pools and outflows created by Ash Springs in Pahranagat Valley, Lincoln County, Nevada (Williams and Wilde 1981). Historically, the distribution of White River springfish in the outflow of Ash Springs was as far downstream as 8 to 11 km (5 to 7 mi) north of Alamo (Miller and Hubbs 1960). Much of this outflow stream west of US Highway 93) is commonly referred to as the Pahranagat Creek or Pahranagat Fitch. Williams and Wilde (1981) described the spring pool population of White River springfish as being separated from the outflow stream population by steep topography that would have prevented migration of springfish in the outflow stream into the spring pool. Monitoring of White River springfish has been sporadic, most recently qualitative, and appears to be stable but remains at depressed levels based on earlier historical accounts. Potential threats from habitat development on private lands seem to have lessened but remain possible. Uncertainties regarding groundwater withdrawal and climate change may pose future threats to the species. Recreational use of Ash Springs pools on public land threatens habitat by affecting bank stability, shoreline vegetation, and water quality. Predation and competition continue to be the greatest threat. Based on the information available, White River springfish remains at risk of extinction because of its restricted range, depressed population, and ongoing threats.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Hiko White River Springfish (*Crenichthys baileyi grandis*) and White River Springfish (*Crenichthys baileyi baileyi*) 5-Year Review: Summary and Evaluation. Reno, Nevada. pp.32

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the White River springfish will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 6, and 7). The risk of mortality is expected to be low to high in bin 2, low to high in bin 6, and low in bin 7, depending on the use. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

For mosquito control: We anticipate the risk of mortality will be high for bin 2, medium for bin 6, and low for bin 7. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for individuals in all bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 0.03%: Estimated mortality among exposed individuals: 2(L&H), 6(L&M &H), 7(L&M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 0.03%: Estimated sublethal effects among exposed individuals: G:2(L&M),6(L&M),7(L&M); R:2(L&M),6(L&M),7(L); B:2(L&M&H),6(L&M&H),7(L)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 0.03%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 6(H), 7(L,H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 0.7%; Estimated mortality among exposed individuals: 2(H),6(M),7(L)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 0.7%: Estimated sublethal effects among exposed individuals: G:2(M),6(L),7(L); R:2(L),6(L),7(L); B:2(M),6(L),7(L)
Indirect	Mosquito control overlap 0.7%: Estimated mortality among

	exposed aquatic invertebrate prey: 2(H), 6(H), 7(H)

Risk modifiers: The White River springfish feeds opportunistically; it has an omnivorous diet that may include food such as diatoms, algae, plant parts, detritus, and macroinvertebrates. Most springfish females appear to spawn twice annually. Spawning occurs throughout the year and is asynchronous, but there may be a peak in spawning during the warm summer months. The number of eggs deposited per spawning event is approximately 3 to 17. This species is a broadcast spawner, releasing eggs and sperm into open water for external fertilization. Eggs are adhesive and attach firmly to nearby vegetation. There is no subsequent parental care. The lifespan is approximately 3 to 4 years.

Allowable uses driving effects/other considerations: Although some uses could result in malathion concentrations that are highly toxic to exposed individuals, the major consideration is the low occurrence of use sites in the species range (total overlap 0.03%).

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	21,385	0.70		NA	2,6,7	2H 6M 7L
Other Crops	D,I	6	0.00	0	0.00	2,6,7	2H 6H 7M
Other Grains	D,I	33	0.00	33	0.00	2,6,7	2H 6H 7M
Corn	D,I	0	0.00	0	0.00	2,6,7	2H 6H 7M
Developed	D,I	231	0.01	12	0.00	2,6,7	2L 6L

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							7L
Pasture	D,I	628	0.02	620	0.02	2,6,7	2H 6H 7M
Sub-TOTAL (D): *Other uses with direct effects*[3]		898	0.03	665	0.02		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		898	0.03	665	0.02		
TOTAL[4]:		22,283	0.73	665	0.02		

 # acres in species range: 3,035,324 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,757,516 acres, 90.848%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the White River springfish. As discussed below, even though the vulnerability is mediun to the species, the risk and the likelihood of exposure to malathion is anticipated to be low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The White River springfish has a medium vulnerability based on its status, distribution, and trends. The White River springfist is present in thermal pools and their outfalls, and has a small number of populations with limited ability to move between populations based on topographic barriers. We anticipate individuals that are exposed to malathion for most uses would experience variable (low to high) levels of mortality and sublethal effects, depending on use type and waterbody size. We also anticipate invertebrate prey would also experience high levels of mortality if exposed.

However, both the vulnerability and risk to individuals if exposed would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. In addition, where use may occur, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the White River springfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual White River springfish and their invertebrate prey to occur only at very low levels over the duration of the Action, and we do not expect species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of this species in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Empetrichthys latos	Pahrump poolfish	8389

Family: Cyprinodontidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Historically, Pahrump poolfish occurred in a single isolated spring, Manse Spring, on private property in the Pahrump Valley of southern Nye County, Nevada. However, they were extirpated in 1975, after their habitat was eliminated due to excessive groundwater pumping for agricultural development. Prior to this event, flow reductions from groundwater pumping, aquatic vegetation removal, introduction of nonnative species and other activities impacted the species Currently, Pahrump poolfish are located at Shoshone Ponds Natural Area on lands managed by the Bureau of Land Management (BLM) southeast of Ely, White Pine County, Nevada; and at the Corn Creek Spring system on the Desert National Wildlife Refuge northwest of Las Vegas, Clark County, Nevada. In addition, there is a refugium site under renovation on lands managed by Nevada State Parks at Lake Harriett, Spring Mountain Ranch State Park, west of Las Vegas in Clark County, Nevada.

When the recovery plan for the Pahrump poolfish was written in 1980, protecting habitat and populations of transplanted populations was primary need for survival and recovery of the Pahrump poolfish. Over three decades later, the need to protect habitat and transplanted populations remains. The majority of the tasks in the recovery plan that address this need are not fully completed or are ongoing. Additionally, there has been little progress made to re-establish Pahrump poolfish into their ancestral habitat (Manse Spring) as this site is privately owned. Manse Springs was recognized in the recovery plan as the highest priority site for establishing a population of Pahrump poolfish. Threats to current Pahrump poolfish populations remain an issue for the species' recovery. Human-exerted pressures are likely to significantly reduce and limit groundwater sources on which Pahrump poolfish sites depend. Nonnative species continue to be a significant threat to Pahrump poolfish populations. The overall threat to Pahrump poolfish populations remains high. There are a number of factor, which threaten the continued existence and viability of healthy, self-sustaining populations.

EB/CE Source:
U.S. Fish and Wildlife Service. 2018. Pahrump Poolfish (*Empetrichthys latos*) 5-Year Review: Summary and Evaluation. Las Vegas, Nevada. pp. 27

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Pahrump poolfish will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 5, and 6). The risk of mortality is expected to be high for bins 2 and 5 and medium to high for bin 6 depending on the use. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 2.53%: Estimated mortality among exposed individuals: 2(L&H), 5(M&H), 6(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 2.53%: Estimated sublethal effects among exposed individuals: G:2(L&M),5(L&M),6(L&M); R:2(L&M),5(L&M),6(L); B:2(L&M&H),5(L&M&H),6(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 2.53%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 5(H), 6(M,H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 0.32%; Estimated mortality among exposed individuals: 2(H),5(H),6(M)

Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 0.32%: Estimated sublethal effects among exposed individuals: G:2(M),5(M),6(L); R:2(L),5(L),6(L); B:2(M),5(M),6(L)
Indirect	Mosquito control overlap 0.32%: Mortality risk to exposed aquatic invertebrate prey: 2(H), 5(H), 6(H)

Risk modifiers: This species is an omnivore, feeding opportunistically on a wide variety of available plant and animal material. Little is known about Pahrump poolfish reproduction. Demersal spawning occurs year-round but appears to peak between March and April. During their breeding period, females seek seclusion for egg-laying in remote areas of the spring. One study found that female Pahrump poolfish produced between eight and 111 eggs.

Allowable uses driving effects/other considerations: While effects to exposed individuals could be high, there are a low number uses likely to occur in the species range and the overall footprint for all uses is relatively small. Uses with the highest overlap are Wheat (2.41%), Pasture (0.08) and Other Crops (0.03%).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	0	0.32		NA	2,5,6	2H 5H 6M
Other Crops	D,I	0	0.03	0	0.00	2,5,6	2H 5H 6H
Other Row Crops	D,I	0	0.00	0	0.00	2,5,6	2H 5H 6H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Other Grains	D,I	0	0.01	0	0.01	2,5,6	2H 5H 6H
Corn	D,I	0	0.00	0	0.00	2,5,6	2H 5H 6H
Cotton	D,I	0	0.00	0	0.00	2,5,6	2H 5H 6H
Developed	D,I	0	0.01	0	0.00	2,5,6	2L 5M 6L
Rice		0	0.00	0	0.00		
Wheat	D,I	3	2.41	3	2.67	2,5,6	2H 5H 6M
Vegetables & Ground Fruit	D,I	0	0.00	0	0.00	2,5,6	2H 5H 6H
Orchards & Vineyards	D,I	0	0.00	0	0.00	2,5,6	2H 5H 6H
Pasture	D,I	0	0.08	0	0.07	2,5,6	2H 5H 6H
Sub-TOTAL (D): *Other uses with direct effects*[3]		3	2.53	4	2.75		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		3	2.53	4	2.75		
TOTAL[4]:		4	2.85	4	2.75		

 # acres in species range: 130 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 130 acres, 99.688%

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Pahrump poolfish. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Pahrump poolfish has a high vulnerability based on its status, distribution, and trends. Although the species exists in several refugia populations, primarily on Federal lands, threats remain to these populations. The low numbers of poolfish in its isolated habitats naturally make it vulnerable to risks associated with small, restricted populations. If individuals of a species are exposed, we anticipate high levels of mortality, especially in smaller flowing and static water bodies, while surivivors would experience medium to low sublethal imapcts. We estimate impacts to their invertebrate prey would also be high.

However, both the vulnerability and risk to individuals if exposed would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage will be low, based primarily on the usage data we acquired and the fact that the species range overlaps primarily with Federal lands, as described in the Opinion and summarized for this species above. In addition, where usage may occur, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Pahrump poolfish and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual poolfish and their invertebrate prey to occur only at very low levels over the duration of the Action, and we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Pahrump poolfish in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Fundulidae)

Scientific Name:	**Common Name:**	**Entity ID:**
Fundulus julisia	Barrens topminnow	4318

Family: Fundulidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Barrens topminnow (*Fundulus julisia*, Williams and Etnier 1982) is a small fish endemic to streams on the Barrens Plateau in middle Tennessee. This species is a spring specialist that is found in springhead pools and the slower areas of spring runs. Typical of members of the genus *Fundulus*, Barrens topminnows prefer areas of slower current. Barrens topminnows have only been found in areas with a large proportion of groundwater influence in the streams. Due to the groundwater influence of these habitats, the temperatures are relatively stable, ranging from 15°C-25°C (59-77°F). The karst topography of the Barrens Plateau area allows for a number of spring systems to be present, though not all of these have been inhabited by the topminnow. In times of drought, if the discharge of the springs is severely reduced, Barrens topminnows likely move downstream into more permanent water if suitable habitat is available. The Barrens topminnow is a protracted, fractional spawner (a few eggs at a time over a long period) that spawns over the course of the warm months (April to August), peaking from May to June. Most fish mature and are ready to spawn within the first year, though some of the later spawned fish are in year 2 before they spawn (Rakes 1989, entire). The Barrens topminnow is currently found in Warren, Coffee, Franklin, Cannon, and Dekalb Counties in Tennessee. The native populations from the Duck River drainage were extirpated soon after discovery, before fish could be kept in an ark population or genetic samples taken. Sites within the drainage are currently stocked with fish from Witty Creek Managament Unit (MU) and/or the Hickory Creek MU. In an effort to maintain the species, Barrens topminnows have been stocked into sites where the population had been extirpated and into springs within the native watersheds where they were not known historically, but appeared to have appropriate habitats. The Western Mosquitofish (*Gambusia affinis*) poses the largest and most direct threat to the continued existence of the Barrens topminnow. This small, live-bearing fish is native to Tennessee, but not naturally found on the Barrens Plateau. These fish were likely first introduced to the plateau in the 1960s in an effort to control mosquitos. Native predatory centrarchid (sunfish) species, cattle/livestock operations,

habitat alteration, drought, and impoundments are also believed to negatively affect the species. Currently, the Barrens topminnow is known from the headwaters of three river basins, though genetically represented by Evolutionarily Significant Units (ESUs) of two of those watersheds and only one of those is subdivided into separate MUs. The populations in the Duck River basin were historically extirpated. The Elk River ESU is likely currently extirpated, only being represented by an ark population. The remaining MUs both exhibit low resilience due to low abundance, small number of occupied sites, and stressors affecting the viability of the populations at those sites. Representation and redundancy are also low for this species because of the loss of two watersheds and the low resilience of the remaining MUs. The main threats to the Barrens topminnow are competition from introduced Western Mosquitofish, and the drying of springs during droughts.

EB/CE Source:
U.S. Fish and Wildlife Service. 2017. Species Status Assessment for the Barrens Topminnow (*Fundulus julisia*). Version 1.1.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Barrens topminnow will experience direct mortality or sublethal effects for most uses of malathion. The risk or mortality is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 21.53%: Estimated mortality among exposed individuals: 2 M & H.
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 21.53%: Estimated sublethal effects among exposed individuals: G:2 (L, M, & H); R:2 (L&M); B:2 (L&M&H); E:2(M&H);
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 21.53%: Estimated mortality among exposed aquatic invertebrate prey: 2(H)
MOSQUITO CONTROL	

Direct (mortality)	Mosquito control overlap 14.06%; Estimated mortality among exposed individuals: 2(H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 14.06%: Estimated sublethal effects among exposed individuals: G:2(M); R:2 (L); B:2(M)
Indirect	Mosquito control overlap 14.06%: Estimated mortality among exposed aquatic invertebrate prey: 2 (H)

Risk modifiers:
Indirect effects to prey invertebrates:
Because aquatic invertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly afterThe Barrens topminnow is a generalist feeder and preys upona variety of benthic macroinvertebrates, microcrustaceans, gastropods, and terrestrial invertebrates that fall into their habitats,therefore, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. These reductions to invertebrate prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

Allowable uses driving effects/other considerations:

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		4,263,076	14.06	127,067	0.42	2	2H
Other Crops		28,565	0.09	0	0.00	2	2H
Open Space Developed		7,807	0.03	821	0.00	2	2M
Other Grains		31,232	0.10	2,831	0.01	2	2H
Corn		908,579	3.00	9,283	0.03	2	2H
Cotton		261,359	0.86	22,421	0.07	2	2H
Developed		997,005	3.29	49,850	0.16	2	2M
Rice		2,505	0.01	2,330	0.01	2	2H
Wheat		16,984	0.06	1,405	0.00	2	2H
Vegetables & Ground Fruit		2,709	0.01	452	0.00	2	2H
Orchards & Vineyards		601	0.00	318	0.00	2	2H
Pasture		2,001	0.01	930	0.00	2	2H
Nurseries		4,737	0.02	4,737	0.02	2	2H
Sub-TOTAL (D): *Other uses with direct effects*[3]		2,264,277	7.47	95,543	0.32		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		2,264,277	7.47	95,543	0.32		
TOTAL[4]:		6,527,353	21.53	222,610	0.73		

 # acres in species range: 30,323,427 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 3,153,986 acres, 10.401%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Barrens topminnow. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals may be affected over the duration of the Action, we do not expect species-level effects to occur.

The Barrens topminnow has a high vulnerability based on its status, distribution, and trends. The Barrens topminnow is restricted to six populations in springhead pools and slow-flowing areas of spring runs on the Barrens Plateau in Tennessee. Several populations have low abundance and low resilience to stochastic events, and the species' recovery outline indicates a population decline for the species. Threats include predation and habitat alteration (livestock influences, riparian vegetation removal, drought, and water impoundment).

Although the Barrens topminnow has high vulnerability and risk to exposed individuals,and the overlap of labeled uses is high (21.53%), we anticipate that these factors would be mitigated in large part by the low usage (<1%) within the range of the species on non-Federal lands. Additionally, the species range occurs partly on Federal lands (~10%), where we also anticipate only low numbers of individuals affected, as described in the Usage section of the Opinion). In addition to the extremely low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Barrens topminnow and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate low levels of adverse effects to individuals and their prey from the proposed use of malathion over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Barrens topminnow in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Poeciliopsis occidentalis	Gila topminnow (incl. Yaqui)	219

Family: Poecyailiidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Habitat destruction and introduction of non-native species have caused severe reductions of Gila topminnow populations, and are the main causes for its listing as an endangered species (USFWS 1984; Williams et al. 1985, 1989; Simons et al. 1989). During the late 1800s and early 1900s, several factors caused widespread habitat changes throughout the Southwest. Heavy overgrazing and wood cutting combined with a drought during 1891-1893 caused extensive loss of vegetation resulting in 50-75% loss from cattle herds (Hastings and Turner 1965; Deacon and Minckley 1974; Hendrickson and Kubly 1984; Bahre and Hutchison 1985). This lack of vegetation made the area vulnerable to erosion when the drought ended. Floods, unbuffered by vegetation, scoured watercourses, deeply incised marshy cienega habitats, lowered water tables, desiccated watersheds, and turned permanent flowing waters into occasionally flooded arroyos. Marshes dried, springs failed, and streamside backwaters and inlets disappeared (Miller 1961; Fradkin 1981; Rea 1983; Hendrickson and Minckley 1985; Bahre 1991). In only 10 years, the San Pedro River was "incised from its mouth for 125 miles upstream" (Bryan 1925). Groundwater pumping began around this time and caused additional lowering of the water table (Rogers 1980). Habitats were further impacted by construction of water diversions and dams, which dewatered downstream reaches and created artificial habitats favoring non-native fish species (Minckley et al. 1991). Historic events permanently altered much of the aquatic habitat in the arid southwest, but current and future activities also present a great risk. Land use practices such as livestock grazing, mining, timber cutting, road maintenance, and recreation pose threats through increased erosion, intensified flood events, and decreased groundwater storage to both existing populations and habitats proposed for reestablishment. In addition, continued urban and suburban development and population growth affects potential recovery of the species through increased groundwater pumping and diversions to supply the growing populations, stream and river channelization, and increased water pollution. Some populations are supported in habitats constructed or modified by man and require periodic maintenance for support of the population. Performance of this maintenance may be limited by future budgetary restrictions within the

various agencies responsible for management. In addition, habitats identified for recovery of Gila topminnow do not receive statutory protection and may be damaged or destroyed before Gila topminnow reestablishment, thus continuously reducing the likelihood of recovery of the species. Introduction of non-native pathogens, parasites, plants, invertebrates, amphibians and fish may negatively affect the native fishes of the Southwest.

Human movements of Gila topminnow began as early as 1936 for the purposes of mosquito control. Many reintroductions have occurred since then for the purposes of conservation of the species. Reintroductions have occurred into both anthropogenic and naturally occurring habitats (Minckley and Brooks 1985). In September of 1981 a Memorandum of Understanding between the U.S. Fish and Wildlife Service, the U.S. Forest Service, and the Arizona Game and Fish Commission provided a catalyst for large-scale reintroductions of topminnows. This reintroduction program has had limited success (Brooks 1985, 1986; Simons 1987; Bagley et al. 1991; Brown and Abarca 1992; Weedman and Young 1997). Most of the populations established during these attempts disappeared almost immediately, while a few survived for 5-10 years. The reasons for failure of these populations was obvious in some cases (dredging, drying, flooding, bulldozing, replacement by mosquitofish), while others were only speculative. Most of the habitats stocked lacked contiguous habitats from which Gila topminnow could re-populate and were of such small size they lacked resiliency to natural and anthropogenic factors. Currently, 17 reestablished populations persist in the wild within historic range. A philosophical change in the approach to recovery of Gila topminnow occurred between the early 1980s and the present. Originally, it was thought that the Gila topminnow could be quickly and easily recovered through a quantity-driven approach by establishing many new populations (the "Johnny Applefish" approach). The limited success of this approach became apparent in the late 1980s and emphasis was switched to protection of natural and reestablished populations in conjunction with a quality-driven approach of reintroduction to better quality areas. Recovery efforts have included attempts to reclaim habitats by removing non-native fish species (Meffe 1983). Recently, several management activities to protect Gila topminnow have taken place in habitats occupied by natural populations. At Cottonwood Spring, the Service and The Nature Conservancy have signed and implemented a Partners for Wildlife agreement with the landowner to build an exclosure around the spring and associated Sonoita Creek and exclude grazing within the riparian area. The Coronado National Forest has conducted formal consultation to close roads, construct exclosures, and modify Allotment Management Plans to improve conditions for the Gila topminnow in Redrock Canyon. They have also outlined plans to monitor riparian conditions, including aquatic systems and fish populations. Portions of lower Sonoita Creek, Fresno Canyon, and Coal Mine Canyon have been acquired by Arizona State Parks and are now part of the Sonoita Creek State Natural Area. Cienega Creek has been largely fenced to exclude cattle. There have also been other grazing management actions, reconstruction of a part of the stream, and headcut repair. Additional conservation measures taken include establishment of populations at Dexter National Fish Hatchery and Technology Center and Arizona State University. Habitat protections such as road closures, livestock exclosures, recreation management, fish barrier construction, closure of areas to fishing, and habitat construction have been done. The Arizona Game and Fish Department continues a monitoring and reintroduction program partially funded through Section 6 of the Endangered Species Act. Section 7 consultations on Federal activities has resulted in additional protections to populations present on Federal lands.

EB/CE Source:
U.S. Fish and Wildlife Service. 1998. Gila Topminnow (*Poeciliopsis occidentalis occidentalis*) Revised Recovery Plan. Phoenix, Arizona. pp. 89

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Gila topminnow will experience direct mortality or sublethal effects for most uses of malathion for all bins (2, 3, 5, and 6). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 2.19%: Estimated mortality among exposed individuals: 2/3(L&H), 5(M &H), 6(M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 2.19%: Estimated sublethal effects among exposed individuals: G:2/3(L&M),5(L&M),6(L&M); R:2/3(L&M),5(L&M),6(L); B:2/3(L&M&H),5(L&M&H),6(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 2.19%: Estimated mortality among exposed aquatic invertebrate prey: 2/3(H), 5(H), 6(H) Estimated mortality among exposed prey fish: 2/3(L&H), 5(L&H), 6(L&M&H)
MOSQUITO CONTROL	

Direct (mortality)	Mosquito control overlap 9.55%; Estimated mortality among exposed individuals: 2/3(H),5(H),6(M)
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 9.55%: Estimated sublethal effects among exposed individuals: G:2/3(M),5(M),6(L); R:2/3(L),5(L),6(L); B:2/3(M),5(M),6(L)
Indirect	Mosquito control overlap 9.55%: Estimated mortality among exposed aquatic invertebrate prey: 2/3(H), 5(H), 6(H) Estimated mortality among exposed prey fish: 2/3(M), 5(H), 6(L)

Risk modifiers: Gila topminnows are opportunistic omnivorous feeders. Primary food items include detritus, vegetation, amphipods, ostracods, and insect larvae; and rarely, other fishes.

Allowable uses driving effects/other considerations: While there are many uses that could occur in the species range and malathion concentrations resulting from most of those uses could be highly toxic to exposed individuals, the footprint for all uses is relatively small (2.19% total overlap). Uses with the highest overlap are Developed (1.35%), Other Crops (0.33%), Cotton (0.22%), and Pasture (0.22%).
Mosquito control: Mortality effects resulting from mosquito control activities could be high/medium and this use is estimated to occur over 9.55% of the species range.

In the “Approach to the Effects Analysis” section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Gila topminnow (incl. Yaqui) does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, they can mitigate their potential risk of exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	996,443	9.55		NA	2,3,5,6	2H 3 5H 6M
Other Crops	D,I	34,549	0.33	0	0.00	2,3,5,6	2H 3 5H 6H
Other Row Crops	D,I	18	0.00	9	0.00	2,3,5,6	2H 3 5H 6H
Other Grains	D,I	2,569	0.02	2,057	0.02	2,3,5,6	2H 3 5H 6H
Corn	D,I	1,750	0.02	279	0.00	2,3,5,6	2H 3 5H 6H
Cotton	D,I	22,802	0.22	4,774	0.05	2,3,5,6	2H 3 5H 6H
Developed	D,I	140,890	1.35	7,044	0.07	2,3,5,6	2L 3 5M 6M
Wheat	D,I	7,219	0.07	4,880	0.05	2,3,5,6	2H 3 5H 6H
Vegetables & Ground Fruit	D,I	2,349	0.02	1,931	0.02	2,3,5,6	2H 3 5H 6H
Orchards & Vineyards	D,I	1,245	0.01	836	0.01		2H 3

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							5H 6H
Pasture	D,I	15,005	0.14	13,618	0.13	2,3,5,6	2H 3 5H 6H
Nurseries	D,I	173	0.00	173	0.00	2,3,5,6	2H 3 5H 6H
Sub-TOTAL (D): *Other uses with direct effects*[3]		228,568	2.19	35,599	0.34		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		228,568	2.19	35,599	0.34		
TOTAL[4]:		1,225,011	11.74	35,599	0.34		

 # acres in species range: 10,435,538 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 5,422,539 acres, 51.962%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Gila topminnow (incl. Yaqui). As discussed below, even though the vulnerability and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Gila topminnow (incl. Yaqui) has a medium vulnerability based on its status, distribution, and trends. While the species does include some populations that are declining, various efforts have been undertaken to establish additional populations for the species and address habitat impacts. We anticipate individuals that are exposed to malathion for most uses would experience high levels of mortality, and exposed survivors would experience variable levels of sublethal effects based on use type and waterbody size. We also anticipate invertebrate prey would also experience high levels of mortality if exposed. However, both the vulnerability and risk to individuals if exposed is largely mitigated by the low degree of usage with the range of the species (0.34%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. In addition to the extremely low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Combined, these conservation measures substantially reduce exposure to the Gila topminnow and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, we expect exposure of individual Gila topminnows and their invertebrate prey to occur only at very low levels over the duration of the Action, and we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Gila topminnow (incl. Yaqui) in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Ictaluridae)

Scientific Name:	Common Name:	Entity ID:
Noturus placidus	Neosho madtom	270

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Neosho madtom was listed as a threatened species in May 1990. At the time of listing, three populations were known, and their status was assumed to be stable. Habitat loss for the species was extensive due to construction of reservoirs. Known threats to the Neosho madtom include gravel bar removal, drought, chemical pollution, sedimentation, alteration of flow regimes, and interspecific competition. Knowledge of the species' reproductive ecology and population biology was lacking. Since the Neosho madtom was listed, four generalized populations have been recognized. The population in the Neosho and Cottonwood Rivers upstream of John Redmond Reservoir appears stable, and is characterized by high numbers of individuals per unit area. This stream reach has a relatively natural hydrograph and generally moderate to high quality habitat with a low magnitude and immediacy of threat. The Neosho River population downstream of John Redmond Reservoir is generally low in abundance, and has exhibited a slow decline in numbers since monitoring began in 1991. The species in this reach is subject to rapid increases and decreases in flows due to dam releases; unnatural periods of high attenuated flows that may impact reproduction and recruitment; and has a mix of low to high quality habitat, with quality generally increasing as the stream flows south. This population has a moderate magnitude of ongoing threat. The Spring River population upstream from the confluence of Turkey Creek appears stable, but is characterized by low numbers, likely resulting from minimal amounts of suitable habitat present. Threats to species in this reach are believed low in magnitude and non-imminent. The population in the Spring River downstream of Empire Lake was not known to exist until 1994, and the species has only been captured five times in this reach. Little work has been completed in this section of river to document habitat availability and quality, and the species' distribution. However, it is likely impacted to some degree by lead and zinc contamination resulting from past mining activity.

The most severe impacts to the Neosho madtom since listing likely affect the population downstream of John Redmond Reservoir. Hydrological changes involving flow levels, timing, and periodicity likely impacts habitat quality and quantity, reproductive activity, recruitment, and the aquatic invertebrate fauna (food source). Gravel bar removal (gravel mining) is still a threat, particularly in the Neosho and Cottonwood Rivers. However, the magnitude of threat from this activity has decreased substantially due to regulations prohibiting mining beneath the waterline. The occurrence of drought, in combination with appropriation of water rights, continues as a moderate, non-imminent threat to the species. Chemical pollution and sedimentation continue to impact the Neosho madtom and its habitat at similar levels to when listed, with most resulting from non-point source runoff from agricultural and urban activities. Interspecific competition between the Neosho madtom and other fishes, originally believed to be a threat, has been disproven by recent research. The Neosho madtom’s present status appears stable in the Neosho and Cottonwood Rivers upstream of John Redmond Reservoir and in the Spring River upstream of the confluence with Turkey Creek (upstream population) despite low abundance. The lower Spring River population is largely undocumented, and persists in extremely low abundance. However, due to its recent discovery, not enough information exists to determine population trends and magnitude and imminence of threat. The Neosho River population downstream of John Redmond dam to the Lake O’ the Cherokees in Oklahoma is experiencing a very slow decrease in abundance, likely being influenced by 30 John Redmond Dam operations and the presence of many lowhead dams. Overall threats to the species have remained similar, or have minimally decreased, since the time of listing. Generally, we believe the species as a whole has a low-moderate magnitude of threat, of a non-imminent basis, with the exception of the decreasing population downstream of John Redmond Reservoir whose threat is higher in magnitude and of a more imminent nature.

Following the listing of the Neosho madtom in 1991, a strong degree of conflict arose concerning commercial gravel mining operations in relation to the species’ habitat and income losses to several regional businesses. The level of conflict has been reduced in recent years due to changes in regulations. However, public water demand has also increased during this time and is forecast to increase further in the coming years, likely increasing the level of conflict (Kansas Division of Water Resources 2006, Kansas Water Office 2006, U.S. Army Corps of Engineers 2011).

The 2020 5-Year Review indicated the following:
Numerous past surveys indicate that the Neosho madtom still persists within the Neosho river basin, despite the fact that numerous stressors still exist today. However, numbers of individuals remain low to moderate. Our review of new information does not change our evaluation of species status and the threats affecting the species from our most recent review of the species. Specifically, existing and potential habitat modifications, such as impoundments, gravel dredging, channelization, water diversions, water allocation, and water quality remain threats to the species. These existing and potential threats, along with the low to moderate numbers of Neosho madtoms counted during surveys, continue to support our previous evaluation.

EB/CE Source:
U.S. Fish and Wildlife Service. 2020. 5-Year Review for the Neosho Madtom (*Noturus placidus*). Kansas Field Office. pp. 4

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Neosho madtom will experience direct mortality or sublethal effects for most uses of malathion in all bins (3 and 4). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 12.09%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 12.09%: high levels of effect on behavior for a few uses.
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 12.09%: high levels of mortality on aquatic invertebrate prey.
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 9.53%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control overlap 9.53%: medium levels of effect on growth and behavior
Indirect	Mosquito control overlap 9.53%: high levels of mortality on aquatic invertebrate prey

Risk modifiers: Neosho madtoms are invertivore/generalists. Their diet includes larval insects occurring in streambed crevices.

Indirect effects to aquatic invertebrate prey

Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of benthic macroinvertebrate prey, short-term indirect effects to aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to aquatic invertebrate prey suggest.

In the “Approach to the Effects Analysis” section of the main body of the Opinion we describe specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

Allowable uses driving effects/other considerations:

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	739,293	9.53	36,300	0.47	3,4	2H 3 4
Other Crops	D,I	11,489	0.15	0	0.00	3,4	2H 3 4
Other Row Crops	D,I	137	0.00	147	0.00	3,4	2H 3 4
Other Grains	D,I	43,007	0.55	48,141	0.62	3,4	2H 3

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
							4
Corn	D,I	503,283	6.49	15,055	0.19	3,4	2H 3 4
Cotton	D,I	48	0.00	33	0.00	3,4	2H 3 4
Developed	D,I	118,488	1.53	5,924	0.08	3,4	2M 3 4
Rice		0	0.00	0	0.00		
Wheat	D,I	228,358	2.94	202,494	2.61	3,4	2H 3 4
Vegetables & Ground Fruit	D,I	19	0.00	19	0.00	3,4	2H 3 4
Orchards & Vineyards	D,I	1,083	0.01	205	0.00	3,4	2H 3 4
Pasture	D,I	31,249	0.40	13,736	0.18	3,4	2H 3 4
Nurseries	D,I	367	0.00	367	0.00	3,4	2H 3 4
Sub-TOTAL (D): *Other uses with direct effects*[3]		937,529	12.09	286,122	3.69		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		937,529	12.09	286,122	3.69		
TOTAL[4]:		1,676,823	21.62	322,422	4.16		

^ This species only occurs in bins 3 and 4. Bin 2 was added to provide EECs to estimate effects in bins 3 and 4. We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 7,756,137 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 43,426 acres, 0.560%

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the

Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Neosho madtom. As discussed below, even though the vulnerability is high for this species, the risk is low, and we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Neosho madtom has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we do not anticipate exposure to result in mortality based on updated information from EPA on bins 3 and 4 modeling (See above discussion in Risk Modifiers). We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, and to both behavioral effects and growth from mosquito adulticide. Effects to prey are variable, with generally high levels of mortality of invertebrate prey anticipated. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (21%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4.16%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. The species range is very large (>7 million acres), and we do not anticipate individuals would necessarily be found in the affected areas of the waterbodies near application sites when malathion is applied, although small numbers of individuals may occur in these areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from other sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Neosho madtom and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Neosho madtom in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Percidae)

Scientific Name:	Common Name:	Entity ID:
Etheostoma wapiti	Boulder darter	297

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Population size/location(s) unknown
Number of Populations: Population size/location(s) unknown
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
From 2017 5-Year Review:
When listed in 1988, boulder darters were known only from about 10 isolated localities in some 60 miles (96 kilometers) of the Elk River in Giles and Lincoln counties, Tennessee, and Limestone County, Alabama, and the extreme lower ends of Richland Creek and Indian Creek, Giles County, Tennessee (USFWS 1989). The historic collections from these localities document less than 100 boulder darters in the Elk River system prior to 1990. Conservation Fisheries, Inc. collection efforts from 1993 to 1997 produced only 11 additional specimens in 1991, and observations of additional individuals at two additional sites, below Harms Mill and at Hobbs Bridge (Rakes and Shute 2001). Since that time, Conservation Fisheries, Inc. began developing techniques for captive propagation (using a surrogate species), and FWS Tennessee Wildlife Resources Agency, and Tennessee Valley Authority cooperated in a project to reintroduce the species into sections of the Elk River where it was no longer found (Rakes et al. 1999). Surveys have detected individuals in several locations, but overall population information and locations is unknown. Small popuation sizes and apparently fragmented distributions are assumed, which is anticipated to leave the boulder darter vulnerable to heightened reductions in genetic variation through the processes of inbreeding and random genetic drift.

From 2009 5-Year Review:
As indicated in the Recovery Plan (USFWS 1989), toxic chemical spills, siltation, improper pesticide use, and cold water releases from Tims Ford Reservoir remain threats to the boulder darter. Additional threats to the boulder darter include gravel dredging, agricultural practices, and physical habitat destruction resulting from a variety of anthropogenic impacts (i.e., siltation, disturbance of riparian corridors, and changes in channel morphology).

The most significant of these impacts is siltation caused by excessive releases of sediment from activities such as agriculture, resource extraction (e.g., coal mining, silviculture), road construction, and urban development (Waters 1995). Non-point source pollution from land surface runoff can originate from virtually any land use activity and may be correlated with impervious surfaces and storm water runoff. Pollutants may include sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray water leakage, and petroleum products. These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the chemistry of affected streams such that the habitat and food sources for species like the boulder darter are negatively impacted.

Construction and road maintenance activities associated with urban development typically involve earth-moving activities that increase sediment loads into nearby streams. Other siltation sources, including timber harvesting, clearing of riparian vegetation, and mining and agricultural practices, allow exposed earth to enter streams during or after precipitation events. Portions of the Elk River and its tributaries are listed as impaired by the State of Tennessee due to *Escherichia coli*, siltation, physical substrate alterations, flow alteration, low dissolved oxygen, alteration of stream-side vegetative cover, nutrient levels, and thermal modifications (Tennessee Department of Environment and Conservation (TDEC) 2008a). State and federal water quality laws have not been used to their full potential in preventing pollution from agricultural, municipal, and industrial sources.

Major sources of pollution in the Elk River basin include pasture grazing, upstream impoundment, industrial and municipal point-source discharges, sand and gravel mining, non-irrigated crop production, and off-road vehicles (TDEC 2008a). However, the 2009 5-Year Review reported TDEC was currently developing nutrient Total Maximum Daily Loads (TMDLs) for the Upper and Lower Elk River watersheds. As a part of the TMDL process, TDEC will determine the sources and extent of nutrient impairment, quantify nutrient loadings and source contributions, and develop cause and effect relationships between nutrient loadings and response parameters in the Elk River basin (TDEC 2008b).

Although the 2009 5-Year Review indicated the Tennessee Valley Authority was currently implementing operational changes at Tims Ford Reservoir, the adaptive management process was described as experimental and the probability of success uncertain. The boulder darter has been successfully propagated; however, the threat of Tims Ford Reservoir operations has prevented the successful reintroduction and recovery of this species in the Elk River.

EB/CE Source:

U.S. Fish and Wildlife Service. 2017. Boulder Darter (*Etheostoma wapiti*) 5-Year Review: Summary and Evaluation. Cookeville, Tennessee.

U.S. Fish and Wildlife Service. 2009. Boulder Darter (*Etheostoma wapiti*) 5-Year Review: Summary and Evaluation. Cookeville, Tennessee.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Overlap with species range (total uses without mosquito control/mosquito control): 6.52%/16.76%

***Risk modifiers*:** The boulder darter feeds opportunistically primarily on a range of benthic macroinvertebrate prey, such as isopods, copepods, chironomid larvae, and other aquatic insect larvae. Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Boulder darter larvae are pelagic feeders and are thought to feed on drifting zooplankton while occupying gently flowing pools (USFWS 2017 5 year review). As they mature, individuals feed on later instar invertebrates or larger size classes of microcrustaceans. Since the boulder darter is a generalist feeder that relies on a variety of benthic macroinvertebrates, microcrustaceans and drifting zooplankton prey at various life stages, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Indirect effects to prey invertebrates:
Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since the boulder darter feeds upon a variety of benthic macroinvertebrate, microcrustaceans, and aquatic insect larvae, short-term indirect effects to aquatic invertebrate are anticipated to have a limited effect on food resources. These reductions to invertebrate prey if they occur are likely temporary (based on application frequency) and primarily related to lower volume bins, and spatially limited with community recovery over a short period of time. Thus, we anticipate that risk will be lower than the modeled indirect effects to prey suggest.

The boulder darter is found in the main channel of the Elk River and a few of its larger tributaries, which are medium to small rivers, characterized as bins 3 and 4. Recall from section "Approach to the Effects Analysis" from the main body of the Opinion that specific considerations were made for species that occur in bins 3 and 4 and that they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Due to the potential issues inherent in the modeling for these bins, we instead relied on bin 2 estimates as an upper bound for bins 3 and 4 exposures. We acknowledge that the EEC estimates for the uses within the range of this species from a bin 2 water are overestimates and we don't anticipate the boulder darter would be exposed to the concentrations of malathion in a bin 2 water modeled by EPA from the BE. Further investigation by EPA into bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

Species occurs in bins 3 and 4. See Risk Assumptions (above) for Risk to individuals and Species.

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

PCT totals

- All R-Plot layers except mosquito control: 2.9%
- Mosquito control: 1.73%

 # acres in species range: 2,099,378 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 28,294 acres, 1.348%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of

area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the boulder darter. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The boulder darter has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, or in some cases medium effects to growth and behavior (e.g., from mosquito adulticide). Effects to prey are variable, with generally high levels of mortality of invertebrate prey anticipated.

Although the overlap of use layers with the species range is high (23.28%), risk is anticipated to be low based on the risk modifier for bins 3 and 4 discussed above (non-toxic effects to species in these bins). We also anticipate usage within the non-Federal portion of the species’ range will be low (4.63%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. We anticipate only very small numbers of individuals may occur in the affected areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the boulder darter and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate very small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the boulder darter in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Percidae)

Scientific Name:	Common Name:	Entity ID:
Etheostoma fonticola	Fountain darter	228

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The species is found in two locations, San Marcos River and Comal River system. Sensitive to both direct and indirect (e.g., food source) effects of contaminants and other stochastic events. Based on 74 *E. fonticola* that contained mature ova, the mean fecundity was 19, which is less than in other darters. This low fecundity is probably compensated for by repeated spawnings of small groups of eggs throughout the year. It is not known how many ova are spawned annually by each *E fonticola*.

A primary threat to the species and its ecosystems is loss of springflows. Springflows at San Marcos and Comal Springs are tied inseparably to water usage from the entire Edwards Aquifer, and use of groundwater in that region decreases flow of water from the springs. Water quality declines would likely impact the species. Water quality includes chemical and physical factors. Some of the chemical constituents that may be important include dissolved ions, trace elements, pH, nutrients, dissolved oxygen, and organic contaminants (e.g., compounds of petrochemical or pesticide origins). Some of the physical factors considered important include water temperature, air temperature, light, turbidity, and sedimentation. Other threats to water quality occur as a result of human activities in the recharge zone and in the local watersheds. Permitted, unpermitted, and accidental discharges (such as sewage leaks) into waterways are possible threats that need to be evaluated and addressed (Emery 1967, Vaughan 1986). Surface runoff, particularly in urban areas, may impact the springs, lakes, and river systems. Stormwater runoff may include such things as pesticides and herbicides, fertilizers, soil eroded from construction activities, silt, suspended solids, garbage, hydrocarbon and inorganic/metal compounds from vehicles and machinery, household solvents and paints, and other urban runoff from point and non-point pollution sources (Urban Drainage and Flood Control District 1992).
Human modifications (such as bank stabilization, dams, and landowner maintenance activities in waterways and on adjacent tracts of land) have significantly altered natural configurations and

drainage in the San Marcos and Comal systems. These alterations, in turn, have changed the historical magnitude and occurrence of episodic events such as flooding. Indirect impacts from surrounding development and urbanization have also changed these systems. Certain non-native species pose a significant threat to the listed species due to competition over habitat or diet and/or by modifying habitat, such as non-native elephant ears (*Colocasia esculenta*) and giant ramshorn snails (*Marisa cornuarietis*). In addition, some species prey on the listed species. Decreased flow may exacerbate the problem posed by non-native species. Various activities have been planned and pursued to address some of these impacts, including management plans, habitat conservation planning and other efforts.

EB/CE Source:
U.S. Fish and Wildlife Service. 1996. San Marcos and Comal Springs and Associated Aquatic Ecosystems (Revised) Recovery Plan. Austin, Texas. pp. 134

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the fountain darter will experience direct mortality or sublethal effects for most uses of malathion in all bins (2 and 3). The risk of mortality is expected to be high for all bins. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 8.97%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 8.97%: high levels of effect on behavior for a few uses
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 8.97%: high levels of mortality on aquatic invertebrate prey
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 5.57%: high levels of mortality
Sublethal	Mosquito control overlap 5.57%: medium levels of effect on growth and behavior

Indirect	Mosquito control overlap 5.57%: high level of mortality

Risk modifiers: Fountain darters are invertivores. They feed on copepods, dipteran (fly) larvae, and mayfly larvae.

Indirect effects to aquatic invertebrate prey: Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to aquatic invertebrate prey suggest.

In the "Approach to the Effects Analysis" section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Fountain darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, they can mitigate their potential risk of exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Allowable uses driving effects/other considerations:

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Morality Effect associated with bin^ (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	69,039	5.57	NA	NA	2,3	2H 3
Other Crops	D,I	2,921	0.24	0	0.00	2,3	2H

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Morality Effect associated with bin^ (H, M, L)
		Acres	%	Acres	%		
							3
Other Row Crops	D,I	113	0.01	124	0.01	2,3	2H 3
Other Grains	D,I	21,878	1.76	22,626	1.82	2,3	2H 3
Corn	D,I	22,042	1.78	4,101	0.33	2,3	2H 3
Cotton	D,I	5,779	0.47	5,574	0.45	2,3	2H 3
Developed	D,I	48,925	3.94	2,446	0.20	2,3	2L 3
Wheat	D,I	9,169	0.74	9,812	0.79	2,3	2H 3
Vegetables & Ground Fruit	D,I	9	0.00	8	0.00	2,3	2H 3
Orchards & Vineyards	D,I	98	0.01	45	0.00	2,3	2H 3
Pasture	D,I	2	0.00	3	0.00	2,3	2H 3
Nurseries	D,I	290	0.02	290	0.02	2,3	2H 3
Sub-TOTAL (D): *Other uses with direct effects*[3]		111,228	8.97	45,029	4.03		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		111,228	8.97	45,029	4.03		
TOTAL[4]:		180,266	14.53	45,029	4.03		

^We consider the bin 2 estimates as an upper bound of bin 3 & 4 exposures.

 # acres in species range: 1,240,347 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 11,502 acres, 0.927%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program, which has a history of implementation of species protection mesures for the species[1]), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

[1]While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the Description of the Action section of the Opinion. For example, the 2018 FWS informal section 7(a)(2) consultation with APHIS includes the following conservation measure for the fountain darter: "No use within 60 feet of identified aquatic habitat or recharge areas of the Edwards Aquifer. Monitor for run-off."

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the fountain darter. As discussed below, even though the vulnerability is high and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The fountain darter has a high vulnerability based on its status, distribution, and trends. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, or in some cases medium effects to growth and behavior (e.g., from mosquito adulticide). Effects to prey are variable, with generally high levels of mortality of invertebrate prey anticipated. The risk to the species posed by labeled uses across the range is anticipated to be medium based on the overlap of use layers with the species range (15%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. We anticipate only very small numbers of individuals may occur in the affected areas and be exposed over the duration of the proposed action. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the fountain darter and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate very small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the fountain darter in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	Common Name:	Entity ID:
Etheostoma okaloosae	Okaloosa darter	224

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Increasing population(s)
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
From 86 FR 64158-64176; 2021 (Removal of the Okaloosa Darter from the Federal List of Endangered and Threatened Wildlife; Proposed Rule): We are proposing to delist Okaloosa darters based on all six extant populations exhibiting genetic differentiation and the species is extant across all three representation units. Overall, the populations are robust. Because approximately 90 percent of the species' range is under the management of Eglin Air Force Base, urbanization will have little to no future effect. The Okaloosa darter occurs in multiple stream systems, and no long-term threats are presently impacting the Okaloosa darter at the species level. Since delisting would be, in part, due to conservation actions taken by stakeholders, we have prepared a draft post-delisting monitoring plan for Okaloosa darters.

Reclassification document (76 FR 18087-18103, 2011)
The endemic Okaloosa darter is known to occur in six clear stream systems that drain into two Choctawhatchee Bay bayous in Walton and Okaloosa Counties in northwest Florida. Okaloosa darters are currently found in the tributaries and the main channels of the following six streams: Toms, Turkey, Mill, Swift, East Turkey, and Rocky Creeks. Approximately 90% of the 457 square kilometer (176 square mile) watershed drainage area that historically supported the Okaloosa darter is under the management of Eglin Air Force Base (AFB), and we estimate that 98.7% of the stream length in the darter's current range is within the boundaries of Eglin AFB. Eglin AFB encompasses the headwaters of all six of these drainages, and the remainder of the these streams flow out of Eglin AFB into the urban complex of the Cities of Niceville and Valparaiso (USAF 2006, p. 3–1).

As identified in our 2007 5-year status review (Service 2007, p. 6–7), the longterm trend in the average counts at each monitoring site indicated that the four smallest darter watersheds (Toms, Swift, Mill, and East Turkey), as well as West Long Creek and East Long Creek, were decreasing while the watersheds of Rocky Creek and Turkey Creek were increasing. However, sampling conducted since restoration activities on Mill Creek were completed indicates that darter numbers are now increasing. Using the estimated length of occupied habitat for these creeks, darter numbers are stable or increasing in 86% of their current range and decreasing in 14% of their current range. All of the declining trends were sampled by seining, not visual surveys, and may reflect variable sampling efficiency over time. Standardized sampling since the status review continues to show robust numbers of Okaloosa darters.

Only stressors associated with one of the five listing factors currently poses a known threat to the Okaloosa darter, namely the present or threatened destruction, modification, or curtailment of its habitat or range. Eglin Air Force Base manages the vast majority of the Okaloosa darter's current range, or about 99%. We have seen substantial progress of Eglin Air Force Base addressing threats to the darter's habitat under the base's Integrated Natural Resources Management Plan and general ongoing habitat restoration. Resource stewardship on Eglin AFB is generally reducing the threat of habitat destruction and range reduction (for example, restoring erosive, near-stream borrow pits). Eglin AFB is addressing the threat of sedimentation from unpaved roads and from areas adjacent to poorly designed and maintained paved roads. Similarly, restoration of Mill Creek on the Eglin Golf Course, which had been substantially altered by culverts and anthropogenic impoundments, has been completed. As the smallest of the six darter watersheds, the darter population in Mill Creek is probably most vulnerable to extirpation. We anticipate that restoration at Mill Creek will secure a viable population in this system. Eglin has worked diligently to generally improve habitat quality within its boundaries. Outside of Eglin's borders, we have been working with the City of Niceville to improve their wastewater collection system and install more appropriate culverts at a number of road crossings. However, additional improvements are necessary before this threat of sedimentation and pollution is completely removed. Brown darters and habitat loss from beaver activity were identified as other natural and anthropogenic factors affecting the continued existence of darters. After several years of monitoring and recent genetics work, it does not appear that the brown darter is either expanding its range or displacing Okaloosa darters in most sympatric areas. The overall effect of beaver activity on the darter is poorly understood. However, even if brown darters and habitat loss from beaver activity do pose localized threats, we do not believe these to be significant to the Okaloosa darter rangewide.

Pollution other than sedimentation poses a potential threat to darters in six stream segments. While no streams in the darter's range are designated by DEP as impaired, 6 of the 13 segments sampled using three biological indicators were considered potentially impaired and are on the "3c planning list," which means that "enough data and information are present to determine that one or more designated uses may not be attained according to the Planning List methodology." One stream site has been characterized as "severely limited by pollutants from the landfill." Using comparable aquatic insect sampling methods, the Service (Thom and Herod 2005, Table 4–1) found 12 out of the 42 sites sampled within the darter's range to be impaired. An impaired water body is one where the biological integrity of the system as determined through indicators has been compromised because of pollutants, indicating that Okaloosa darter habitat is degraded.

Based on these data, it appears likely that the wastewater treatment sprayfields located near the headwaters of East Turkey Creek and Swift Creek are adversely affecting water quality.

EB/CE Source: USFWS 2021. Endangered and Threatened Wildlife and Plants; Removal of the Okaloosa Darter from the Federal List of Endangered and Threatened Wildlife; Proposed Rule. Federal Register 86 (November 17, 2021): 64158-64176.

USFWS 2021. Endangered and Threatened Wildlife and Plants; Final Reclassification of the Okaloosa Darter from Endangered to Threatened and Special Rule; Final Rule. Federal Register 76 April 1, 2011): 18087-18103.

Overall Vulnerability: ☐ **High** ☐ **Medium** ☒ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Okaloosa darter will experience direct mortality or sublethal effects for most uses of malathion. The risk of mortality is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap 6.26%: high levels of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 6.26%: high levels of effect on behavior for a few uses
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 6.26%: high levels of mortality on aquatic invertebrate prey.
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 66.21% high level of mortality
Sublethal – growth (G), reproduction (R) and behavior (B)	Mosquito control 66.21%: medium levels of effect on growth and behavior
Indirect	Mosquito control overlap 66.21%: high levels of mortality on aquatic invertebrate prey

Risk modifiers: Okaloosa darters are invertivores. They feed on aquatic insects, crustaceans, and other small invertebrates.

Indirect effects to aquatic invertebrate prey

Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources.

Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations:

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		1,276,020	66.21	86,395	4.48	2	2H
Other Crops		38,711	2.01	0	0.00	2	2H
Other Row Crops		13,148	0.68	7,487	0.39	2	2H
Other Grains		4,362	0.23	2,588	0.13	2	2H
Corn		2,390	0.12	743	0.04	2	2H
Cotton		13,630	0.71	5,762	0.30	2	2H
Developed		46,566	2.42	2,328	0.12	2	2M
Wheat		432	0.02	147	0.01	2	2H
Vegetables & Ground Fruit		36	0.00	26	0.00	2	2H
Orchards & Vineyards		1,154	0.06	845	0.04	2	2H
Pasture		35	0.00	19	0.00	2	2H
Nurseries		149	0.01	149	0.01	2	2H
Sub-TOTAL (D): *Other uses with direct effects*[3]		120,611	6.26	41,865	1.04		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		120,611	6.26	41,865	1.04		
TOTAL[4]:		1,396,631	72.47	128,260	5.53		

 # acres in species range: 1,927,196 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 493,937 acres, 25.630%

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ **High** ☒ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton , orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Okaloosa darter. As discussed below, even though the risk is high for this species, the vulnerability of the species is low, and we anticipate the likelihood of exposure to malathion is medium. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Okaloosa darter has a low vulnerability based on its status, distribution, and trends, as described above. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, although some uses, such as mosquito adulticide, would result in medium levels of effects to growth and behavior. Effects to prey are variable, with generally high levels of mortality of invertebrate prey anticipated. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (72%), as described above.

We anticipate usage within the non-Federal portion of the species' range will be medium (5.53%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. However, as noted above in the Environmental Baseline and Cumulative Effects section above, we estimate that 98.7% of the stream length in the darter's current range is within the boundaries of Eglin Air Force Base, and thus, the usage estimate (and the related estimate of exposure) may be overestimated. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. Additionally, where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates for certain uses, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the Okaloosa darter and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate very small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Okaloosa darter in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Etheostoma chermocki	Vermilion darter	316

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Stable (per 2019 5-Year Review)
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The vermilion darter is listed in the Turkey Creek watershed due to urbanization and industrialization. The current range of the vermilion darter is reduced to localized sites due to fragmentation, separation, and destruction of vermilion darter populations. There are both natural (waterfall) and anthropogenic (impoundments) dispersal barriers that contribute to the separation and isolation of vermilion darter populations and affect water quality and quantity. The primary threats to the species are: degradation of water quality due to sedimentation and pollutants; altered stream flow regimes and water quantity due to construction and maintenance activities; insufficient stormwater management; and impoundments (five within the Turkey Creek and Dry Creek system). Other threats include: in-stream rock extractions; off-road vehicle usage; road, culvert, bridge, gas and water easement construction and maintenance (Drennen pers. obs. 1999-2009, Blanco and Mayden 1999). These activities lead to water quality degradation, stream channel instability, fragmentation of habitat and hydrology, and overall changes in the geomorphology of the Turkey Creek watershed. In addition, natural waterfalls are dispersal barriers to the connectivity of the vermilion darter populations.

All together, the vermilion darter's habitat is fragmented and the various subpopulations may be genetically isolated. The reduction of habitat for spawning, rearing of young, population maintenance, and reduction of adaptive capabilities increases the possibility of local extinctions (Hallerman 2003; Burkhead et al. 1997). Noteworthy increases of land acquisition within the Turkey Creek watershed have occurred, although destruction of hill tops for subdivision construction in the headwaters decreases downstream water quality and proliferates stormwater runoff. The vermilion darter and its habitat continue to be unprotected from present and foreseeable threats.

The vermilion darter population in Turkey Creek and tributaries shows evidence of sustainability, even though recent survey numbers are low at some sites within the species' range. Since 2001, in most stream reaches of the species habitat, population numbers have been low but stable. Significant conservation gains have been made within site-specific habitats of the vermilion darter, such as the Turkey Creek mainstem, the Turkey Creek Nature Preserve and Center, Turkey Creek at Tapawingo Spring confluence, and the headwaters of the Unnamed Tributary to Beaver Creek. Restoration of the Upper Turkey Creek portion of the species' range at Old Shadow Lake Dam was recently initiated. The removal of the dam will increase the upstream range of the species about 100 m (Rushing 2011).

Upstream areas are of prime development interests for exclusive subdivision development. Routinely after each major storm event, significant amounts of sediment and gravel from these development sites enter the system, increasing the water turbidity from a normal 10 NTU's to 100 NTU's or more (Drennen, pers. obs., 2009). The survivability of the species is perilous due to threats that render the species vulnerable to random natural and anthropogenic events such as: continued deterioration of water quality and quantity; increased stormwater runoff, urbanization and industrialization; geomorphic modifications of the tributaries; degradation of spring water flow and spring water quality; and persistent low and sporadic population numbers of the vermilion darter.

A major highway divides the watershed. Eastward (upstream), the watershed is experiencing rapid residential and business growth; while to the west (downstream), there are numerous commercial, residential, and reclaimed strip-mining sites. Several conservation measures and efforts are also being implemented. Potential impacts to the Turkey Creek watershed have been reduced by numerous measures enacted by partners living or working in the watershed. The development of Best Management Practices for construction, foresty, and agriculture are being pursued. Constituents are seeking to protect wateshed quality through community action groups using Partners for Fish and Wildlife projects and other grass roots efforts. Memoranda of Understanding have been implemented to encourage coordination between local jurisdiction and the Service, and lands have been acquired to protect habitat and support removal of harmful structures and other anthropogenic objects from the species habitats.

From the 2019 5-Year Review:
The vermilion darter population in Turkey Creek and tributaries appears to be relatively stable as reflected in recent surveys coupled with slight range extensions (Kuhajda, pers. comm., 2017). In addition, conservation gains have been made within site-specific habitats of the vermilion darter due to acquisition of habitat by Freshwater Land Trust and restoration efforts in the Turkey Creek watershed. However, upstream areas within the watershed are of prime development interests for hilltop removal for exclusive subdivision development. Routinely after each major storm event, significant amounts of sediment and gravel from these development sites enter the system, increasing the water's turbidity and changing the bottom substrate. Water quality degradation continues to be an issue throughout the Turkey Creek watershed and poses the major threat.

EB/CE Source:

U.S. Fish and Wildlife Service. 2019. Vermilion Darter (*Etheostoma chermocki*) 5-Year Review: Summary and Evaluation. Jackson, Mississppi. pp. 29.

U.S. Fish and Wildlife Service. 2011. Vermilion Darter (*Etheostoma chermocki*) 5-Year Review: Summary and Evaluation. Jackson, Mississppi. pp. 20.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Vermilion Darter (*Etheostoma chermocki*). Jackson, Mississppi. pp. 40.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Species occurs in bins 2, 3. See Risk Assumptions (above) for Risk to individuals and Species.

Risk modifier: Vermillion darter adults and juveniles feed opportunistically primarily on a range of benthic insectivorous prey, such as chironomid, tipulid and caddis larvae, and other aquatic insect larvae. They also feed on microcrustaceans (Carney and Burr, 1989, USFWS 2007). Because benthic macroinvertebrates exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. Since vermillion darters are generalist feeders and rely on a variety of benthic macroinvertebrate and microcrustacean prey, short-term indirect effects to aquatic invertebrate prey base are anticipated to have a limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Indirect effects to aquatic invertebrate prey
Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

In the “Approach to the Effects Analysis” section of the main body of the Opinion we described specific considerations that we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Vermilion darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their potential risk of exposure to malathion is partially mitigated by their reliance upon these higher flowing aquatic habitats, reducing their overall risk.

Overlap with species range (Total uses without mosquito control/Mosquito Control): 7.07%/37.35%

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

PCT totals
- All R-Plot layers except mosquito control: 0.94%
- Mosquito control: 5.59%

 # acres in species range: 325,006 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 0 acres, 0.000%

Overall Usage: ☐ **High** ☒ **Medium** ☐ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of

area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*:

Species specific measures: In addition to the general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, the registrants have also agreed to the following species-specific measure: Mosquito Adulticide:

Where feasible, avoid application within low flow areas. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, reach out to local FWS Ecological Services field offices to determine appropriate measures to minimize exposure to the affected species (FWS points of contact are available through the Information, Planning, and Consultation (IPaC) website https://ecos.fws.cov/ipac/). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

Avoidance and use limitation areas such as the species' range, critical habitat, or key habitat types and areas, are effective ways to reduce exposure to malathion by preventing use directly in these important areas, thus reducing the likelihood the species will come into contact with malathion. Use limitation areas were identified as low flow areas (bin 2) based on modeled EECs at levels where toxic effects to the species if exposed would occur. Avoidance of applications near low flow habitats would avoid exposure to malathion and potential toxic effects to the species.

The Service evaluated these additional measures and concluded that, in addition to changes to the general labels, will provide the necessary levels of protection for the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the vermilion darter. As discussed below, even though the vulnerability is high and the risk is medium for this species, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Vermilion darter has a high vulnerability based on its status, distribution, and trends, as described above. Where individuals are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, with each of these effects varying in part by use category. We generally expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, although some uses, such as mosquito adulticide, would result in medium levels of effects to growth and behavior. Effects to prey are variable, with generally high levels of mortality of invertebrate prey anticipated. The risk to the species posed by labeled uses across the range is anticipated to be relatively high based on the overlap of use layers with the species range (43%), as described above.

We anticipate usage within the non-Federal portion of the species' range will be medium (5.53%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. Additionally, the vermilion darter generally occupies the Turkey Creek watershed, which is located in the upper reaches of the mapped current range. Mosquito adulticide usage data that we acquired shows that this usage occurs in Blount County, Alabama, which occurs in the lowest reaches of the species current range map. Therefore, mosquito adulticide usage within the occupied range of the species is likely much lower than 5.59% identified in the usage section above. Where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, reduced application number and rates for certain use sites, and the species-specific mosquito adulticide measure, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to the species and their prey resources. Combined, these conservation measures substantially reduce exposure to the vermilion darter and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate very small numbers of individuals would be adversely affected by mortality, sublethal, or prey base effects over the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the vermilion darter in the wild.
Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes (Poeciliidae)

Scientific Name:	Common Name:	Entity ID:
Gambusia gaigei	Big Bend gambusia	213

Family: Poeciliidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Big Bend gambusia is a short-lived species found in a single spring system comprised of 2 isolated pond habitats in Big Bend National Park. "Several thousand" individuals have been reported, but no recent population trends are available. A third captive stock is maintained elsewhere. The small area of suitable habitat in the spring ponds severely limits the number of possible individuals.

The Big Bend gambusia has an extremely limited range, which has been reduced since the species' discovery in the 1920s. It has never been known from more than the two isolated locations in the area of Boquillas Crossing and near Rio Grande Village (Hubbs et al. 2008, p. 38). This narrow range, in combination with a short life span of one year, significantly increases the probability of extinction from either known or unknown threats (Johnson and Hubbs 1989, p. 316) or stochastic events (Melbourne and Hastings 2008, p. 100). One future event that negatively impacts this population could easily result in the complete loss of the species in the wild. Therefore, any impacts on the fish from ongoing or future threats would likely be of high magnitude. The fish does not migrate and is not found in downstream riverine habitats in the Rio Grande due to habitat differences (such as highly variable water temperature) that favor the western mosquitofish (Hubbs and Broderick 1963, p. 47). Numerous efforts have been made to introduce the fish into other spring habitats within the Park, but none have been successful (Hubbs and Broderick 1963, pp. 47-48). Other spring habitats along the Rio Grande (in Texas and Mexico) have been searched for natural populations, but none have been found *(Hubbs and Broderick 1963, p. 47).*

The information reviewed does not indicate that impacts to spring flows from a significant increase in groundwater use or declines in recharge are imminent (defined here as likely to occur in the next 15 years) at this time. However, diminished spring flows could occur over the foreseeable future of 50 to 100 years as a result of climate change or to meet increased human needs for more water resources. The magnitude of impact on the Big Bend gambusia if this threat were realized is extremely high. Because the range of the species is limited to a small, isolated location, habitat modification due to a decline in spring flows could result in its extinction in the wild. The threat from competition with western mosquitofish is high and ongoing, and the magnitude of the impact of this threat on the species is also high. Additional threats include habitat modification from water quality degradation, local habitat changes, and the introduction of a disease, parasite, or non-native species. All of thee above threats must be considered in the context of a fish with an extremely small range, no opportunity for movement, a relatively small population size, and a short life span. Therefore, the magnitude of impact of any potential threat or future stochastic event is exceptionally high. Any events negatively affecting the species or its habitat could result in extinction of the Big Bend gambusia in the wild.

Based on the 2012 5-year review, the Big Bend National Park's General Management Plan, the Park manages the Big Bend gambusia occupied habitat and surrounding area for the long-term conservation benefit of the species. The Park also has oversight and control regarding actions that occur in and near the species habitat.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Big Bend Gambusia (*Gambusia gaigei*) 5-Year Review: Summary and Evaluation. Austin, Texas. pp. 31.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Big Bend gambusia will experience direct mortality or sublethal effects for most uses of malathion in all bins (2, 5, and 6). The risk of mortality is expected to be low or high for bin 2, medium or high for bin 5, and low to high for bin 6, depending on the use. We expect individuals will be at greater risk of lethal effects than sublethal effects. We anticipate risk to exposed aquatic invertebrate prey will be high for all uses and bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	Total overlap <0.01%: Estimated mortality among exposed individuals: 2(L&H), 5(M &H), 6(L&M&H)

Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap <0.01%: Estimated sublethal effects among exposed individuals: G:2(L&M),5(L&M),6(L&M); R:2(L&M),5(L&M),6(L); B:2(L&M&H),5(L&M&H),6(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap <0.01%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 5(H), 6(H)
MOSQUITO CONTROL	
Direct (mortality)	NA
Sublethal	
Indirect	

Risk modifiers: The Big Bend gambusia is restricted to two constructed spring ponds (Spring 1 and Spring 4 refuge ponds) in the Rio Grande Village area of Big Bend National Park. This species is live bearing. Females produce probably 5 - 8 broods per year. Females likely only live for one year. Fecundity of the fish varies seasonally with reproduction occurring from 5 to 8 months a year. Broods were found to contain from 16 and up to 50 young in peak late spring periods, and interbrood intervals ranged from 24 to 29 days.

Indirect effects to aquatic invertebrate prey
Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations: Although some uses could result in malathion concentrations that are highly toxic to exposed individuals, the major consideration is the low occurrence of use sites in the species range (total overlap <0.01%).

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control		0	0.00	0	0		
Other Crops	D,I	46	0.00	0	0.00	2,5,6	2H 5H 6M
Other Row Crops	D,I	7	0.00	7	0.00	2,5,6	2H 5H 6M
Other Grains	D,I	2	0.00	2	0.00	2,5,6	2H 5H 6M
Corn	D,I	12	0.00	0	0.00	2,5,6	2H 5H 6M
Cotton	D,I	77	0.00	1	0.00	2,5,6	2H 5H 6M
Developed	D,I	2,459	0.05	123	0.00	2,5,6	2L 5M 6L
Rice		0	0.00	0	0.00		
Wheat	D,I	25	0.00	1	0.00	2,5,6	2H 5H 6M
Vegetables & Ground Fruit	D,I	2	0.00	0	0.00	2,5,6	2H 5H 6H
Orchards & Vineyards	D,I	9	0.00	9	0.00	2,5,6	2H 5H 6H
Nurseries	D,I	15	0.00	15		2,5,6	2H 5H 6H
Pasture	D,I	62	0.00	52	0.00	2,5,6	2H 5H 6M
Sub-TOTAL (D):		2,714	0.06	210	0.00		

[1] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Other uses with direct effects[3]							
Sub-TOTAL (I): *Other uses with indirect effects*[3]		2,714	0.06	210	0.00		
TOTAL[4]:		2,714	0.06	210	0.00		

 # acres in species range: 4,565,418 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 812,546 acres, 17.798%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

jeopardize the continued existence of the Big Bend gambusia. As dicussed below, while the species vulnerability and risk are considered high, the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Big Bend gambusia has a high vulnerability based on its status, distribution, and trends. While the overall range of the species is large (>4 million acres), individuals of the species are restricted to two constructed spring ponds (Spring 1 and Spring 4 refuge ponds) in the Rio Grande Village area of Big Bend National Park. Because of their limited distribution and short life span, this species is sensitive to stochastic events. While most of the stressors for this species are related to water quantity and impacts from nonnative species, although water quality and habitat degradation have also been identified as a concern. We anticipate that individuals are exposed to malathion, they would experience variable levels of mortality or sublethal effects depending on use type and size of their aquatic habitats. We also anticipate that any exposed invertebrate prey items would experience mortality.

However, the vulnerability of the species and risk to individuals if exposed are mitigated by the very low degree of overlap of labeled uses within the range of the species, and the location of the species on Federal lands (i.e., in Big Bend National Park), where we expect usage to be much low over the duration of the proposed action. Similarly, we anticipate usage within the non-Federal portion of the species' range will be very low (<0.01%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. While the magnitude of impact of any potential threat or future stochastic event is exceptionally high for this species, we also anticipate the likelihood of exposure is extremely low. We anticipate it would be very unlikely for individuals to be exposed or their food resources to be impacted either via runoff to the spring ponds they inhabit or from upstream sources based on the low levels of anticipated usage within their range. In addition to the extremely low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions and aquatic habitat buffers, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Additionally, aquatic application buffers increase the distance of application to aquatic environments, thereby minimizing potential runoff. Combined, these conservation measures substantially reduce exposure to the Big Bend gambusia and its prey resources and therefore minimizes overall risk and adverse effects to the species. With such minimal estimated usage and the adoption of conservation measures, we do not anticipate effects to individuals or prey resources over the duration of the Action, and thus, do not anticipate species-level effects to occur.

Therefore, we anticipate that the Action would not appreciably reduce survival and recovery of the Big Bend gambusia.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Fishes

Scientific Name:	**Common Name:**	**Entity ID:**
Gambusia heterochir	Clear Creek gambusia	214

Family: Poeciliidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The species has an extremely restricted range in west-central Texas. The Clear Creek gambusia exists only in the spring fed headwaters of Clear Creek, a perennial tributary of the San Saba River in the Colorado River Basin of Menard County, Texas. The fish is not found in downstream habitats due to increased temperature and pH fluctuations which favor the western mosquitofish (Hubbs 1959, p. 242; 2001, p. 321). Hubbs (1957, p. 8) speculated that Clear Creek gambusia may have once been more widely distributed in central Texas, but was outcompeted by western mosquitofish in other locations. At times, some individuals of Clear Creek gambusia have been found downstream of the headspring pool where other small springs enter the creek system (Edwards and Hubbs 1985, p. 14; Hubbs 2001, p. 317). These small spring areas are very restrictive in size and contain mostly western mosquitofish with no physical separation of the two species.

The best available information indicates that the primary threats to the Clear Creek gambusia are: 1) habitat loss from the potential loss of spring flow due to a decline in groundwater levels, and 2) hybridization or competition with western mosquitofish initially due to the local habitat modifications, but now caused by the failure of the upper dam to maintain a barrier between spring outflow and downstream habitats. The information reviewed does not indicate that impacts to spring flows from significant increase in groundwater use or declines in recharge is imminent (defined here as likely to occur in the next 10 years). However, it is likely to occur over the foreseeable future of 50 to 100 years as a result of climate change and the increasing human need for more water resources. The magnitude of impact on the Clear Creek gambusia if this threat were realized is extremely high. Because the range of the species is limited to one small, isolated location, habitat modification due to a decline in spring flows could result in its extinction. The threats associated with hybridization and competition may be occurring now due to the recent erosion of the upper dam, allowing renewed access to the upper spring pool by western mosquitofish. If the impacts of these threats are the same as observed between 1953 and

1978, then the population of Clear Creek gambusia will be depressed, but not eradicated until the upper dam can be repaired. Therefore, the magnitude of the impact of this threat on the species is considered moderate to high. Secondary threats include habitat modification from water quality degradation, local habitat changes, lack of regulatory mechanisms, and introduction of a disease, parasite, or non-native species (resulting in competition or predation). None of these concerns acting alone result in substantial threats to the species, but together any of these could negatively impact the Clear Creek gambusia. Climate change is another source of potential threats to the species. All possible impacts associated with future climate change cannot presently be reliably predicted. However, accelerating climate change will exacerbate any of the threats already considered or could result in whole new threats that are not conceived at this time. Subtle but significant changes in the ecosystem of the Clear Creek gambusia resulting from climate change in the foreseeable future of 50 to 100 years could cause the species extinction and is a threat of high magnitude. All of these threats, both primary and secondary, must be considered in the context of a fish with an extremely small range with no opportunity for movement, a relatively small population size, and a very short life span. Because of these factors, the magnitude of impact of any potential threat or future stochastic event is exceptionally high. Any events negatively affecting the species or its habitat could result in complete extinction of the Clear Creek gambusia.

EB/CE Source:
U.S. Fish and Wildlife Service. 2010. Clear Creek Gambusia (*Gambusia heterochir*) 5-Year Review Summary and Evaluation. Austin, Texas. pp. 40.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate the Clear Creek gambusia will experience direct mortality or sublethal effects for most uses of malathion for all bins (2 and 6). The risk of mortality is expected to be high for bin 2 and low to high for bin 6 depending on the use. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for nearly all uses and bins.

For mosquito control: We anticipate that individuals exposed to malathion in bin 2 would be at high risk of mortality, whereas individuals in bin 6 would be at low risk. We expect individuals to be at greater risk of lethal effects than sublethal effects. We anticipate risk to aquatic invertebrate prey to be high for individuals in both bins.

Risk to the species from labeled uses across the range:
The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	

Use areas – mortality	Total overlap 2.43%: Estimated mortality among exposed individuals: 2(L&H), 6(L&M&H)
Sublethal – growth (G), reproduction (R) and behavior (B)	Total overlap 2.43%: Estimated sublethal effects among exposed individuals: G:2(L&M),6(L&M); R:2(L&M),6(L); B:2(L&M&H),6(L&M)
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Total overlap 2.43%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 6(L&H)
MOSQUITO CONTROL	
Direct (mortality)	Mosquito control overlap 2.88%; Estimated mortality among exposed individuals: 2(H), 6(L)
Sublethal	Mosquito control overlap 2.88%: Estimated sublethal effects among exposed individuals: G:2(M), 6(L); R:2(L), 6(L); B:2(M), 6(L)
Indirect	Mosquito control overlap 2.88%: Estimated mortality among exposed aquatic invertebrate prey: 2(H), 6(H)

Risk modifiers: Clear Creek gambusia are invertivores, feeding on small invertebrates, primarily the Clear Creek amphipod (*Hyalella texana*). Female may store sperm for several months, capable of producing about 50 young every 7 weeks; live bearing. The reproductive season for Clear Creek gambusia is February to October with highest fecundity occurring in June to August. Fecundity varies from 1 to 28 with an average of 9 embryos per brood (young fish birthed at the same time). Gambusia rarely live more than one year and may reach maturity as early as three months of age. Females commonly outnumber males by nearly two to one.

Indirect effects to aquatic invertebrate prey

Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

Allowable uses driving effects/other considerations: There are several uses that could cause individuals to be exposed to malathion; however, the overall footprint for all uses (excluding mosquito control) is relatively small (2.43% overlap). Nevertheless, exposures from most uses could be highly toxic, particularly to individuals in bin 2 waters. Uses with the highest overlap are Wheat (1.64%), Other Grains (0.28%), and Developed (0.15%).

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE
(Anticipated usage within the range based on past usage data)

Use type	Risk to species[139]	Use overlap with range		Estimated usage in range[140]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Mosquito Control	D,I	31,004	2.88	0	0	2,6	2H 6L
Other Crops	D,I	2,328	0.22	0	0.00	2,6	2H 6M
Other Row Crops	D,I	1	0.00	1	0.00	2,6	2H 6M
Other Grains	D,I	2,974	0.28	3,106	0.29	2,6	2H 6M
Corn	D,I	85	0.01	76	0.01	2,6	2H 6M
Cotton	D,I	1,039	0.10	863	0.08	2,6	2H 6H
Developed	D,I	1,632	0.15	82	0.01	2,6	2L 6L
Wheat	D,I	17,709	1.64	17,627	1.64	2,6	2H 6M
Vegetables & Ground Fruit	D,I	3	0.00	2	0.00	2,6	2H 6H
Orchards & Vineyards	D,I	378	0.04	420	0.04	2,6	2H 6H

[139] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[140] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species [139]	Use overlap with range		Estimated usage in range[140]		Bins associated with use type	Mortality Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Pasture	D,I	4	0.00	4	0.00	2,6	2H 6M
Sub-TOTAL (D): *Other uses with direct effects*[141]		26,153	2.43	22182	2.06		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		26,153	2.43	22182	2.06		
TOTAL[142]:		57,156	5.31	22182	2.06		

 # acres in species range: 1,077,175 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1 acres, 0.000%

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is

[141] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.
[142] TOTAL includes usage on all use sites with effects, including mosquito control.

limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Clear Creek gambusia. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low.While we anticipate that small numbers of individuals will be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Clear Creek gambusia has a high vulnerability based on its status, distribution, and trends. The species exists in a single population in a vulnerable spring-fed habitat, and water quality degradation is considered a threat to the species. The risk to the individuals exposed to malathion is high and would be expected to result in mortality or sublethal impacts. Invertebrate prey resources would experience high mortality from exposure.

However, both the vulnerability and risk to individuals if exposed would be mitigated by the low degree of overlap of labeled uses with the range of the species. Similarly, we anticipate usage within the range will be low, based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. The 5-Year Review for the species states that the magnitude of impact of any potential threat or future stochastic event is exceptionally high, and that any events negatively affecting the species or its habitat could result in extinction of the species. However, it also notes that a single threat acting alone (such as water quality degradation, which may occur temporarily as a result of downstream runoff from application of malathion), would not be expected to result in a substantial threat to the species. In addition to the low malathion usage within the species range, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes, will further reduce the risk of exposure to the species and its prey resources.

As stated previously, conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to listed species or their prey resources. Changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Combined, these conservation measures substantially reduce exposure to the Clear Creek gambusia and its prey resources and therefore minimizes overall risk and adverse effects to the species. Thus, while we anticipate low levels of adverse effects to individuals and their preyover the duration of the Action, we do not anticipate species-level effects to occur.

Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Clear Creek gambusia in the wild.

Conclusion: Not likely to jeopardize

SUBSET 2: Summarized Analysis

The following species sections include a summarized analysis of risk related to overlap and usage (without including information in the tables for these species sections, as we did for Subset 1). All species in this subset are anticipated to have low usage (<5%). While we performed the same R-Plot analysis and evaluated the results, we are presenting the conclusions for the Subset 2 taxa in a streamlined, abbreviated manner for the Biological Opinion.

We considered the vulnerability of each species together with their status, environmental baseline, and cumulative effects. We also briefly considered the overlap with the species range, and whether and to what the degree the species overlapped with Federal lands (where we anticipate only low levels of usage, as described in the Usage section of the Biological Opinion). Our assumptions related to anticipated risk to individuals from lethal, sublethal, and prey base effects were not described individually for each of the species in Subset 2, but are presented below by aquatic habitat bin category, based on our analysis of the species R-Plots, and general trends we observed during the analyses (see *Risk Assumptions* below). We then determinated whether the proposed action is likely to jeopardize the continued existence of the listed entity in question[1].

Risk Assumptions:
The following taxa have varying levels of vulnerability and risk, but usage and anticipated exposure is low. For this subset, we considered the relevant aquatic habitat bins for the species, then reviewed the use and usage data to confirm our assumptions about effects anticipated with combinations of bins. We found several general patterns that were applicable to the analysis and served as assumptions to inform our conclusions that were consistent with the overall approach considered in the Biological Opinion. These are related to Bin combinations, where the species may be found in:

- <u>Small waterbodies (e.g., bins 2 and 5):</u>
    - Mortality: We anticipate a high level of mortality for some (or all) uses for a given species. However, where the only use is Developed, low mortality is anticipated, based on the R-Plot analysis.
    - Sublethal: We anticipate high levels of effects on behavior for some uses and low to medium effects on growth, reproduction, and/or behavior for other uses. However, where the only use is Developed, we anticipate low levels of sublethal effects based on the R-Plot analysis.
    - Indirect Effects: We anticipate high levels of mortality to invertebrate and piscine (fish) prey for most or all uses.

[1] For ease of organization, after listing risk assumptions, the species within this subset, and applicable general conservation measures below, we provide our determination prior to describing the species-specific information (i.e., status, vulnerability, environmental baseline, cumulative effects, and overlap information).

- Larger flowing waterbodies (bins 3 and 4):
    - Mortality: We anticipate a high level of mortality for some (or all) uses; however, due to modeling issues (as described in the Biological Opinion), we consider the bin 2 estimates as an upper bound of bin 3 and 4 exposures.
    - Sublethal: We anticipate high levels of effect on behavior for some uses; otherwise, the risk of sublethal effects are expected to be medium to low.
    - Indirect Effects: We anticipate high levels of mortality effects to invertebrate and piscine (fish) prey for most or all uses.
- Medium static waterbodies (bin 6), with flowing waterbodies
    - Mortality: We anticipate high level of mortality for some (or all) uses for a given species. However, where the only use is Developed, we anticipate low mortality based on the R-Plot analysis.
    - Sublethal: We anticipate high levels of effects on behavior for some uses and low to medium effects on growth, reproduction, and/or behavior for other uses. However, where the only use is Developed, we anticipate only low levels of effects based on the R-Plot analysis.
    - Indirect Effects: We generally see high levels of mortality effects to invertebrate and piscine (fish) prey or most or all uses.
- Medium static waterbodies (bin 6) without flowing waterbodies
    - Mortality: We anticipate high level of mortality for some (or all) uses.
    - Sublethal: We anticipate medium levels of effect on growth and behavior
    - Indirect Effects: We anticipate high levels of mortality effects to invertebrate and piscine (fish) prey for most or all uses.
- Medium (bin 6) and Large static waterbodies (bin 7):
    - Mortality: For bin 6, we anticipate high mortality; for bin 7 we anticipate medium mortality
    - Sublethal: We anticipate medium effects on growth and behavior
    - Indirect Effects: We anticipate high mortality to invertebrate and piscine (fish) prey for most or all uses.
- Large static waterbodies (bin 7) and any combination of other waterbodies:
    - Mortality: We expect low to high mortality depending on the use types
    - Sublethal: We anticipate high levels of effect on behavior for some uses; other sublethal effects are medium to low
    - Indirect Effects: We anticipate high mortality to invertebrates for most or all uses, and variable levels of effects to piscine (fish) prey.

This category includes the remaining fish species, shown below. We do not provide detailed use and usage information for these species in the following sections, although R-Plots for the species are provided in Appendix M, and individual conclusions are found in the table below and in the biological opinion. These species have variable levels of vulnerability and risk if individuals are exposed, but we anticipate all would have low exposure based on the low usage data.

Table 1 (Subset 2). Species by taxonomic group and their assigned aquatic habitat bins. For risk to individuals and species for each aquatic habitat bin type, see *Risk Assumption* (above). (NJ = Is not likely to jeopardize)

Order	Family	Scientific Name	Common Name	Entity ID	Aquatic Bins						Conclusion
					2	3	4	5	6	7	
Atheriniformes	Atherinidae	*Menidia extensa*	Waccamaw silverside	243		*				*	NJ
Cypriniformes	Cyprinidae	*Cyprinella caerulea*	Blue shiner	300	*	*					NJ
Cypriniformes	Cyprinidae	*Cyprinella formosa*	Beautiful shiner	276	*	*		*	*		NJ
Cypriniformes	Cyprinidae	*Dionda diaboli*	Devils River minnow	272	*	*	*				NJ
Cypriniformes	Cyprinidae	*Eremichthys acros*	Desert dace	266	*			*	*		NJ
Cypriniformes	Cyprinidae	*Erimonax monachus*	Spotfin Chub	237		*	*				NJ
Cypriniformes	Cyprinidae	*Erimystax cahni*	Slender chub	246		*	*				NJ
Cypriniformes	Cyprinidae	*Gila bicolor ssp.*	Hutton tui chub	261				*	*		NJ
Cypriniformes	Cyprinidae	*Gila bicolor ssp. mohavensis*	Mohave tui chub	225				*	*		NJ
Cypriniformes	Cyprinidae	*Gila bicolor ssp. snyderi*	Owens Tui Chub	262	*			*	*	*	NJ
Cypriniformes	Cyprinidae	*Gila cypha*	Humpback chub	209	*	*	*				NJ
Cypriniformes	Cyprinidae	*Gila ditaenia*	Sonora chub	255	*			*			NJ
Cypriniformes	Cyprinidae	*Gila elegans*	Bonytail chub	249		*	*			*	NJ
Cypriniformes	Cyprinidae	*Gila intermedia*	Gila chub	6297	*	*		*	*		NJ
Cypriniformes	Cyprinidae	*Gila nigrescens*	Chihuahua chub	254	*	*					NJ
Cypriniformes	Cyprinidae	*Gila purpurea*	Yaqui chub	263	*	*		*	*		NJ
Cypriniformes	Cyprinidae	*Gila robusta*	Roundtail chub	3497	*	*					NJ

Order	Family	Scientific Name	Common Name	Entity ID	Aquatic Bins						Conclusion
					2	3	4	5	6	7	
Cypriniformes	Cyprinidae	*Gila robusta jordani*	Pahranagat roundtail chub	226	*	*		*			NJ
Cypriniformes	Cyprinidae	*Gila seminuda (=robusta)*	Virgin River Chub	256	*	*	*				NJ
Cypriniformes	Cyprinidae	*Hybognathus amarus*	Rio Grande Silvery Minnow	309		*	*				NJ
Cypriniformes	Cyprinidae	*Lepidomeda albivallis*	White River spinedace	282	*	*		*	*		NJ
Cypriniformes	Cyprinidae	*Lepidomeda mollispinis pratensis*	Big Spring spinedace	280	*			*	*		NJ
Cypriniformes	Cyprinidae	*Lepidomeda vittata*	Little Colorado spinedace	281	*	*		*			NJ
Cypriniformes	Cyprinidae	*Meda fulgida*	Spikedace	296	*	*		*			NJ
Cypriniformes	Cyprinidae	*Moapa coriacea*	Moapa dace	211	*	*			*		NJ
Cypriniformes	Cyprinidae	*Notropis albizonatus*	Palezone shiner	278	*	*					NJ
Cypriniformes	Cyprinidae	*Notropis cahabae*	Cahaba shiner	277	*	*					NJ
Cypriniformes	Cyprinidae	*Notropis girardi*	Arkansas River shiner	299	*	*	*				NJ
Cypriniformes	Cyprinidae	*Notropis mekistocholas*	Cape Fear shiner	242	*	*	*		*		NJ
Cypriniformes	Cyprinidae	*Notropis simus pecosensis*	Pecos bluntnose shiner	279		*				*	NJ
Cypriniformes	Cyprinidae	*Notropis topeka (=tristis)*	Topeka shiner	311	*	*		*			NJ

Order	Family	Scientific Name	Common Name	Entity ID	Aquatic Bins						Conclusion
					2	3	4	5	6	7	
Cypriniformes	Cyprinidae	*Phoxinus cumberlandensis*	Blackside dace	295	*						NJ
Cypriniformes	Cyprinidae	*Plagopterus argentissimus*	Woundfin	234	*	*	*	*			NJ
Cypriniformes	Cyprinidae	*Ptychocheilus lucius*	Colorado pikeminnow (=squawfish)	215	*	*	*	*			NJ
Cypriniformes	Cyprinidae	*Rhinichthys osculus lethoporus*	Independence Valley speckled dace	268	*			*			NJ
Cypriniformes	Cyprinidae	*Rhinichthys osculus nevadensis*	Ash Meadows speckled dace	264	*	*		*			NJ
Cypriniformes	Cyprinidae	*Rhinichthys osculus oligoporus*	Clover Valley speckled dace	265	*			*	*		NJ
Cypriniformes	Cyprinidae	*Rhinichthys osculus thermalis*	Kendall Warm Springs dace	227	*			*			NJ
Cypriniformes	Cyprinidae	*Tiaroga cobitis*	Loach minnow	273	*	*					NJ
Gasterosteiformes	Gasterosteidae	*Gasterosteus aculeatus williamsoni*	Unarmored threespine stickleback	232	*			*	*		NJ
Osmeriformes	Osmeridae	*Hypomesus transpacificus*	Delta smelt	305			*		*	*	NJ
Osmeriformes	Osmeridae	*Spirinchus thaleichthys*	Longfin smelt	11262		*	*		*	*	NJ

Order	Family	Scientific Name	Common Name	Entity ID	Aquatic Bins						Conclusion
					2	3	4	5	6	7	
Perciformes	Gobiidae	*Eucyclogobius newberryi*	Tidewater goby	306	*	*	*	*	*	*	NJ
Perciformes	Percidae	*Crystallaria cincotta*	Diamond darter	6557	*	*	*				NJ
Perciformes	Percidae	*Etheostoma boschungi*	Slackwater darter	239	*	*					NJ
Perciformes	Percidae	*Etheostoma chienense*	Relict darter	313	*	*					NJ
Perciformes	Percidae	*Etheostoma etowahae*	Etowah darter	315	*	*					NJ
Perciformes	Percidae	*Etheostoma moorei*	Yellowcheek darter	6662	*	*					NJ
Perciformes	Percidae	*Etheostoma nianguae*	Niangua darter	257	*	*					NJ
Perciformes	Percidae	*Etheostoma nuchale*	Watercress darter	229	*						NJ
Perciformes	Percidae	*Etheostoma osburni*	Candy darter	8352	*	*	*				NJ
Perciformes	Percidae	*Etheostoma percnurum*	Duskytail darter	308		*	*				NJ
Perciformes	Percidae	*Etheostoma phytophilum*	Rush Darter	3525	*	*		*			NJ
Perciformes	Percidae	*Etheostoma rubrum*	Bayou darter	244	*	*					NJ
Perciformes	Percidae	*Etheostoma scotti*	Cherokee darter	269	*	*					NJ
Perciformes	Percidae	*Etheostoma sp.*	Bluemask (=jewel) Darter	307	*	*					NJ

Order	Family	Scientific Name	Common Name	Entity ID	Aquatic Bins						Conclusion
					2	3	4	5	6	7	
Perciformes	Percidae	*Etheostoma spilotum*	Kentucky arrow darter	10060	*	*					NJ
Perciformes	Percidae	*Etheostoma susanae*	Cumberland darter	5719	*						NJ
Perciformes	Percidae	*Etheostoma trisella*	Trispot darter	3069	*	*					NJ
Perciformes	Percidae	*Percina antesella*	Amber darter	293		*	*				NJ
Perciformes	Percidae	*Percina aurolineata*	Goldline darter	298	*	*					NJ
Perciformes	Percidae	*Percina aurora*	Pearl darter	4431		*	*				NJ
Perciformes	Percidae	*Percina jenkinsi*	Conasauga logperch	294		*					NJ
Perciformes	Percidae	*Percina pantherina*	Leopard darter	238		*	*				NJ
Perciformes	Percidae	*Percina rex*	Roanoke logperch	240		*	*				NJ
Perciformes	Percidae	*Percina tanasi*	Snail darter	235		*	*			*	NJ
Percopsiformes	Amblyopsidae	*Amblyopsis rosae*	Ozark cavefish	260	*			*	*		NJ
Salmoniformes	Salmonidae	*Oncorhynchus aguabonita whitei*	Little Kern golden trout	248	*	*					NJ
Salmoniformes	Salmonidae	*Oncorhynchus apache*	Apache trout	220	*						NJ
Salmoniformes	Salmonidae	*Oncorhynchus clarkii stomias*	Greenback Cutthroat trout	222	*	*	*		*	*	NJ

Order	Family	Scientific Name	Common Name	Entity ID	Aquatic Bins						Conclusion
					2	3	4	5	6	7	
Salmoniformes	Salmonidae	*Oncorhynchus clarkii henshawi*	Lahontan cutthroat trout	233	*	*			*	*	NJ
Salmoniformes	Salmonidae	*Oncorhynchus clarkii seleniris*	Paiute cutthroat trout	223	*	*		*	*	*	NJ
Salmoniformes	Salmonidae	*Oncorhynchus gilae*	Gila trout	221	*	*		*	*	*	NJ
Salmoniformes	Salmonidae	*Salmo salar*	Atlantic salmon	10077	*	*	*	*	*	*	NJ
Salmoniformes	Salmonidae	*Salvelinus confluentus*	Bull Trout	301	*	*	*		*	*	NJ
Scorpaeniformes	Cottidae	*Cottus paulus (=pygmaeus)*	Pygmy Sculpin	241		*			*		NJ
Scorpaeniformes	Cottidae	*Cottus specus*	Grotto Sculpin	4248	*	*					NJ
Siluriformes	Ictaluridae	*Ictalurus pricei*	Yaqui catfish	259	*	*					NJ
Siluriformes	Ictaluridae	*Noturus baileyi*	Smoky madtom	258/ 5981	*	*					NJ
Siluriformes	Ictaluridae	*Noturus crypticus*	Chucky Madtom	7150	*	*					NJ
Siluriformes	Ictaluridae	*Noturus flavipinnis*	Yellowfin madtom	247	*	*					NJ
Siluriformes	Ictaluridae	*Noturus furiosus*	Carolina madtom	5288	*	*	*				NJ
Siluriformes	Ictaluridae	*Noturus stanauli*	Pygmy madtom	271		*	*				NJ

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure

Exposure Modifiers:

A reassessment of our crop use data layers shows that within the “Other Row Crops” layer shows that usage in this category may be overestimated. This UDL is composed of sunflower, peanuts, tobacco, sugar beets, and hops, of which, only hops is a registered use site on malathion labels and is thus the only crop in this layer that is relevant in our analysis. USDA data shows that 96% of hops are grown in the Pacific Northwest region (in Idaho, Oregon, and Washington), with some small farms in Florida reporting occasional hop production. Given the highly specific regions that hops are grown in, we can assume that potential exposure to malathion from “other row crops” use sites is 0 outside of these areas.

Indirect effects to aquatic invertebrate prey

Because benthic macroinvertebrates and micro-crustaceans exhibit a range of sensitivities to malathion, abundance of invertebrates is expected to be reduced where exposure occurs, but not completely eliminated. Reductions in aquatic invertebrate prey density and richness is likely of short duration with recovery of invertebrate density anticipated to occur within a few weeks, and invertebrate richness often shortly after. For most fish species that are generalist feeders and rely on a variety of aquatic invertebrate prey, short-term indirect effects to some aquatic invertebrate prey items are anticipated to have a spatially and temporally limited effect on food resources. Thus, we anticipate that risk will be lower than the modeled indirect effects to invertebrate prey suggest.

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers significantly reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to significantly reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects for the species shown above in Table 1, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of these species. As discussed below, while these species have varying levels of vulnerability, and risk to individuals is anticipated to be relatively high where exposure occurs, we anticipate low usage and, thus, low levels of malathion exposure of individuals, their forage base, and habitat. We anticipate small number of individuals of these species will be affected over the duration of the proposed action, but we do not anticipate species-level effects for any of the species in Table 1 above. In addition, we anticipate that the conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced application number and rates on certain use sites will further reduce the risk of exposure.

These conservation measures are intended to reduce the amount of malathion runoff and spray drift that enter into sensitive habitats (e.g., species habitat, aquatic environments). For example, by placing a 48-hour rain restriction on agricultural applications, malathion has the ability to degrade after application (e.g., by hydrolysis, other processes) prior to any rain/runoff events, thus minimizing malathion runoff into aquatic habitats and decreasing exposure to each of the listed fish and their food items. Increasing application buffers reduces the amount of malathion that drifts off target and subsequently into non-target environments. In addition, changes to residential labels limits applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used in residential areas and resulting amounts of runoff and drift. Additional reductions in the number of applications and rates allowed for certain crops (e.g., corn, vegetables and ground fruit) further reduces the amount of malathion used in agricultural settings, thereby decreasing potential exposure to each of the species and their food items. Combined, these conservation measures substantially reduce exposure to the fish species above (Table 1) and their forage base and therefore, minimizes overall risk and adverse effects to these species. Thus, while we anticipate small numbers of individual fish would be affected over the duration of the action, we do not anticipate species-level effects.

To provide additional context for our determination that the use of malathion, as proposed is not likely to jeopardize any of these species, we discuss vulnerability, risk to individuals (if exposed), and usage, using examples of our considerations from the list above. However, in each case, we expect exposure will be limited, based primarily on the very low anticipated usage on both Federal and non-Federal lands.

Vulnerability: For each species, we considered the information available for the species, as summarized in the Status of the Species (Appendix C of this Opinion) and in the accounts for each species below. Most species in Table 1 are considered highly vulnerable, based on the one or more factors related to their status, as described in the Biological Opinion. Assumptions about vulnerability are informed by the species status (e.g., endangered, threatened, recommended for a change in listing status from a recent 5-Year review), number of populations, population size and distribution, and species trends. Some species are limited to single or small numbers of populations (e.g., Big Spring and White River spinedace, blue shiner, Waccmaw silverside, Pecos bluntnose shiner, woundfin, Clover Valley speckled dace, unarmored threespine stickleback). Some of these species may be narrow endemics or have isolated or constrained populations that are vulnerable to stochastic events or localized extirpations where a large proportion of a population(s) is impacted. Other species may have numerous populations or subpopulations, or have relatively widespread ranges (e.g., tidewater goby, Cherokee darter, Kentucky arrow darter, leopard darter, Apache trout, Topeka shiner), which reduce the likelihood of population-level effects from stochastic events or localized extirpations. The vulnerability rankings assigned to each of the following species below were estimated based on these factors.

Risk to individuals. As with analyses presented above, and according to the *Risk Assumptions described above,* we anticipate high levels of lethal and sublethal effects to individuals where exposure occurs, for most use categories (with the exception of Developed uses, as previously described), and to a lesser degree, by water body size. We assume that where waterbodies tend to be smaller streams or static waters (e.g., bin 2, bin 5), these impacts are likely to be higher, compared to larger water bodies (e.g., where concentrations may be lower due to dilution or other factors as described in the *Effects of the Action* section of the Biological Opinion). Where individuals of these species are exposed to malathion applications, we anticipate high levels of mortality, with survivors experiencing sublethal effects, and with each of these effects varying in part by use category. We expect the highest levels of sublethal effects to exposed individuals would result in behavioral effects, although growth and sublethal effects would also be anticipated, though generally to a lesser degree.

We anticipate high levels of mortality of invertebrate prey, and in some cases, piscine prey, where malathion enters the waterbody from runoff (or in the case of cave species, infiltration through the overlying porous substrate or other groundwater inputs) exposed. We anticipate small numbers of individuals of the three species may occur in the areas exposed to malathion via runoff from application areas and would be exposed over the duration of the proposed action. We anticipate mortality would occur where individuals were exposed, with survivors experiencing sublethal effects. Where localized effects (e.g., reductions in prey) occur as a result of applications of malathion, we anticipate additional food resources from upstream sources would quickly recolonize, or individuals would seek out other areas of available prey.

Usage Data and Likelihood of Exposure. We anticipate usage within the non-Federal portion of the species' range will be low (<5%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species ranges, but we assume only low levels of usage for this species, per the rationale related to usage on Federal lands as described in the Biological Opinion. Thus, while the risk to individuals may be high if exposure occurs, we anticipate that such exposure would be rare and infrequent based on the usage data for each species, and only very small numbers of individuals of these species would be exposed over the duration of the proposed action.

For many of the species, pesticides were mentioned in species' listing or recovery documents as either a potential concern or previously identified threat or stressor. In some cases, specific pesticides (e.g., atrazine, diazinon, or legacy pesticides such as dichloro-diphenyl-trichloroethane [DDT]) or types of pesticides (e.g., herbicides) were mentioned, but the description did not further identify or exclude malathion from the analysis. This information is shown, where available in the vulnerability accounts for each species in the sections that follow. We considered whether the use of the generic term "pesticide" without further definition or classification in a given fish species' listing or recovery documents should be indicative of malathion usage in particular, for the purposes of our determinations for the species in Table 1 above. We recognize there are a large number of pesticides that have been used and are currently used in agricultural and non-agricultural use sites.

Our assumptions about the best available scientific and commercial usage data in particular, as described in the Usage Section of the Biological Opinion suggest that, for malathion, the low usage values for the species under consideration are the best representation of anticipated usage and resulting exposure and effects to individual and species. Therefore, without malathion-specific information in the information provided below (primarily from species listing and recovery documents), we did not assume that generic use of the word "pesticides" should have a greater weight on our determinations than the general or California PUR usage data described in the Usage Section of the Biological Opinion.

In summary, we anticipate that, over the duration of the proposed action, very small numbers of individuals of the species in Table 1 above will experience adverse effects either from exposure to malathion, or through small reductions in their prey base. However, we do not anticipate that these adverse effects would have population- or species-level effects for any of the fish species in Table 1. Thus, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the following species in the wild.

Integration and Synthesis Summary: Fishes (Atheriniformes)

Scientific Name:	Common Name:	Entity ID:
Menidia extensa	Waccamaw silverside	243

Family: Atherinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The range of the Waccamaw silverside has not changed since listing. The species is known only from Lake Waccamaw, the lower stretch of Big Creek and a short stretch of the Waccamaw River just downstream from the Lake Waccamaw Dam in Columbus County, NC. While population size is difficult to determine, this species continues to be commonly found in schools near the surface throughout Lake Waccamaw (Rohde et al. 1994; Heise and Jones 2010). Currently, the species does appear to have a self-sustaining population. Shute et al (2000) believes that the population is similar to that observed in 1979-1981 (Shute et al. 1981). The NC Natural Heritage Program ranks the Waccamaw silverside population in Lake Waccamaw as "Excellent", indicating that it is likely to persist into the foreseeable future (i.e., at least 20 to 30 years), given current conditions; the population in the Waccamaw River just downstream of the dam is ranked as "Extant", indicating that, while present, there is insufficient information to determine viability (Sarah McRae, NC Natural Heritage Program, 2009, pers. comm.). The Waccamaw silverside remains vulnerable to threats to water quality and habitat degradation from anthropogenic land-use activities, drought, physical constraints of its habitat, and natural and introduced predators. Lake Waccamaw is classified by the NC Division of Water Quality as an Outstanding Resource Water (ORW). This classification is meant to preserve water quality and to protect against degradation. However, the shoreline of Lake Waccamaw is becoming densely developed (Chris Helms, Lake Waccamaw State Park, 2010, pers. comm.; Fritz Rohde, National Marine Fisheries Service, 2010, pers. comm.) and there are several water quality and water quantity issues surrounding Lake Waccamaw. Fertilizers and herbicides from encroaching lawns and gardens, sedimentation from nearby logging activities, pollution from recreational boaters, and antiquated sewer and septic systems seeping waste into the lake appear to be the biggest water quality threats. In addition, several drainage ditches contribute sediment and chemical pollution (i.e., herbicides) directly to the lake during storm events. In terms of water quantity, nearby ditches have been diverting water away from the lake to irrigate loblolly pine plantations (Chris Helms, Lake Waccamaw State Park, 2010 pers. comm.).

EB/CE Source:

U.S. Fish and Wildlife Service. 1993. Waccamaw Silverside Recovery Plan. Atlanta, GA. 24 pp.

U.S. Fish and Wildlife Service. 2011. Waccamaw Silverside (*Menidia extensa*) 5-Year Review: Summary and Evaluation. Raleigh Ecological Services Field Office, Raleigh, North Carolina. 14 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 310,248 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 0 acres, 0.000%

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in Bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Integration and Synthesis Summary: Fishes (Cypriniformes)

Scientific Name:	Common Name:	Entity ID:
Cyprinella caerulea	Blue shiner	300

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Blue shiners are distributed within four major watersheds of the upper Coosa River system (Choccolocco Creek, West Fork of the Little River, Weogufka Creek, in Alabama; Conasauga River in Georgia, and the lower Jacks River in Tennessee). The blue shiner requires water of relatively high quality and appears sensitive to turbidity and siltation. Major threats are habitat alteration and water quality degradation. The threats to water quality include chemical contaminants such as glyphosate, nitrate/nitrite, soluble reactive phosphorus, and cations such as sodium and calcium (Freeman et al. 2009); dissolved nutrient concentrations (Baker et al. 2013); geomorphology changes and biological indicator changes such as vegetation, invertebrates, and fish cohorts (Ramsey 1976; Stiles 1978; Howell et al.1982; Stiles and Ramsey 1986; Pierson et al. 1989; Stiles 1990; USFWS 1992; Freeman and Weyers 1999; Howard et al. 2002; O'Neil and Chandler 2005; Kuhajda 2007; Powers 2008); and adequate instream flows (Annear et al. 2004). Studies show that increased urbanization leads to declining water quality in streams and fish assemblages (Onorato et al. 2000, Anderson et al. 1995, Weaver and Garman 1994) which curtails the connectivity of fish habitat and results in isolated populations. Throughout the species' range, hardness and alkalinity are also water quality parameters of concern (ADEM 2005). Larval blue shiners are very sensitive to excessive chlorides (Keller, Environmental Protection Agency, email report to Daniel Drennen, 2002), which disturb osmoregulation, specifically in the gills and kidneys, and lead to reduced survival, growth, and reproduction through impaired respiration and renal function.

EB/CE Source:
U.S. Fish and Wildlife Service. 2014. Blue Shiner (*Cyprinella caerulea*) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 29.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Blue shiner does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, they can mitigate their potential risk of exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

USAGE

 # acres in species range: 2,420,747 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 675,322 acres, 27.897%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by

allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Cyprinella formosa	Beautiful shiner	276

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Population size/location unknown
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
In 1994, the occurrence of the Yaqui beautiful shiner in the USA originates from stock collected under permit from the Mexican government in 1989 from Rio Moctezuma, Chihuahua and held at Dexter National Fish Hatchery & Technology Center (NFHTC), Dexter, NM. The stock was released on San Bernardino National Wildlife Refuge in 1990 and now lives as reproducing populations in three ponds. Dexter NFHTC also has in culture a stock of the Guzinan beautiful shiner previously captured from Rio Casas Grandes, Chihuahua (Jensen 1993), in anticipation of future reintroduction. The beautiful shiner is suffering reductions in natural range in Mexico as a result of changes in land and water use and impacts of non-native species (e.g., Miller 1978; Chernoff & Miller 1982; Hendrickson et al. 1981; Hendrickson 1984). Since no 5-Year Review has been done, it is not known if the range has expanded outside of these ponds.

From 2020 5-Year Review: Based on information collected for this 5-Year Review, the beautiful shiner's status is considered uncertain at this time. No systematic sampling for beautiful shiner in the Rio Yaqui has occurred in nearly 40 years, and thus we have no information on their current status in Mexico.

Beautiful shiner have been reestablished at San Bernardino NWR, and their populations have been self-sustaining and secure in multiple San Bernardino NWR/Leslie Canyon NWR habitats since reintroduction in May 1990.

Non-indigenous fish species have been successfully eradicated on San Bernardino NWR, Leslie Canyon NWR, and Slaughter Ranch (private property) since the 1990's. USFWS personnel have surveyed annually and occasionally biannually and no longer observe any non-indigenous fish species at San Bernardino NWR, Leslie Canyon NWR, House Pond on Slaughter Ranch, and Big Tank on El Coronado Ranch. Though American bullfrogs (Lithobates catesbeiana), a non-native amphibian, remain and in adjacent wetlands, we believe this species poses little direct risk to beautiful shiner, though it may compete for limited food resources. Since the initial invasion of bullfrogs, the numbers of beautiful shiner have continued to remain stable and self-sustaining, indicating that bullfrogs do not pose a threat to the persistence of the beautiful shiner. However, non-indigenous species continue to pose a direct risk to beautiful shiner in Mexico.

EB/CE Source:

U.S. Fish and Wildlife Service. 1994. Fishes of the Rio Yaqui Recovery Plan. Region 2, USFWS, Albuquerque, New Mexico. 56 pp.

U.S. Fish and Wildlife Service. 2020. Beautiful shiner (*Cyprinella formosa*) 5-Year Review: Summary and Evaluation. San Bernardino National Wildlife Refuge, Douglas, Arizona. 28 pp.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Beautiful shiner does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their potential risk of malathion exposure is at least partially reduced by using these higher flowing aquatic habitats.

USAGE

 # acres in species range: 5,981,895 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,630,935 acres, 43.982%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Dionda diaboli	Devils River minnow	272

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
This species occurs in three streams in Val Verde and Kinney counties, Texas, all tributaries to the Rio Grande: Devils River, San Felipe Creek and Pinto Creek. The current status of the species in Sycamore Creek, Texas, and in the Río Salado drainage in Mexico is not known. The species is believed to be extirpated from the lower portions of the Devils River (now Amistad Reservoir in Val Verde County), Las Moras Creek (Kinney County), and from the Río San Carlos (Mexico).

Abundance appears to vary widely between years based on survey efforts, with some populations having very low numbers. Little is known about the species' life history in the wild, but individuals likely live 1 to 2 years (based on similar species). The species is also sensitive to various threats and stressors, including water quality and quantity threats and non-native species. It has been noted that this species no longer occurs in streams with reduced water quality impacted by a numer of pollutants, including pesticides (5-Year Review)

Ongoing primary threats (highlighted in the Special Management Considerations or Protections section of the final critical habitat rule) include: (1) loss of spring and stream flow due to groundwater withdrawals; (2) impacts from non-native species, mainly armored catfish (this threat has increased since the listing); (3) degradation of water quality due to pollution; and (4) alterations of stream channel habitats. Devils River minnows no longer occur in streams with reduced water quality impacted by unnatural chemical inputs, human and animal waste products, pesticides, petroleum residues, and suspended sediments (73 FR 46988). Water quality degradation and contamination are inherent threats to the population in San Felipe Creek because of its urban location. Studies by the Texas Commission on Environmental Quality (TCEQ), formerly the Texas Natural Resource Conservation Commission (TNRCC 1994, 1996), and the International Boundary and Water Commission (IBWC 1994) found elevated levels of nitrates, phosphates, and orthophosphate in San Felipe Creek, indicating potential water quality problems. Land uses in the immediate area of the springs, such as runoff from the nearby municipal golf course, may have contributed to these conditions. Catastrophic events, such as a large contaminant spill from a transportation vehicle at a bridge crossing, also threaten the species in San Felipe Creek. Continued swimming pool maintenance practices may be negatively affecting the water quality in Las Moras Creek and degrading the stream habitat. Non-native species (i.e., fish, a snail, a mollusk, and several plants) have become established within portions of the Devils River minnow's range (73 FR 46988).

EB/CE Source:

U.S. Fish and Wildlife Service. 2008. Devils River Minnow (*Dionda diaboli*) 5 Year Review: Summary and Evaluation [Short Form]. Austin, Texas. pp. 10.

U.S. Fish and Wildlife Service. 2005. Devils River Minnow (*Dionda diaboli*) Recovery Plan. Albuquerque, New Mexico. pp. 29.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Devils River minnow does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their potential risk of exposure to malathion is partially reduced by their use of higher flowing aquatic habitats, reducing their overall risk.

USAGE

 # acres in species range: 3,659,040 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 51,807 acres, 1.416%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact

amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Eremichthys acros	Desert dace	266

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
This short-lived species is spread across approximately 9 populations in Soldier Meadow that may have occasional connectivity during certain times of the year. The degree to which movement occurs between populations is unknown. Based on the limited survey data, it appears that population sizes fluctuate widely, and the 10,000 to 100,000 population size date from NatureServe appears to be drawn from older data. More recent data suggests that one site may have more substantial numbers (>1,000 at time of survey), but surveys at other sites have reported very few (<10) to no individuals sampled during a given year.

Surveys conducted in 2002-2003 and 2010 indicate that desert dace populations may be declining within a portion of their historical habitat, likely due to non-native species invasions and a reduction of available habitat (Vinyard 1996; Rissler et al. 2004; Byrne 2010). Permanent fish barriers were constructed in 2011 to prevent non-native fish from encroaching further upon desert dace habitat. Additional funding is required to implement identified habitat restoration measures and achieve recovery. Population monitoring has not been frequent enough or sufficiently intensive to determine if some recovery criteria are being met. However, numerous conservation measures have been implemented by BLM in the Soldier Meadow area since 1997, which partially address recovery criterion 4, by reducing various types of habitat modification associated with livestock grazing and recreational use of hot springs and surrounding areas.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Desert Dace (*Eremichthys acros*) 5 Year Review: Summary and Evaluation. Reno, Nevada. pp. 27.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

 # acres in species range: 883,450 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 780,967 acres, 88.400%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Erimonax monachus	Spotfin chub	237

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The spotfin chub (*Hybopsis monacha*) once occured widely in 12 tributary systems lying in 5 states. It now is extant in only 4 systems: Little Tennessee River, North Carolina; Duck and Emory Rivers, Tennessee; and North Fork of Holston River, Tennessee and Virginia.

Most literature and museum records report low population numbers for Spotfin Chub, suggesting that it has always been an uncommon species (Etnier and Starnes 1993; Jenkins and Burkhead 1993; Boschung and Mayden 2004). The specific epithet in Latin, assigned by E.D. Cope, describer of the species, translates to "unique, single, solitary" reflecting the species' apparent rareness (Etnier and Starnes 1993). Rarity in these collections could at least partially be attributable to its general occurrence in larger streams coupled with it frequenting habitats that are not easily sampled with casual collecting techniques like seining (Etnier and Starnes 1993). Most occurrences in smaller streams are considered marginal (Jenkins and Burkhead 1982, 1984). The Recovery Plan noted four population clusters of Spotfin Chub in Tennessee River tributary drainages: Buffalo River, Emory River, Little Tennessee River, and North Fork Holston River. Three additional records outside of these clusters have been reported since the Recovery Plan was finalized. The extent of known occurrences in streams in all population clusters has apparently expanded since 1983. There are three basic reasons for this trend: 1) the potential for Spotfin Chub discovery has increased as stream sampling has expanded since the Recovery Plan was written, 2) the ability biologists have for finding the species has improved concurrent with increased sampling in Tennessee River drainage streams, and 3) there have been noticeable water quality improvements in some streams (e.g., chemical contaminant reduction in the North Fork Holston River; cleaner industrial discharges in Kingsport at the origin of the Holston River; abandoned mine recovery on a tributary Crab Orchard Creek) (C.F. Saylor, TVA retired, pers. comm., 2014).

Reasons for the reduction or extirpation of the initial spotfin populations from most of their former range were likely due to intermittent detriments or permanent destruction of their habitats such as: impoundments, channelization, pollution, turbidity or siltation, temperature change, possibly overcollecting, and interspecific competition as described by Jenkins and Burkhead (1982). Massive application of ichthyocide wiped out the entire Abrams Creek population.

Localized seining in the North Fork Holston sharply depleted populations made vulnerable by enigmatic concentration at gravel areas. Natural factors such as cool maximum temperature and small stream size probably limited some populations. The latter two conditions tend to coincide, and when so, populations may have been truly marginal.

Compared to 40-50 years ago, Spotfin Chub has improved in overall conservation status. However, current data indicates that the species remains generally sporadic or occasional in distribution and occurs in discrete reaches in most streams of occurrence. Only in select stream reaches (e.g., lower Emory River, upper Little Tennessee River) is the species considered generally distributed and common in occurrence and abundance. All four Spotfin Chub population clusters are susceptible to various stressors, including the effects of habitat fragmentation and population isolation, and sedimentation, while general developmental activities (e.g., Little Tennessee River), coal mining and oil and natural gas exploration (e.g., Emory River), residual contamination (e.g., Holston River), and general rarity (Buffalo River) are also ongoing stressors. Further, the chance for a catastrophic stochastic event drastically affecting a population and its habitat is heightened in streams with limited habitat reaches, namely Buffalo, Cheoah, and Tellico rivers. A benthic habitat specialist, the species requires spawning and foraging sites swept relatively free of fine sediments. These biological and ecological attributes make this species more susceptible to habitat perturbations than most other stream cyprinids.

2019 5-Year Review
General threats to the species remain similar to what they were in 1977 when this species was listed as threatened and what they were in 1983 when the Recovery Plan was written. There have been few significant improvements regarding threats since 1983. However, the deleterious effects of habitat fragmentation and isolated populations, stochastic events, and climate change were not mentioned as threats to the species.

The total population size for spotfin chub, though undetermined, must be relatively small compared to historic levels. The Buffalo River and Holston River population clusters are both considerably smaller than those in Little Tennessee River and Emory River, though the species appears to be expanding appreciably in the Holston River drainage. Four streams within the historical range of spotfin chub have been the target of population reintroduction efforts since the late 1980’s, with only Abrams Creek having failed. Though there is good evidence that the reintroduction efforts into Cheoah and Tellico rivers will be successful at establishing viable populations, continued monitoring over several more years will need to occur to determine if they are truly viable and self-sustaining. There is not enough evidence at this time to determine if ongoing reintroduction attempts in Shoal Creek will become successful at creating a self-sustaining population.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Spotfin Chub (*Erimonax monachus*) 5-Year Review: Summary and Evaluation. Asheville Field Office, Asheville, North Carolina. 41 pp

U.S. Fish and Wildlife Service. 1983. Spotfin Chub (*Erimonax monachus*) Recovery Plan. Asheville Endangered Species Field Station, Asheville, North Carolina. 60 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 8,989,344 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,352,822 acres, 26.173%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–

4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Erimystax cahni	Slender chub	246

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The slender chub is restricted to the upper Tennessee River drainage in Tennessee and Virginia. It has been observed (Noel Burkhead, U. S. Geological Survey, personal communication with Jim Widlak 2008) that the species' benthic feeding and spawning orientation, in addition to life history attributes (lower fecundity relative to many other fishes, short lifespan, and low dispersal ability) increased the species' vulnerability.

About 430 slender chub specimens have been collected from all sites between 1893 and 1996, although only one individual has been collected since 1987. The largest collection was 86 individuals from the Powell River in 1976 (data summarized from Burkhead and Jenkins 1982, Shute et al. 2008c, Simons 2013). When the species was collected, the mean number of individuals per sample was 11.9 and ranged from a single individual to 57 and 86 in the Clinch and Powell rivers, respectively (data summarized from those presented by Shute et al. 2008c).

Pollutants likely to affect water quality in the Clinch and Powell rivers from land uses in these rural watersheds include sediments, fertilizers, herbicides, pesticides, and animal wastes from row crop and livestock farming, pharmaceuticals from municipalities, septic tank and gray water leakage from rural communities in the watersheds, and petroleum products from highways that cross or run parallel to streams. These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the habitat and food sources for species like the slender chub.

While coal mining and related activities in the Clinch River and Powell River drainages continue to impact slender chub's riverine habitat, a multi-agency coordination in the Clinch and Powell Rivers is intended to reduce water and habitat quality impacts from coal mining in these watersheds. Regions III and IV of U.S. Environmental Protection Agency and state agencies signed an MOU to establish a working group for improving communications and coordinating efforts to protect and restore the Clinch and Powell Rivers. These agencies and others are working together to reduce human impacts associated with coal mining and processing, agriculture, urbanization, and the development of transportation corridors. Possibly as a result of these efforts, although both Clinch and Powell rivers continue to be impacted by coal mining activities, water and habitat quality in both rivers are improving. This is indicated by recent, apparently successful efforts to reintroduce captively propagated mussels (S. A. Ahlstedt, consultant, personal communication with C. F. Saylor 2013, Dan et al. 2011). However, physical habitat destruction resulting from a variety of other anthropogenic impacts such as nonpoint source runoff and resultant sediment deposition, disturbance of riparian corridors, and changes in channel morphology continues to plague the Clinch and Powell watersheds. In addition to coal mining, the most significant sources of sediment are from activities such as agriculture, silviculture, road construction, and urban development. Activities that contribute sediment discharges into a stream system change the erosion or sedimentation pattern, which can lead to the destruction of riparian vegetation, bank collapse, excessive instream sediment deposition, and increases in both water turbidity and temperatures.

EB/CE Source:
U.S. Fish and Wildlife Service. 2014. Slender Chub (*Erimystax (=Hybopsis) cahni*) 5 Year Review: Summary and Evaluation. Cookeville, Tennessee. pp. 22.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 4,900,121 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 687,791 acres, 14.036%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Gila bicolor ssp.	Hutton tui chub	261

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

From 2019 5-Year Review:
Potential threats to the Hutton tui chub include any actions that would negatively affect water quality, quantity, or extent in the two springs such as groundwater withdrawal or channeling for irrigation diversions; potential contamination of water in the springs due to contaminants from a nearby chemical waste site; and the uncertain effects of climate change. We have no new data to inform us about the status of these threats at this time, due to lack of access to the springs in recent years.

From 2013 5-Year Review:
The species hasa small population size and restricted distribution. The known range of the Hutton tui chub is limited to two small springs (Hutton Spring and 3/8 Mile Spring) in Lake County, Oregon. Available habitta in Hutton Spring was estimated at approximately 100sqm and the unvegetated open water habitat as 36sqm. The 3/8 mile spring is described as two small pools with surface area of approximately 2 sqm. Surveys in 2005 and 2007 estimated population size in Hutton Spring at 809 and 959, respectively. The survey in 2007 also estimated numbers at 87 in 3/8 Mile Spring.

From 2008 5-Year Review:
The Hutton tui chub was listed as threatened in 1985 because it had an extremely limited distribution, occurred in low numbers, and inhabited springs that were susceptible to destruction, modification, and human disturbance. Some of the initial factors that were directly degrading Hutton Spring such as mechanical manipulation and direct trampling of vegetation by livestock are not known to have occurred since the Hutton tui chub was listed as Threatened under the Endangered Species Act. Channeling of water or groundwater pumping (which could lower the water table) for irrigation purposes could destroy the spring ecosystem. A field reconnaissance conducted in 2005 did not reveal any sign of artificial channeling of water from the spring for irrigation purposes. The Service has no information regarding groundwater pumping activity at

Hutton Spring and there is no apparent water pumping activity occurring. Livestock trampling of the spring could have a negative impact on Hutton tui chub. Although trampling of the habitat by watering livestock has occurred in the past, Hutton Spring is fenced and livestock do not wallow in the spring or drink directly from it and there is no evidence of any recent “mechanized” impacts. The fence around the spring is still present and appears to be in adequate condition. Some maintenance may be needed to ensure that cattle cannot access the spring and to ensure longevity of the fence. The Oregon Department of Fish and Wildlife (ODFW) 2005 Progress Report noted that the Hutton Spring habitat was in good condition but that encroachment by aquatic macrophytes may be limiting population abundance (Scheerer and Jacobs 2005). 3/8 Mile Spring occurs on private property and is presently not fenced to exclude livestock. No additional information is available at this time on the status of 3/8 Mile Spring. Hutton Spring is located approximately 1.75 miles north of a large chemical disposal site. Wastes from the dump have already contaminated the adjacent ground water, surface-water, and air in the Alkali Lake area. It is likely that the spring habitat of the Hutton tui chub will become contaminated within the foreseeable future as levels of these toxic chemicals increase. This could endanger the Hutton tui chub and possibly result in its extinction if measures are not taken to prevent contamination of its habitat. Since the time of listing, the Oregon Department of Environmental Quality (ODEQ) has been monitoring the Alkali Lake Chemical Waste Disposal Site. Chemical analyses of soil, surface water, sediment, and groundwater identified dioxins, furan, herbicides, semi volatile organic compounds, pesticides, volatile organic compounds and metals as contaminants at the site. Groundwater monitoring has identified a contaminant plume extending to the northwest about 2,000 feet from the chemical waste disposal site. The plume has not expanded during the past 10 years (Ernst et al. 2005). Hutton Spring is nearly directly north of the site, but is currently considered to be outside of the extent of contamination from the waste disposal site. To limit potential exposures, an interim soil cap was placed on the chemical waste disposal site and fences with warning signs surround the site.

EB/CE Source:

U.S. Fish and Wildlife Service. 2008. Hutton tui chub (*Gila bicolor ssp.*) 5 Year Review: Summary and Evaluation. Portland, Oregon. pp. 20.

U.S. Fish and Wildlife Service. 2013. Hutton tui chub (*Gila bicolor ssp.*) 5 Year Review: Summary and Evaluation. Portland, Oregon. pp. 8.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 1,892,355 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,460,906 acres, 77.200%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Gila bicolor mohavensis	Mohave tui chub	225

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s),
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Threats to the subspecies include hybridization with the arroyo chub, habitat alteration and loss, and predation from non-native, aquatic species. Most of these threats occurred and continue to occur in the historical habitat of the Mohave tui chub, the Mojave River. All three populations are threatened by climate change and extirpation from stochastic events.

- Lake Tuendae: Threats to this portion of the population in this anthropogenic pond include predation from non-native mosquitofish, introduction of the parasitic Asian tapeworm with mosquitofish, and habitat loss and degradation from improper maintenance of water flows and cattails. MC Spring: Threats to this portion of the population include genetic drift and habitat loss from improper maintenance of water flows and cattails.
- Camp Cady: Threats to the population in this anthropogenic pond include genetic drift and habitat loss and degradation from improper maintenance of water flows and cattails.
- Lark Seep: Threats to the population at this anthropogenic location include habitat loss and degradation from improper maintenance of water flows and cattails.

Although the three populations of Mohave tui chubs are located on public lands that include general management plans for the lands, the long-term sustainability and viability of these populations of Mohave tui chubs is uncertain. The science of conservation biology teaches that a few isolated populations are not adequate to prevent extinction from stochastic events and will likely experience reductions in genetic diversity. Additional populations, especially populations that are interconnected, have a higher probability of both long-term survival and maintaining genetic diversity. Therefore, three isolated locations that are currently support the Mohave tui chub are insufficient to ensure the species' survival despite ongoing management at each.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Mohave tui chub (*Gila bicolor mohavensis* = *Siphaletes bicolor mohavensis*) 5 Year Review: Summary and Evaluation. Ventura, California. pp. 29.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 690,741 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 687,932 acres, 99.593%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Scientific Name:	Common Name:	Entity ID:
Gila bicolor ssp. snyderi	Owens tui chub	262

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The listing rule identified extensive habitat destruction and modification as threatening the Owens tui chub (50 FR 31594). These continue to be threats. Currently, most streams and rivers in the Owens Basin have been diverted and some impounded. Much of the aquatic habitat in the Owens Valley has been eliminated or modified since the early 1900s. Water has been dammed, diverted, transported to Los Angeles for human consumption, or is used locally for agriculture and human consumption. Of the remaining perennial aquatic habitat in the Owens Valley, much of it contains the abiotic features (e.g., water velocity, water quality, cover) needed by the Owens tui chub but not the biotic features (e.g., absence of non-native aquatic species that prey on or hybridize with Owens tui chubs).

The Owens tui chub, which used to occur throughout the Owens River and its tributaries in the Owens Basin, is restricted to six isolated populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in anthropogenic ponds at upland sites with water supplied by artificial methods. The occupied habitat at Hot Creek Headwaters, Little Hot Creek Pond, White Mountain Research Station, and Mule Spring is 0.8 ha (2 ac) or smaller at each site.

The habitats for these five populations are threatened by water diversions, failure of infrastructures that deliver water to these habitats, and/or emergent vegetation. Most of the water rights in the Owens Basin are owned by the city of Los Angeles. Currently, the demand for water from the Owens Basin is high and growing as Los Angeles continues to grow. The city operates and maintains dams, diversion structures, groundwater pumps, and canals to capture and convey much of the water from the Owens Basin to Los Angeles. The remaining groundwater, which provides water to isolated springs and springs that are the headwaters of streams in the Owens Basin, and surface water are used extensively for agriculture and municipal purposes in the Owens Basin. These anthropogenic changes to aquatic habitat in the Owens Basin dramatically reduced suitable aquatic habitat for the Owens tui chub. They reduced the occurrence of the Owens tui chub from a common, wide-ranging species in the Owens Basin to a rare species occurring at a few sites, representing less than 1% of the fish's historical range (50 FR 31594). In addition to the increasing water demands for the greater Los Angeles area, areas adjacent to the Owens Valley (e.g., Round, Chalfant, and Hammil Valleys) are growing, and the demand for water is growing. This increased demand has resulted in an increased withdrawal of ground and surface water from the Owens Valley Groundwater Basin, which affects springs and other surface waters in the Owens Basin (Pinter and Keller 1991). Other factors that have been recognized to affect the species to varying degrees include stochastic and catastrophic events, disease, predation, hybridization, competition with other (e.g., introduced) species, and indirect effects from actions that are not regulated (such as overdrafting of the underlying aquifer via groundwater withdrawal).

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Owens tui chub (*Siphateles bicolor snyderi = Gila bicolor snyderi*) 5 Year Review: Summary and Evaluation. Ventura, California. pp. 35.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 2,303,356 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 1,763,278 acres, 76.553%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Gila cypha	Humpback chub	209

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (3/19/2018): Downlist to Threatened
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (few)
Species Trends: Stable
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
From the 2018 5-Year Review;
Based on the current condition of the Humpback Chub described in the Species Status Assessment (SSA) report, we conclude that the current risk of extinction is low, such that the species is not in danger of extinction throughout all of its range. Current resource conditions in both the upper and lower basin are fair to good and are mostly adequate to support the species. These resource conditions support a large, stable population in the lower basin and multiple extant populations in the upper basin. The species currently demonstrates sufficient individual and population resiliency, redundancy, and representation across both the upper basin and lower basin populations, such that the potential extirpation of multiple populations is not likely to occur now and in the short-term. The current resiliency of the large core population in the lower basin and the current resiliency of the four populations in the upper basin decrease the risk to the species from stochastic and catastrophic events

From the 2001 5-Year Review:

Historic abundance of the humpback chub is unknown, but is surmised from various reports and collections that indicate the species currently occupies about 68% of its historic habitat of about 756 km of river. Six self-sustaining populations of humpback chub are known to exist. Each of these populations consists of a discrete reproducing group of fish, with independent stock-recruitment dynamics, and is geographically separated from other populations. Five of the populations occur in the upper basin recovery unit: 1) Black Rocks, Colorado River, Colorado; 2) Westwater Canyon, Colorado River, Utah; 3) Yampa Canyon, Yampa River, Colorado; 4) Desolation/Gray Canyons, Green River, Utah; and 5) Cataract Canyon, Colorado River, Utah (Service 1990). The only population in the lower basin recovery unit occurs in the mainstem Colorado River in Marble and Grand Canyons and the Little Colorado River.

At the time of listing, habitat losses were documented but the threats to humpback chub were poorly understood and distribution and abundance of the species were not well known. The decline of the species was probably a combination of threats, including direct loss of habitat and changes in flow and temperature. In addition, interaction with non-native fish may have had a decimating effect in waters not affected by dams. Humpback chub are adapted to life in deep, canyon-bound reaches of the Green, Colorado, and Little Colorado Rivers. Streamflow regulation and associated habitat modification are primary threats to humpback chub populations. Reservoir inundation, cold-water releases from dams, streamflow alteration, changes in channel geomorphology, and modification of sediment transport have impacted habitat of the native Colorado River fishes, including the humpback chub. Dams were considered a major threat to the humpback chub at the time of listing; however, construction of new dams affecting occupied habitat ceased nearly 4 decades ago. Changes in channel geomorphology of habitat occupied by humpback chub are not extensive because most habitat occurs in rocky canyon-confined reaches with low susceptibility to geomorphic modification.

The threat of predation by non-native fishes on humpback chub has been recognized in two populations in the upper basin. Channel catfish (*Ictalurus punctatus*) are the principal predator of humpback chub in Desolation/Gray Canyons (Chart and Lentsch 2000) and Yampa Canyon (Upper Colorado River Endangered Fish Recovery Program 1999). Control of the release and escapement of non-native fishes into the mainstem, floodplain, and tributaries is a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous non-natives from riverside features. Annual flooding of the river can inundate riverside ponds potentially containing large numbers of green sunfish (*Lepomis cyanellus*), black bullhead (*Ameiurus melas*), largemouth bass (*Micropterus salmoides*), and other non-native fishes that may escape to the river during high flows (Valdez and Wick 1983). Three management actions are identified to reduce the threat of non-native fishes: high spring flows, non-native fish control strategies, stocking agreements. Active control programs should be implemented or continued (as needed) for problematic non-native fishes in Yampa Canyon and Desolation/Gray Canyons. Humpback chub, bonytail (*Gila elegans*), and roundtail chub (*Gila robusta*) are sympatric Colorado River mainstem species with substantial evidence of introgressive hybridization (Dowling and DeMarais 1993). The potential role of pesticides and pollutants in suppressing populations of *Gila* were discussed by Wick et al. (1981). Potential spills of hazardous materials threaten some populations of humpback chub. All States have hazardous-materials spills emergency-response plans that provide a quick cleanup response to accidental spills.

EB/CE Source:

U.S. Fish and Wildlife Service. 2018. Humpback chub (*Gila cypha*) 5 Year Review: Summary and Evaluation. Lakewood, Colorado. pp. 15.

U.S. Fish and Wildlife Service. 2011. Humpback chub (*Gila cypha*) 5 Year Review: Summary and Evaluation. Lakewood, Colorado. pp. 15.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Humpback chub does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their potential risk of exposure to malathion is reduced by using these higher flowing aquatic habitats, thereby lowering their overall risk.

USAGE

 # acres in species range: 64,588,650 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 47,695,128 acres, 73.844%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Gila ditaenia	Sonora chub	255

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Population size/location unknown
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Sonora chub was known to occur in Sycamore Creek of Santa Cruz County of Arizona at the time of listing in 1986, and the captive population at the Arizona Sonoran Desert Museum (ASDM) within the U.S. was established in 1988. A second population, or more likely a metapopulation that includes Sycamore Creek, is now known to occur in California Gulch and its tributary streams.

The threats faced by the Sonora chub at the time of listing and during the preparation of the recovery plan including habitat loss, non-native fishes and parasites, and water developments, continue to exist in both Sycamore Canyon and California Gulch. Cross-border incursions and the law enforcement response to them represent factors that have been present since before the 1986 listing, and which continue to affect the species. Climate change, a threat not identified during listing and recovery planning, along with water development which was previously known, threaten to alter the hydrologic conditions which sustain the streams in which Sonora chub occurs, potentially reducing the species' resilience and ability to persist through stochastic events such as drought and floods. Drought is becoming prevalent throughout the Southwest; as mean annual temperatures increase, precipitation becomes more variable. Drought conditions are ongoing, with 'severe drought' predicted for the south of Arizona (ADWR 2012c) in the future. The degradation, siltation, and water pollution caused primarily by livestock grazing within the riparian corridors, road construction, runoff from roads, construction of infrastructure, repair of infrastructure, human use, and mining operations have potential adverse effects on the Sonora chub. The Sonora chub is a desert fish adapted to the fluctuations of a desert environment; after drought conditions, it has been known to rapidly expand and recolonize California Gulch and newly re-wetted reaches. If habitat conditions along water ways can be maintained, then this ability to respond to favorable water conditions is encouraging for the population to avoid the danger of extinction. Construction of roads or bridges as described above might have temporary adverse effects, but long-term effects can be beneficial to the chub if it reduces off-road use. The use of fire retardant buffers around habitat will potentially minimize adverse effects from those chemicals, and potentially prevent severe fires from causing adverse habitat modifications. As described above, Sycamore Canyon and California Gulch are not suitable terrain for grazing, but effects have occurred from trespass cattle (USFWS 2012a). Furthermore, if a catastrophic decline or an adverse take event occurs, the ASDM population can serve as a source of fish to repopulate the area once the habitat returns to favorable conditions.

EB/CE Source:
U.S. Fish and Wildlife Service. 2013. Sonora chub/Charalito Sonorense (*Gila ditaenia*) 5 Year Review: Summary and Evaluation. Phoenix, Arizona. pp. 41.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

 # acres in species range: 159,979 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 132,634 acres, 82.907%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by

allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Gila elegans	Bonytail chub	249

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The bonytail is a fish species endemic to warm-water habitats of the Colorado River and its tributaries. The species was historically widespread and common from Mexico to Wyoming, but by the late 1970s had declined to less than 50 known individuals. The U.S. Fish and Wildlife Service (Service) originally listed bonytail as an endangered species in 1980 under the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 et seq.), citing extirpation from most of its range in the Colorado River Basin due to habitat alteration (45 FR 27710; April 23, 1980). The decline of bonytail populations, likely beginning in the 1950s, was largely undocumented prior to the last wild individuals being brought into captivity.

Large mainstem dams, water diversions, habitat modification, nonnative fish species, and degraded water quality that caused population declines of other native fishes in the Colorado River likely also affected bonytail (Miller 1961; Minckley and Deacon 1991). Glen Canyon Dam physically separates bonytail populations into two recovery units, the upper and lower basins. Two management programs, the Upper Colorado River Endangered Fish Recovery Program (UCREFRP) in the upper basin and the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) in the lower basin undertake the majority of management actions for the conservation of the species, including stocking, flow management, nonnative fish removal, and habitat development.

Despite management efforts, signs of bonytail survival in the wild remain rare and the ecology of the species remains poorly understood. Without viable, wild bonytail populations, the species continues to rely on hatchery propagation to persist in the wild and advance recovery efforts. The founder population of 10 individuals used for hatchery broodstock was captured from Lake Mohave between 1976 and 1978 (USFWS 2002). Hatcheries in the upper basin produce and stock over 35,000 adult bonytail per year into upper basin rivers, including the Green, White, Yampa, Dolores, Gunnison, San Rafael, Price, and Colorado rivers (UCREFRP Integrated Stocking Plan Revision Committee 2015). In the lower basin, hatcheries produce and stock over 13,000 adult bonytail per year into several reaches, and backwaters, of the lower Colorado River

(LCR MSCP 2015). The Programs successfully maintain genetic diversity and refuge populations of the species. However, when hatchery reared individuals are stocked into the wild, survival rates are extremely low, and therefore the viability of bonytail populations remain low.

The 2002 recovery goals for bonytail identified the alteration of habitat (flow regimes, water temperature, physical habitat and barriers reducing connectivity; Factor A) and the presence of nonnative species (Factor C) as significant threats to the species. Management actions through two conservation programs continue to address these identified threats (Factor D), but the lack of viable bonytail populations in the wild and ongoing threats continue to influence the condition of the species. Habitat alteration and nonnative predators remain threats to the bonytail.

The effects of pollutants remains somewhat unknown but the imminent threat of potential spills or leaching of environmental contaminants still remain high for bonytail (Factor E). Available data suggests that a very small percentage of stocked bonytail survive long-term in the mainstem of the Colorado River. The LCR MSCP manages three isolated backwaters where bonytail are recruiting and are likely self-sustaining, including High Levee Pond, Imperial Ponds and Davis Cove backwater (J. Newton, personal communication 2019). All three locations are managed specifically for bonytail, and nonnative fish species are excluded. Despite natural reproduction within the upper and lower basins in some managed floodplain wetlands and backwater habitat (Bestgen et al. 2017, LCR MSCP 2018), survival of larval bonytail has not been observed and no young-of-year or juvenile fish have ever been found in the rivers of the Colorado River basin. No self-sustaining populations in the rivers of the upper or lower basins have been established.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Bonytail chub (*Gila elegans*) 5 Year Review: Summary and Evaluation. Denver, Colorado. pp. 7.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 25,593,453 acres
% of range in California (i.e., where CalPUR data is available): 2%

Range overlap with Federal lands: 18,751,504 acres, 73.267%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Gila intermedia	Gila chub	6297

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Historically, Gila chub was recorded from nearly 50 rivers, streams, and spring-fed tributaries throughout the Gila River basin in southwestern New Mexico, central and southeastern Arizona, and northern Sonora, Mexico (Miller and Lowe 1967, Rinne and Minckley 1970, Minckley 1973, Rinne 1976, DeMarais 1986, Sublette et al. 1990, Weedman et al. 1996); occupancy of Gila chub throughout its range was more dense; and currently-occupied sites were likely more expansive in distribution (Hendrickson and Minckley 1984, Minckley 1985, Rinne and Minckley 1991). Gila chub now occupies an estimated 10 to 15% of its historical range (Weedman et al. 1996, FWS 2005) and approximately 25 of these current localities are considered occupied, but all are small, isolated, and face one or more threats (Weedman et al. 1996, FWS 2005). The biological status of several of these populations is uncertain, and the number of localities currently occupied may overestimate the number of remnant populations because some might not persist if the core connected population was extirpated.

Approximately 85-90% of the Gila chub's habitat has been degraded or destroyed, and much of it is unrecoverable. Today, much of the remaining Gila chub habitat is still extensively grazed, current mining operations operate in its watersheds, increased recreation use adds to habitat alteration, and the introduction of non-natives adds to habitat degradation. An estimated 59% of the land supporting all of the extant populations occurs on Bureau of Land Management and U.S. Forest Service lands. Other ownership includes Arizona State Land Department, the Audubon Society, the Nature Conservancy, Tribal lands, and multiple private landowners. In a consultation completed for the species in 2013, it was indicated that, range-wide, more than 32 consultations have been completed or are underway for actions affecting Gila chub. These opinions primarily include the effects of grazing, water developments, fire, species control efforts, recreation, sport fish stocking, native fish restoration efforts, and mining.

EB/CE Source: U.S. Fish and Wildlife Service. 2005. Endangered and Threatened Wildlife and Plants; Listing Gila Chub as Endangered With Critical Habitat. Federal Register 70:66664-66721.

U.S. Fish and Wildlife Service. 2013. Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona. Arizona Ecological Services Office, Phoenix, Arizona. 506 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Gila chub does occupy other aquatic habitats that may be exposed to potentially higher levels of malathion due to lower volume in those habitats, their potential overall risk of exposure to malathion is lowered by also using these higher flowing aquatic habitats.

USAGE

 # acres in species range: 4,994,391 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,661,182 acres, 53.283%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic

habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Gila nigrescens	Chihuahua chub	254

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened, Five-Year Review Recommendation (1/13/2010: Uplist to Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Within the historical range of the Chihuahua chub, stream and wetland habitat of the Chihuahua chub has been greatly reduced and degraded through depletion of ground water, water diversion, dewatering, channelization, dam construction, municipal and agricultural pollution, non-native fish, and livestock grazing. The local and regional effects of these activities are expected to increase with increasing human population because a larger human population will result in increased development. These factors have led to stream drying, habitat fragmentation, unsuitable water quality, and loss of the deep pools and overhanging banks that the species requires. Although regulatory controls are protecting the species in New Mexico, the majority of historical habitat occurs in Mexico where it appears there is little protection for the species.

Because Chihuahua chub evolved in a fish community with few other species, non-native species likely have a negative impact on the Chihuahua chub. However, interactions with non-native species have not been specifically investigated. Chihuahua chub is susceptible to disease and infection from non-native parasites such as anchor worm, yellow grub, and ich. If water temperatures rise in concert with air temperatures from climate change, it is anticipated that Chihuahua chub may become more susceptible to disease and infection because fish become stressed as water temperature increases and dissolved oxygen decreases. This would be especially true if the fish were caught in isolated pools that were drying. Climate change is projected to lead to decreased stream flow and increased conflict over a scarce resource.

The population of Chihuahua chub in the Mimbres River, New Mexico currently appears to be stable. However, because of the extremely limited amount of occupied habitat, the dependence of the population on stocking, and the ongoing threats to the population, its status remains precarious. The purchase of parcels of property on the Mimbres River by other New Mexico Department of Game and Fish and the Nature Conservancy, which include occupied habitat, has improved habitat quality in those reaches. The propagation program at Dexter National Fish Hatchery and Technology Center has provided a steady source of fish to augment the wild population. Annual surveys indicate that the density of Chihuahua chub is slowly increasing in the Mimbres River. Attempts to establish a self-sustaining population in McKnight Creek appear to have failed. However, surveys at Cooney Canyon, approximately 16.5 km (10 mi) upstream of Allie Canyon, discovered Chihuahua chub in 2008 and 2009. Whether this population represents a previously undiscovered population, is the result of dispersal from downstream, or is the product of human conveyance is unknown.

EB/CE Source:
U.S. Fish and Wildlife Service. 2010. Chihuahua chub (*Gila nigrescens*) 5 Year Review: Summary and Evaluation. Albuquerque, New Mexico. pp. 15.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Chihuahua chub does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of higher flowing aquatic habitats.

USAGE
 # acres in species range: 3,863,543 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,855,706 acres, 48.031%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT

modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Gila purpurea	Yaqui chub	263

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (7/3/2019): Downlist to Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
For many years, the Yaqui chub was confused with the similar desert chub (*Gila eremica*) described by DeMarais (1991), which ranges from the westernmost tributaries of the upper Rio Yaqui basin west and southward to the upper Rio Sonora and Rio Matape (Minckley and Marsh 2009). Before genetic work was conducted to examine the fish species, the range of the Yaqui chub was incorrectly thought to include a much larger portion of the Rio Yaqui watershed and about 98 percent of the range of the Yaqui chub was wrongly thought to exist only in Mexico. The Recovery Plan for this species (USFWS 1995) was completed based on this information, which was the best available information at the time. We now recognize that the range of the Yaqui chub is restricted to the Rio San Bernardino system in Arizona and Sonora. It was historically and still remains known in Mexico only from a <3.0 km perennial reach of Rio San Bernardino, immediately south of the international border in Sonora (Varela-Romero et al. 1992). Most of its range is therefore in the U.S., and the majority of that is directly protected on SBNWR.

Continuing threats to this fish include: very limited range, making potential loss from catastrophic events more likely; loss, alteration, and degradation of suitable wetland habitat; competition with, and/or depredation by, non-native species; and long-term drought combined with expanding human populations, which are creating increased demand for water for human consumption (Minckley and Marsh 2009). Yaqui chub populations in the San Bernardino Valley, Douglas High School, and Bar-Boot Ranch continue to be threatened due to infestations by the non-native Asian tapeworm (*Bothriocephasus acheilognathi*), while those on El Coronado Ranch and Coronado National Forest currently remain free of this parasite. However, Kline et al. (2007) determined that Asian tapeworm infestations of Yaqui chub can cause intestinal blockage and a reduced growth rate, but that infestation by this tapeworm did not result in an overall threat to the Yaqui chub population. While this parasite may impact Yaqui chub, it does not appear to kill or threaten the fecundity of the chub, which has adapted to the occurrence of the tapeworm (Kline et al. 2007). Since the development of the 1995 Recovery Plan, populations of Yaqui chub have responded well to conservation efforts and intensive management and have established large and viable populations in diverse habitats (Hendrickson and Brooks 1991; USFWS 1994a).

Approximately 35 managed populations of Yaqui chub currently occur across the known range. Yaqui chub are living in nearly all wetlands on SBNWR (16 separated ponds, San Bernardino River, also known as Black Draw, and Hay Hollow Wash). Additionally, the species has been established in Leslie Creek on Leslie Canyon National Wildlife Refuge (LCNWR), in West Turkey Creek on the Coronado National Forest, and at the following locations on private property: in House Pond on Slaughter Ranch (covered by a conservation easement and a warranty deed), in two ponds on the 99-Bar Ranch, in two ponds on the Bar-Boot Ranch (where it is covered by separate conservation easements and a Safe Harbor Agreement), in one pond at Douglas High School, in eight ponds at El Coronado Ranch (where it is covered by a Habitat Conservation Plan). In Mexico, Yaqui chub have been found in Rio San Bernardino, three adjacent ponds, two springs on Ciénega de San Bernardino, and the spring Los Ojitos.

Since the Recovery Plan was developed, much work has been done to establish the above populations by including understanding and managing water capacity, controlling non-native, harmful species, and protecting habitats from human impacts.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Recovery Plan Amendments for Nine Southwest Species. Albuquerque, New Mexico. pp. 18.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Yaqui chub does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 810,277 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 121,845 acres, 15.037%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Gila robusta jordani	Pahranagat roundtail chub	226

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Population size/location(s) unknown
Number of Populations: Population size/location(s) unknown
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The species has been extirpated from two of three historically occupied spring systems. Degradation of the riparian habitat due to grazing, crop production in adjacent habitat, and loss of riverine canopy was believed to be contributing to the declining Pahranagat roundtail chub population. Non-native species are a threat, primarily due to predation. Additionally, habitat changes have occurred both in and adjacent to aquatic habitats in which they occur. Loss of water and associated alteration of the stream channel and adjacent habitat to provide water for irrigation from the lower part of theditch appear to have been at least a partial factor in the decline of Pahranagat roundtail chub and its habitat. Non-native species have been responsible for the decline and extirpation of numerous native, desert fishes. The impacts from water fluctuation and springhead manipulation have been less severe and are more easily rectified than have the impacts of non-native fish (Courtenay and Deacon 1982, Deacon et al. 1979, Deacon and Minckley 1974). In Pahranagat Valley, preliminary evidence suggests that areas that have been disturbed by algae removal, water level fluctuation, and recreational activities are more apt to be predominated by non-native fishes, whereas native fish are more common in areas with few or no disturbances.

Numerous conservation efforts have been undertaken for the benefit of this and other listed species in the Pahranagat Valley. Pabranagat roundtail chub were established at the Dexter National Fish Hatchery in New Mexico in 1986 to prevent extinction by a catastrophic event. The Bureau of Land Management completed an Ash Springs Coordinated Resource Management Plan for the White River springfish and the Pahranagat roundtail chub in 1989. This plan allows the Bureau of Land Management to manage the recreational activities at the spring sources and provide protection for the area. The Fish and Wildlife Service's National Fisheries Research Center-Reno completed many research tasks specified in the 1985 plan, including Pabranagat roundtail chub life history, abundance and distribution, food habits, habitat use, movement patterns, population dynamics, and inter- and intraspecific interactions (Tuttle et al. 1990). Habitat Conservation Plans have also been pursued to protect this and other species.

EB/CE Source:
U.S. Fish and Wildlife Service. 1998. Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley. Portland, Oregon. pp. 91.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Pahranagat roundtail chub does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 3,093,152 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,812,376 acres, 90.923%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	**Common Name:**	**Entity ID:**
Gila seminuda (=robusta)	Virgin River chub	256

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
After creation of Lake Mead, woundfin and Virgin River chub had a very limited geographic range, largely confined to the Virgin River mainstem downstream from La Verkin Springs to approximately Halfway Wash. This range has been significantly reduced due to red shiner colonization of the Virgin River as well as decreases of instream flows. Red shiner moved up from Lake Mead rapidly displacing native fish in the Virgin River through competition and direct predation. By the late 1980s, the only portion of woundfin and Virgin River chub historic habitat not occupied by red shiner was the Ash Creek to Washington Fields Diversion reach. Although limited numbers of woundfin and Virgin River chub are periodically present in downstream reaches, the only consistently viable populations are present in the 26.3 km (16.3 mi) reach of the Virgin River mainstem between Ash Creek downstream to the Washington Fields Diversion

The limited distribution of woundfin and Virgin River chub populations reduce their ability to respond to stochastic change and makes them particularly vulnerable to catastrophic environmental events. The continued persistence of woundfin and Virgin River chub within this limited distribution threatened by a variety of environmental and human induced factors. Limiting factors include water quality conditions, high water temperatures and clear water associated with low summer flows, predation and competition from nonnative fish, and late summer flow events. Populations are particularly susceptible to episodic spike flows and associated adverse water quality events during late summer low flow and high temperature periods. Runoff and sediment transported by flash events can rapidly reduce dissolved oxygen levels resulting in direct mortality, displacement of fish, and modification of thermal refuge areas. High flow events can also reduce resource and habitat availability through scouring and sediment deposit, and can modify highly productive nursery habitats limiting young-of-year survival and recruitment. In addition, high flow events in late summer can displace a high percentage of larval fish downstream into reaches occupied by red shiner, thus removing or severely limiting annual recruitment.

Woundfin and Virgin River chub population abundance in the Ash Creek to Washington Fields Diversion reach are highly variable and fluctuate with water year. Generally, low water years associated drought reduce abundance of woundfin and Virgin River chub populations, and limit successful reproduction and recruitment. Conversely, high water years with extended spring runoff triggers reproduction and the resulting higher summer flows enhance survival and recruitment. Drought periods with below average water years result in depressed population numbers and distribution of woundfin and Virgin River chub. The persistence of woundfin and Virgin River chub during these poor water years is dependent upon ongoing cooperative intensive management actions (e.g., water releases, hatchery propagation, stocking) to maintain populations and enable population response during favorable conditions. Short lived woundfin are highly susceptible to prolonged low flow periods while the longer life span of Virgin River chub allows populations to withstand low water years and respond during good water years. Thus, Virgin River chub are not as susceptible to stochastic and catastrophic events and populations are better able to respond following population declines.

For the last 15 to 20 years, woundfin and Virgin River chub populations remained low during low water years and responded with large reproduction events and recruitment during high water years (e.g., 2005, 2011). However, despite extremely low water years from 2012 through 2015, woundfin populations in the Ash Creek to Washington Fields Diversion reach responded with reproduction and recruitment in 2015, resulting in unexpectedly high fall and subsequent spring population numbers. This woundfin population increase was likely the result of intensively managed water releases by the Washington County Water Conservancy District to offset high summer water temperature extremes through the pumpback system, increased turbidity, controlled sediment releases, and hatchery stocking. Implementation of these actions through the Virgin River Program has stabilized population declines and maintained woundfin and Virgin River chub populations between Ash Creek and Washington Fields Diversion. Additional partnerships in the lower Virgin River are needed to assist with rotenone treatments, restoration projects, and fish barriers. The continued cooperation between the Washington County Water Conservancy District, local interests, and State and Federal agencies through implementation of the Virgin River Program is necessary to maintain woundfin and Virgin River chub populations within their limited geographic range.

EB/CE Source:

U.S. Fish and Wildlife Service. 2020. Virgin River Fishes, Woundfin (*Plagopterus argentissimus*) and Virgin River Chub (*Gila seminuda*) 5-Year Review: Summary and Evaluation. Utah Field Office, West Valley City, Utah. 140 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Virgin River Chub does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 5,385,073 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 4,646,105 acres, 86.277%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Hybognathus amarus	Rio Grande silvery minnow	309

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Rio Grande silvery minnow historically occupied approximately 3,862 river km (2,400 mi) in New Mexico and Texas. Currently, the Rio Grande silvery minnow is known to naturally occur only in one reach of the Rio Grande in New Mexico, a 280 km (174 mi) stretch of river that runs from Cochiti Dam to the headwaters of Elephant Butte Reservoir. This includes a small portion of the lower Jemez River, a tributary to the Rio Grande north of Albuquerque. Its current habitat is limited to about %7% of its former range, and is split by three river-wide dams into four discrete reaches. It has been declining in distribution and abundance for more than 50 years, and has been extirpated from the Rio Chama,the Pecos River, and most of its historic range in the Rio Grande.

Throughout much of its historic range, the decline of the Rio Grande silvery minnow is attributed primarily to destruction and modification of its habitat due to dewatering and diversion of water, water impoundment, and modification of the river (channelization). Competition and predation by introduced non-native species, water quality degradation, and other factors also have contributed to its decline. While some of the threats have been reduced since the Rio Grande silvery minnow was listed as endangered, none have been eliminated. The status of the species continued to decline through 2003. Since then, the relative abundance of Rio Grande silvery minnow in the remaining population (in the middle Rio Grande) increased, demonstrating the highly variable nature of the population. This population is fragmented and isolated, making it vulnerable to natural and human-caused factors further increasing the risk of extinction. In December 2008, silvery minnows were introduced into the Rio Grande near Big Bend, Texas as a nonessential, experimental population under section 10(j) of the ESA. Preliminary monitoring is being conducted to determine whether or not that reintroduction has been successful.

From 2018 5-year Review: Rio Grande Silvery Minnow remains endangered with extinction based on the current variable and projected hydrology. This includes hydrologic alterations of spring runoff magnitude, duration, and timing, low flows, and other indicators of habitat availability. The physical conditions produced by prolonged and elevated spring runoff events result in the inundation of shallow, low-velocity nursery habitats with increased nutrients, food, cover, and warm temperatures essential for the successful recruitment of Rio Grande Silvery Minnow (Dudley and Platania 1997; Valett et al. 2005; Pease et al. 2006; Porter and Massong 2006; Turner et al. 2010, Hoagstrom and Turner 2015; Dudley et al. 2018; NMISC 2018). Due to climate change, water extraction, and geomorphological changes, the inundated areas during spring runoff flooding will likely diminish and result in a decrease of nursery habitats and subsequent recruitment (USFWS 2016). Water management coordination has improved, genetic management and captive propagation have prevented extinction, and habitat restoration has been implemented, but these activities do not yet prevent population collapse during extended drought years (Archdeacon 2016; Horwitz et al. 2018). Rio Grande Silvery Minnow are short lived and will likely be extirpated with consecutive low spring runoff years followed by reduced flows and extensive river drying without fish passage to perennial water during long-term drought (Dudley et al. 2007b; Horwitz et al. 2018).

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EB/CE Source:
U.S. Fish and Wildlife Service. 2018. Rio Grande Silvery Minnow (*Hybognathus amarus*) 5-Year Review: Summary and Evaluation. New Mexico Ecological Services Field Office, Albuquerque, New Mexico. 24 pp.

U.S. Fish and Wildlife Service. 2010. Rio Grande Silvery Minnow (*Hybognathus amarus*) Recovery Plan, First Revision. Albuquerque, New Mexico. viii + 210 pp.

U.S. Fish and Wildlife Service. 2008. Endangered and Threatened Wildlife and Plants; Establishment of a Nonessential Experimental Population of Rio Grande Silvery Minnow in the Big Bend Reach of the Rio Grande in Texas. Federal Register 73:74357-74372.

U.S. Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants; Final Rule To List the Rio Grande Silvery Minnow as an Endangered Species. Federal Register 59:36988-36995.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 27,577,671 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 7,478,385 acres, 27.118%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Lepidomeda albivallis	White River spinedace	282

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
When the recovery plan for White River spinedace was published in 1994, only a single population remained at the Flag Springs complex. The Flag Springs complex occurs on the Nevada Department of Wildlife-managed Kirch Wildlife Management Area and is one of three springs that compose designated critical habitat for White River spinedace, along with Preston Big Spring and Lund Spring. At the time the recovery plan was completed, the Flag Springs complex population was heavily impacted by largemouth bass (*Micropterus salmoides*) and spinedace were restricted to the northern spring of the complex (Scoppettone 2004a, Service 1994).

The Flag Springs complex population, which was once estimated at less than 50 individuals, is now consistently between 500 and 1,500 individuals, which demonstrates progress towards recovery (NDOW 2016, Scoppettone 2004b, Service 2010). Recent surveys of White River 3 spinedace likely underrepresent the actual population as surveys are impacted by encroaching vegetation due to a lack of prescribed burning (NDOW 2016). The increase in population size is largely attributed to the removal of largemouth bass from the system. More recent habitat restoration projects have likely contributed to the ongoing success.

Despite the improvements at the Flag Springs complex, overall, the threats across the species' historical range remain unchanged as described in the recovery plan and 5-year review. Additionally, little progress has been made in reintroducing spinedace to Preston Big and Lund Springs, both of which are located on private lands. Improving the status of this species at these two springs would require partnerships between agencies, irrigation districts, local communities, and the private landowners where Preston Big and Lund springs occur. To date, efforts to establish partnerships with the irrigation districts, local communities, and private landowners where Preston Big and Lund springs occur have been unsuccessful.

EB/CE Source: 2019 Recovery Plan Amendment

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the White River spinedace does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 8,480,223 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 8,089,301 acres, 95.390%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Scientific Name:	Common Name:	Entity ID:
Lepidomeda mollispinis pratensis	Big Spring spinedace	280

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Big Spring spinedace, a federally threatened species, occurs in an 8-km section of Meadow Valley wash in Condor Canyon north of Panaca, Lincoln County, Nevada. The species has been extirpated from its type locality, the outflow stream from Panaca (Big) Spring, which historically connected with Meadow Valley Wash just below Condor Canyon. The remnant population is vulnerable to catastrophic events, adverse habitat modification, and non-native species introductions. Big Spring spinedace are relatively abundant within Condor Canyon, although actual population size has not been determined.

Big Spring spinedace life history and habitat requirements and limiting factors are poorly understood (from USFWS 1993); Nevada Department of Wildlife discovered a few individuals of what was thought to be an extinct subspecies in Condor Canyon, just northeast of Panaca. Condor Canyon is a small area of Meadow Valley Wash with perennially flowing water. Since the discovery of the Condor Canyon population, some of the fish have been transplanted above a barrier falls and now occur in most of the available habitat within Condor Canyon. The relocation of fish above the barrier falls was carried out by the Nevada Department of Wildlife (Hardy 1980a). However, the available habitat within the approximately 4-mi-long Condor Canyon is limited.

This restricted habitat is threatened by the possible introduction of exotic species and by habitat alteration. The habitat could also be threatened by a major flood (Cal Allan, Nevada Department of Wildlife, retired, pers. comm.; Hardy 1980b) or a severe drought.

From the 2021 5-year Review: The status of the Big Spring spinedace has neither significantly improved nor degraded since the time of its listing. Many aspects of its life history remain unknown and warrant further investigation though progress has been made. Recent USGS surveys have provided improved data concerning the distribution, population size, spawning, and age and growth of Big Spring spinedace (Jezorek et al. 2011). The recovery criteria set forth in the Big Spring spinedace Recovery Plan have not been met and cannot be properly met without further efforts. We have not established a clear population trend, and we have not established refugia, leaving only one geographically limited population of the species that is still subject to a number of threats, in particular, habitat degradation from human activities, predation from nonnative fishes and crayfish, and stochastic events. The historical habitat is privately owned and currently used for agriculture, it is unlikely that this site will be available for restoration within the forseeable future.

EB/CE Source:

U.S. Fish and Wildlife Service. 2021. Big Spring Spinedace (*Lepidomeda mollispinis pratensis*) 5-Year Review: Summary and Evaluation. Southern Nevada Ecological Services Field Office, Las Vegas, Nevada. 18 pp.

U.S. Fish and Wildlife Service. 1985. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status and Critical Habitat for the Big Spring Spinedace. Federal Register 50:12298-12302.

U.S. Fish and Wildlife Service. 1993. Big Spring Spinedace, *Lepidomeda moiispinis pratensis*, Recovery Plan. Portland, Oregon. 42 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 3,044,576 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,762,757 acres, 90.744%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Lepidomeda vittata	Little Colorado spinedace	281

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
New information on Little Colorado spinedace that has become available since completion of the original Recovery Plan is largely summarized in the most recent 5-Year Status Reviews (USFWS 2008, 2018). What we have come to understand is that the Little Colorado spinedace is a fish with a limited, highly fragmented distribution and relatively low numbers, making it highly vulnerable to stressors, particularly drought, ground-water and surface water withdrawals, high severity landscape-scale wildfires, and predation and competition with non-native warm water fishes. Uncertainties and data gaps that may impede recovery progress include climate change and the effects of extended drought and increased human water consumption on the persistence of spinedace habitat; the lack of knowledge regarding genetic diversity; and, inconsistent social attitudes towards the use of piscicide to control invasive non-native fishes and other aquatic organisms.

Currently, the Little Colorado spinedace occurs in disjunct locations in three subbasins of the Little Colorado River (LCR) Basin: the Middle Little Colorado (Hydrologic Unit Code [HUC] 15020008), Chevelon Canyon (HUC 15020010), and Little Colorado Headwaters (HUC 15020001) (Figure 1, Table 1). Little Colorado spinedace may also still inhabit portions of the Little Colorado River in the Upper Little Colorado Subbasin (HUC 15020002), which begins downstream from the Little Colorado headwaters below the dam at Lyman Lake. However, recent trends toward reduced to intermittent flows associated with drought and upstream diversions, combined with the influence of nonnative fishes, have created increasingly unfavorable habitat conditions for spinedace downstream of Lyman Lake.

Currently, threats related to Factor A (Present or threatened destruction, modification or curtailment of the species habitat or range), Factor C (Disease or predation), and Factor E (Other natural or manmade actors) are affecting the species' continued existence. Past land and water management that reduced surface water flow and fragmented habitat; nonnative, predatory fish; and, drought and climate change, which reduce surface water needed to support spinedace will continue to affect Little Colorado spinedace habitat. However, work by the State, the USFWS, and other partners to improve habitat condition, remove nonnative fish, and find new locations for spinedace is making incremental progress toward improving the status of the species (USFWS 2018). Extended drought due to climate change and our inability to fully control nonnative fish are significant impediments to recovery and result in doubt as to the persistence of spinedace habitat into the future. Despite this uncertainty, maintaining as many sites as possible in different geographic and hydrologic settings throughout the range of Little Colorado spinedace is an appropriate strategy for safeguarding the species' ability to withstand the continued effects of these threats.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Recovery Plan Amendments for Eleven Southwest Species. Albuquerque, New Mexico. pp. 14.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Little Colorado spinedace does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 4,182,535 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,534,615 acres, 36.691%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact

amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Meda fulgida	Spikedace	296

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Spikedace previously had a relatively widespread distribution covering portions of Arizona, New Mexico, and northern Mexico. The species has suffered major reductions in numbers and range over time due to persistent threats such that spikedace are now estimated to occur in only 10% of its former range. Currently, only small, isolated populations remain, with limited to no opportunities for interchange between populations or expansion of existing areas, making the species more vulnerable to threats including reproductive isolation.

The two primary threats to the spikedace, (1) non-native aquatic species competition and predation, and (2) alteration or diminishment of stream flows, are persistent, and research indicates that the combination of the two is leading to declines of native species such as spikedace (Propst et al. 2008). The ongoing drought and climate conditions aggravate the loss of water in some areas, and future water development projects have been identified. Finally, opportunities for expansion of the spikedace's range are limited by dams, reservoirs, dewatering, and non-native species distribution. Although some recovery actions have occurred since the 1991 5-year review, the majority of the areas historically occupied by spikedace have experienced a shift from a predominance of native fishes to a predominance of non-native fishes. The low numbers of spikedace, their isolation in tributary waters, drought, ongoing water demands, and other threats lead the Service to conclude the species is now in danger of extinction throughout its range. Spikedace was uplisted from threatened to endangered in 2012.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Endangered Status and Designations of Critical Habitat for Spikedace and Loach Minnow. Federal Register 77(36): 10810-10932.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Spikedace does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 16,006,402 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 9,285,407 acres, 58.011%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Notropis albizonatus	Palezone shiner	278

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The historical range of the palezone shiner included four stream systems: Little South Fork Cumberland River (LSF), McCreary and Wayne Counties, Kentucky; Marrowbone Creek, Cumberland County, Kentucky; Cove Creek, Campbell County, Tennessee; and Paint Rock River (PRR), Estill and Marshall Counties, Alabama (Warren et al. 1994; USFWS 1997). USFWS (1997) described these historical streams as ranging in size from large creeks (third order) to small rivers (fifth order). The Marrowbone Creek and Cove Creek records were each based on single specimens collected in the 1930s (Cove) and 1940s (Marrowbone); multiple attempts to relocate the species in these streams have been unsuccessful (USFWS 1997; M. Thomas, personal communication, 2009), and the species is now considered extirpated from these two streams.

(2020 5-Year Review) The Palezone Shiner is restricted to the Little South Fork system in Kentucky and the Paint Rock River system in Alabama. The species has been extirpated from Marrowbone Creek, Cumberland County, Kentucky (Cumberland River drainage); Cove Creek, Campbell County, Tennessee (Tennessee River drainage); and the Tennessee River mainstem (Guntersville Reservoir), Jackson County, Alabama. Within the Little South Fork, the species occupies a 49.0-km (30.4-mi) stream reach that extends from about the KY 167 bridge crossing in Wayne County downstream to the Freedom Church Road crossing (Freedom Church Ford) at the Wayne County /McCreary County border. Collections in July 2020 documented the species' continued presence at three historical sites, with evidence of reproduction and recruitment. The species occupies about 40.5 km (25.2 mi) in the Paint Rock system, but recent surveys suggest a small population size (Shepard et al. 1997, O'Neil et al. 2013, TVA unpublished data). Stallsmith (2019, pers. comm.) completed surveys from August to October 2018 at six sites in the Paint Rock system, expanding the species' known range by 4.7 km (2.9 mi) in the Paint Rock mainstem (downstream) and by 4.4 km (2.6 mi) in Hurricane Creek (upstream).The species' habitat and range have been severely degraded and limited by water pollution from coal mining and gas exploration activities, reservoir construction and subsequent loss of free-flowing stream habitat, removal of riparian vegetation and concomitant increases in stream temperatures, stream channelization, increased siltation associated with poor agricultural and mining practices, and deforestation of watersheds (Anderson et al. 1991; Henry et al. 1999; Warren and Haag 2005; Jenkins 2007; KDOW 2008). Current regulatory mechanisms have been inadequate to prevent these impacts. Due to the species' limited range, it is also vulnerable to stochastic events such as toxic chemical spills that could cause the extirpation of the species from portions of the LSF or PRR. The disjunct nature of the LSF and PRR populations prohibits the natural interchange of genetic material between these populations, and the small population size reduces the reservoir of genetic diversity within populations. Small, disjunct populations can lead to inbreeding depression and reduced fitness of individuals. It is possible that some of the palezone shiner populations are below the effective population size required to maintain long-term genetic and population viability. Because of its restricted distribution and continued vulnerability to threats, the species continues to meet the definition of endangered (USFWS 2014).

(2020 5-Year Review) The Palezone Shiner continues to be threatened by three of the Service's five listing factors: the present or threatened destruction, modification, or curtailment of its habitat or range; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence. The species' habitat and range have been severely degraded and limited by water pollution from historical coal mining and gas exploration activities, reservoir construction and subsequent loss of free-flowing stream habitat, removal of riparian vegetation and concomitant increases in stream temperatures, stream channelization, increased siltation associated with poor agricultural and mining practices, and deforestation of watersheds. Current regulatory mechanisms have been inadequate to prevent these threats, and past threats are still present and influencing the species' survival and reproduction. Due to the species' limited range, it is also vulnerable to stochastic events such as toxic chemical spills that could cause the extirpation of the species from significant portions of the Little South Fork or Paint Rock systems. The linear nature of occupied reaches on the Little South Fork and Paint Rock increases their vulnerability to a chemical spill, and the hundreds of oil and gas wells in the upper portions of the Little South Fork system represent an abundant source of these pollutants. The disjunct nature of the Little South Fork and Paint Rock populations prohibits the natural interchange of genetic material between these populations, and the small population size reduces the reservoir of genetic diversity within populations. This can lead to inbreeding depression and reduced fitness of individuals. It is possible that some of the Palezone Shiner populations are below the effective population size required to maintain long-term genetic and population viability.

Based on the best available scientific and commercial information available to the Service regarding the species' current status and past, present, and future threats, the species continues to be impacted by poor water quality and habitat deterioration resulting from resource extraction activities and channelization, siltation caused by poor land use practices, reductions in riparian cover, and by other nonpoint-source pollutants. The limited distribution of these populations also makes them vulnerable to toxic chemical spills and limits the natural genetic exchange between and within populations.

EB/CE Source:

U.S. Fish and Wildlife Service. 2020. Palezone shiner (*Notropis albizonatus*) 5-Year Review: Summary and Evaluation. Kentucky Ecological Services Field Office, Frankfort, Kentucky. 30 pp.

U.S. Fish and Wildlife Service. 1993. Endangered and threatened wildlife and plants: determination of endangered status for the duskytail darter, palezone shiner, and pygmy madtom. Federal Register 58: 25758-25763.

U.S. Fish and Wildlife Service. 2014. Palezone shiner (*Notropis albizonatus*) 5-Year Review: Summary and Evaluation. Kentucky Ecological Services Field Office, Frankfort, Kentucky. 19 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 1,598,086 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 425,858 acres, 26.648%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact

amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	**Common Name:**	**Entity ID:**
Notropis cahabae	Cahaba shiner	277

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Cahaba shiner, a cyprinid, is endemic to the mainstem Cahaba River, Alabama. At the time of listing, its range was believed to have been reduced from approximately 76 river mi to 60 river mi with most of the population in only 15 river mi. Historic populations of the Cahaba shiner have been seriously affected by urbanization, sewage pollution, and strip-mining activities in the upper Cahaba River Basin. In 1999, the species' range more than doubled with the discovery of the Locust Fork population, which added 118 km (73 mi) of the Locust Fork of the Black Warrior River and 8 km (5 mi) in Blackburn Fork, a tributary to the Locust Fork (Kuhajda and Shepard 2004). Cahaba shiner populations in most parts of their range are at the same general levels as in 1989 (Jelks et al. 2008).

In general, the Cahaba River has shown marginal improvement in water quality over the last 15 years. However, several studies of the upper Cahaba River watershed identify occasional impairments of the rivers' designated uses by siltation from urbanization and eutrophication from municipal wastewater sources and nonpoint sources (O'Neil 2002, USEPA 2003). Episodes of poor water quality and low water quantity with a high potential of non-point source pollution due to urbanization (ADEM 2013, 2006) occur sporadically and likely impact the species. Technical support for stormwater management, pollution control, habitat enhancement, and other projects within the watershed has been provided by the U.S. Fish and Wildlife Service, U.S. Forest Service, The Nature Conservancy, U.S. Geological Survey, Natural Resource Conservation Service, Alabama Department of Environmental Management (ADEM), and the Alabama Department of Conservation and Natural Resources. Abundant technical watershed-based, river management and conservation plans, including the identification of Total Maximum Daily Loads (TMDLs) and monitoring of water quantity and quality parameters, are available (Cahaba River/Lake Purdy Watershed Protection Policy 2012; Friends of Shades Creek 2008; USFWS 2007; ADEM 2013 2006, 2004; Alabama Clean Water Partnership 2011; McKinney 2006; Cahaba River Society 2005; Black Warrior River Watershed Management Plan 2003). Community action groups strive to protect water quality and quantity through watershed and water quality monitoring projects. Construction of the 52-mile Northern Beltline corridor (in process, as of 2016) is expected to permanently alter portions of Black Warrior and Cahaba River streams and wetlands in 125 places, 90 of which are in the Black Warrior River basin (ADEM 2013). The stream may experience increased water velocities that result in streambed and bank erosion and degradation, sediment and pollutant loading, and other morphological changes runoff (USDOT and ALDOT 2012). While there have been some improvements in the species' numbers and habitat at selected sites, the Service was unable to document that current populations are viable and that water quality degradation no longer poses a threat to this species in the 2016 5-year review.

EB/CE Source:

U.S. Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; Endangered status determined for the fish Cahaba shiner (*Notropis cahabae*). Federal Register 55(207):42961-42966.

U.S. Fish and Wildlife Service. 1992. Cahaba Shiner (*Notropis cahabae*) Recovery Plan. Mississippi Ecological Services Field Office, Jackson, Mississippi. 15 pp.

U.S. Fish and Wildlife Service. 2016. Cahaba Shiner (*Notropis cahabae*) 5-Year Review: Summary and Evaluation. Mississippi Ecological Services Field Office, Jackson, Mississippi. 28 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Cahaba shiner does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 2,347,766 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 105,216 acres, 4.482%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Notropis girardi	Arkansas River shiner	299

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Arkansas River shiner is a minnow (family Cyprinidae) once widespread and common in the western portion of the Arkansas River basin in Kansas, New Mexico, Oklahoma, Arkansas, and Texas. This species is no longer found in over 83 percent of its historical range (3,896 river miles) and now appears to be entirely restricted to portions of the South Canadian River (or identified as Canadian River on USGS topographic maps) in eastern New Mexico, the Texas panhandle, and Oklahoma (673 river miles) (63 FR 64772). A non-native, introduced population of the Arkansas River shiner occurs in the Pecos River in New Mexico, just outside of the species' historical native range (Bestgen et al. 1989, p. 228).

After evaluating threats to the species and assessing the cumulative effects of the threats under the section 4(a)(1) factors, we find that the species' resiliency, representation, and redundancy are at levels that currently allow the Arkansas River shiner to persist in the Arkansas River basin as two self-sustaining populations; one in the upper South Canadian River and one in the lower South Canadian River. The resiliency of each population is currently considered to be at moderate level, making it less vulnerable to a catastrophic event as compared to a population with low resiliency.

However, given current downward trends of the species and its habitat we expect that population resiliency for Arkansas River basin populations of the Arkansas River shiner will be further reduced from current condition. This reduction could lead to low resiliency of both remaining populations within 20 years, with potential extirpation of one of those two populations within 50 years. Future species and water conservation efforts could provide more population resiliency and add redundancy through the successful re-introduction and management of new populations, but those efforts are only in their planning stages. Given that redundancy is currently limited (only two remaining populations) and with future anticipated declines in population resiliency, the remaining populations of Arkansas River shiner will be more vulnerable to extirpations as compared to current condition.

EB/CE Source:
U.S. Fish and Wildlife Service. 2020. Arkansas River Shiner (*Notropis girardi*) 5-Year Review: Summary and Evaluation. Okalahoma Ecological Services Field Office, Tulsa, Oklahoma. 20 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Arkansas River shiner does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 27,413,247 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 988,993 acres, 3.608%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is

limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Notropis mekistocholas	Cape Fear shiner	242

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Cape Fear Shiners have been found in the mainstem reaches and some tributaries of the Cape Fear, Deep, Haw, and Rocky rivers and in Bear Creek in Chatham, Hamett, Lee, Moore, and Randolph counties (Snelson 1971). As an endemic to the Cape Fear River basin, the Cape Fear Shiner's range has always been restricted; however, its range and population size apparently decreased as recently as 50 years ago (Gold et al. 2004; Pottem and Huish 1985, 1986 and 1987; Saillant et al. 2004).

Progress has been made towards improving connectivity of populations via dam removals as well as implementation of management strategies in the Deep and Rocky rivers. Although dams remain a major threat to Cape Fear Shiner movement, recent genetic research indicates that existing dams within the river basin have not created genetically isolated populations of the shiner. Recent habitat assessments throughout the Cape Fear Shiner's historical range indicate that water quality and riparian degradation pose substantial threats to the shiner's recovery. However, multiple ecotoxicology studies on the shiner indicate that existing numeric water quality standards for the State of North Carolina are generally adequate for survival and growth of the Cape Fear Shiner, but that water quality still falls short of the State's standards in some previously or currently occupied Cape Fear Shiner habitats. Additionally, establishment of riparian buffer rules for the upper Cape Fear River basin (beyond the Haw River via the Jordan Lake Nutrient Strategy) as well as reclassification of the basin's water resources to High Quality or Outstanding Resource Waters (at least for the Deep, Rocky, Haw, upper Cape Fear rivers, and tributaries like Buffalo Creek and McLendon's Creek) and site-specific water quality management planning can further improve the Cape Fear Shiner's recovery.

In addition to dams (stream channel and stream flow modification) and water quality (pollution, chemical spills, impoundment for wastewater management), other threats of the Cape Fear Shiner include roadway construction, climate change, and potentially shale gas development. Diseases attributed to gill parasites and liver lesions also may threaten Cape Fear Shiners. In spite of these various threats, however, historical and recent collection surveys indicate the Cape

Fear Shiner remains common at the confluence of the Deep and Rocky rivers, in the lower Rocky River (below Hoosier Dam), along the Deep River between High Falls Dam and the former Carbonton Dam, and along the lower Deep River between Lockville Dam and US Highway 1.

EB/CE Source:
U.S. Fish and Wildlife Service. 2017. Cape Fear Shiner (*Notropis mekistocholas*) 5 Year Review: Summary and Evaluation. Raleigh, North Carolina. pp. 47.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Cape Fear shiner does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 2,443,806 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 147,737 acres, 6.045%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic

habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Notropis simus pecosensis	Pecos bluntnose shiner	279

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Single population
Species Trends: Increasing population(s)
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The historic range of the Pecos bluntnose shiner in the Pecos River was 392 river mi (631 km) from Santa Rosa, New Mexico to the New Mexico-Texas border (Delaware River confluence). At the time of listing in 1987, the Pecos bluntnose shiner was confined to the mainstem Pecos River from the town of Fort Sumner to Major Johnson Springs, New Mexico (roughly 202 river mi, 325 km) (Hatch et al. 1985, Service 1987). In 2003 (Service 2003a), the range of the Pecos bluntnose shiner was described as extending from Old Fort Sumner State Park to Brantley Reservoir (194 mi, 318 km), comprising about 23% of the historical range of the species. The current occupied range of the Pecos bluntnose shiner is from the confluence of Taiban Creek with the Pecos River to Brantley Reservoir. Pecos bluntnose shiner has not been found in the reach above Taiban Creek since 1999, even though there are no apparent barriers limiting Pecos bluntnose shiner access to this area (Service 2003a, Davenport 2008b). This change in distribution, eliminating approximately 5 mi (8 km) between the Old Fort Sumner State Park and Taiban Creek, reduces the occupied range to 186 mi (298 km). The "stronghold" for the species occurs in the Rangelands reach (Hoagstrom 2003a). Habitat availability and suitability are the best within this reach of the river and all size classes are present (Hoagstrom 2003a, b).

Dams have fragmented Pecos bluntnose shiner habitat and altered the natural river hydrograph. The biggest threat to Pecos bluntnose shiner is river intermittency and negative effects on the population have been documented. Although Reclamation is committed to keeping the river whole between Sumner Dam and Brantley Reservoir, their options for maintaining flow are currently limited. If climate change leads to drier and/or hotter conditions, it is unlikely that intermittency could be prevented with the water currently available for Pecos bluntnose shiner conservation. Although golden algae is not currently a threat to Pecos bluntnose shiner, climate change could cause decreases in flow and a greater proportion of flow coming from agricultural return, leading to increased nutrient and salt concentrations. After these changes occur, golden algae could become an issue in portions of the river, depending on how the river is managed. The Pecos bluntnose shiner population is currently stable and is increasing, with the continuous river flows since 2005. Additional secure sources of supplemental water still need to be found, funded, and authorized to ensure that flowing water can be maintained from the Taiban Creek confluence to Brantley Reservoir. If climate change leads to consistently less snow pack in the headwaters, or widespread, long-lasting drought, maintaining a continuous river will become very challenging under current river operations.

EB/CE Source:
U.S. Fish and Wildlife Service. 2010. Pecos Bluntnose Shiner (Notropis simus pecosensis) 5-Year Review: Summary and Evaluation. New Mexico Ecological Services Field Office, Albuquerque, New Mexico. 37 pp.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 10,193,786 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 3,355,884 acres, 32.921%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic

habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Notropis topeka=tristis	Topeka shiner	311

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Topeka shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska. At the time of listing, we concluded that the species was endangered due to the species' recent significant reduction in range and the extirpation of the species throughout most of its historic range, within the context of the expected impacts from present and planned projects and activities. This conclusion has proven accurate in southern portions of the range (i.e., Kansas, Missouri, Nebraska, and most of Iowa) where historic changes in land-use, land-cover, and hydrology have largely reduced the species to small, isolated populations susceptible to ongoing and projected threats (Menzel pers. comm. 2002; 69 FR 44736, July 27, 2004; Howell pers. comm. 2006; Kansas Department of Wildlife and Parks 2006; Kansas Department of Wildlife and Parks 2007; McPeek pers. comm. 2007; Stark 2007; Davis 2008). Even with Federal protection, it is likely that additional sites in this portion of the range will be lost within the foreseeable future, consistent with extirpations in the recent past (Missouri Department of Conservation 1999; Stark et al. 1999; Kerns pers. comm. 2007; Tabor pers. comm. 2009).

However, new distribution data and a better understanding of threats in the northern portion of the species' range has altered our perception of the species' status as a whole. At the time of listing, the Topeka shiner was known from 20 stream sites in Minnesota, South Dakota, and Iowa's Rock River watershed. This apparently limited distribution and the assumption that the species had been lost from so many areas supported our assertion that the species was highly susceptible to documented threats across its range and trending toward extinction. Since listing, additional survey work has resulted in a 7-fold increase in the number of occupied stream sites across this portion of the species' range. Topeka shiner populations in Minnesota and South Dakota now appear to be closely representative of the species' known historic range (Ceas and Anderson 2004; Wall et al. 2004; Wall and Thompson 2007; Ceas and Larson 2008). Such data indicates the species continues to be widespread despite impacts to stream habitat (Ceas and Monstad 2005; Wall and Thompson 2007; Ceas and Larson 2008). While the reason for this apparent resiliency is not certain, it may be related to ecological differences caused by the area's geologic morainal features (Clark 2000; Wall et al. 2004). These features appear to have positively influenced groundwater inputs to streams and perennial pools in intermittent streams, benefiting the species' ability to persist (Berg et al. 2004; Wall et al. 2004). We now know that the extent of the species' population decline is not as severe as originally presumed and that vulnerability of many of the remaining populations is substantially lower than presumed at the time of listing.

2021 5-Year Review
Given the high number of currently occupied streams (223) compared to when the species was listed (approximately 57), the current levels of resiliency found within populations, the spread of populations and population complexes around the six-state range, the genetic and ecological diversity observed, and the lack of significant, imminent stressors, we believe that the Topeka shiner currently has sufficient ability to withstand stochastic and catastrophic events and to adapt to environmental changes. Therefore, we conclude that the current risk of extinction is low, such that the Topeka shiner is not currently in danger of extinction throughout all of its range.

Our review of the best available scientific and commercial information indicates that the Topeka shiner does not meet the definition of an endangered species but does meet the definition of a threatened species in accordance with Section 3(6) and 3(20) of the Act. Therefore, with this 5-year status review, we recommend that the Topeka shiner be downlisted to a threatened species under the Act.

EB/CE Source:
U.S. Fish and Wildlife Service. 2021. Topeka shiner (*Notropis Topeka*) 5-Year Review: Evaluation and Summary. Interior Regions 5 and 7, Denver, Colorado. 20 pp.

U.S. Fish and Wildlife Service. 1998. Endangered and Threatened Wildlife and Plants; Final Rule To List the Topeka Shiner as Endangered. Federal Register 63(240):69008-69021.

U.S. Fish and Wildlife Service. 2010. Topeka shiner (*Notropis Topeka*) 5-Year Review: Evaluation and Summary. Kansas Ecological Services Field Office, Manhattan, Kansas.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Topeka shiner does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 42,050,888 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 533,765 acres, 1.269%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Phoxinus cumberlandensis	Blackside dace	295

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (numerous)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
When the recovery plan for blackside dace was completed in 1988, the species was known from a total of 35 streams in Kentucky and Tennessee. Currently, blackside dace populations are estimated to persist in 125 streams across nine Kentucky counties (Bell, Harlan, Knox, Laurel, Letcher, McCreary, Perry, Pulaski, and Whitley), three Tennessee counties (Campbell, Claiborne, and Scott), and two Virginia counties (Lee and Scott) (Black et al. 2013a; Skelton 2007, 2013; USFWS unpublished data). Considering the distribution of these streams and the species' maximum recorded movement of 4 km, it is estimated the species is currently represented by 57 isolated groups (populations) that are functionally separated from one another. Over the past 27 years, we have gained more protected, occupied streams in the eight sub-basins (recovery units) summarized in the species' recovery plan; however, more information is needed to evaluate the genetic diversity and viability of populations in these streams. Based on survey results and our observations regarding abundance, age-class structure, and recruitment, we estimate that 76 streams contain stable populations, with the remaining 49 streams rated as vulnerable. The species appears to have been extirpated from at least 31 streams in which it was previously documented.

Land ownership in the majority of blackside dace watersheds is private, but significant portions of 47 blackside dace watersheds (watersheds with >50% ownership) are in public ownership. Most of these watersheds (85%) are located on the Daniel Boone National Forest (DBNF) in Laurel, McCreary, Pulaski, and Whitley Counties, Kentucky. Public ownership on the DBNF varies between 25-100%, and DBNF streams are managed under the DBNF's Land and Resource Management Plan (USFS 2004). Outside of the DBNF in Kentucky, public ownership in dace watersheds is limited to the Poor Fork headwaters in Letcher County (Jefferson National Forest), Bad Branch in Letcher County (Bad Branch State Nature Preserve), Watts Creek in Harlan County (Blanton Forest State Nature Preserve), Davis Branch, Little Yellow Creek, and Sugar Run in Bell County, Kentucky (Cumberland Gap National Historical Park (NHP)), and Wolf Creek (Big South Fork National River and Recreation Area (NRRA)) in McCreary County. Within Tennessee, public ownership is limited to the headwaters of Little Yellow Creek in

Claiborne County (Cumberland Gap NHP), two tributaries of Rock Creek (Massey Branch and an unnamed tributary) in Campbell County (Big South Fork NRRA), and four stream systems located on the North Cumberland Wildlife Management Area in Campbell and Scott Counties - Elk Fork Creek, Hudson Branch, Terry Creek, and Straight Fork (including Cross Branch and Jake Branch). New information has been gathered on the species' current distribution and biological requirements since 1988, but management strategies have not been developed.

Three of the five listing factors pose threats to the blackside dace: the present or threatened destruction, modification, or curtailment of its habitat or range; the inadequacy of existing regulatory mechanisms; and other natural or anthropogenic factors affecting its continued existence. The species' habitat and range have been modified and limited by both water quality degradation and physical habitat disturbance. Water quality impacts (e.g., elevated conductivity, high sulfates) associated with surface coal mining, oil and gas exploration, and other land use practices vary from low to high magnitude across the species' range, but they are most severe in the eastern half of the range, where intensive land disturbances, such as surface coal mining, are most prevalent. Activities associated with surface coal mining are a major source of pollutants because they have the potential to contribute high concentrations of dissolved metals and other solids that elevate stream conductivity, increase sulfate and hardness levels, and cause wide fluctuations in stream pH. These water quality changes can be permanent and render these habitats unsuitable for blackside dace. Black et al. (2013b) and Hitt (2014) demonstrated that blackside dace do not persist in areas with elevated stream conductivity, and declines or extirpations have been observed when conductivity levels exceed 240 µS/cm.

Based on all of these factors, we consider water quality degradation to be severe and of high magnitude in the eastern half of the range. In the western half of the species' range, water quality threats are diminished (low magnitude) because surface coal mining is less prevalent, average water quality conditions are better (e.g., low conductivity), and large portions of the upper Cumberland River drainage are in public ownership (e.g., DBNF and North Cumberland Wildlife Management Area). For this particular threat, we consider the variation in magnitude from west to east and arrive at an overall threat magnitude of "moderate." Physical habitat degradation associated with sedimentation and other physical habitat disturbance (e.g., loss of riparian vegetation, channelization) is widespread across the blackside dace's range. Sedimentation/siltation is the most significant threat to physical habitat quality across the species' range, and sedimentation continues to be ranked by the Kentucky Department of Widlife as the most common stressor of aquatic communities in the upper Cumberland River system. We consider physical habitat threats to be of moderate magnitude due to their widespread occurrence and the fact that several blackside dace populations have disappeared from systems impacted solely by these threats.

Current regulatory mechanisms, such as the Federal Clean Water Act, have contributed to some water quality and habitat improvements across the species' range, especially on public lands (e.g., DBNF); however, they alone have been inadequate to prevent water quality degradation and habitat disturbance. The disjunct nature of some blackside dace populations restricts the natural interchange of genetic material between populations and makes natural repopulation following localized extirpations arduous without human intervention. The small size of many blackside dace populations may make them vulnerable to extirpation from intentional or accidental toxic chemical spills, habitat modification, progressive degradation from runoff (non-point source pollutants), natural catastrophic changes to their habitat (e.g., flood scour or drought), and other stochastic disturbances, such as loss of genetic variation and inbreeding. The species' patchy distribution limits the natural genetic exchange between and within its populations. Based on the best available scientific and commercial information available to the Service regarding the species' current status and past, present, and future threats, the species continues to be impacted by poor water quality and habitat deterioration resulting from resource extraction activities, siltation caused by poor land use practices, reductions in riparian cover, and by other nonpoint-source pollutants.

EB/CE Source:
U.S. Fish and Wildlife Service. 2015. Blackside Dace (*Phoxinus cumberlandensis*) 5 Year Review: Summary and Evaluation. Frankfort, Kentucky. pp. 84.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

 # acres in species range: 5,692,041 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,308,357 acres, 22.986%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Plagopterus argentissimus	Woundfin	234

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
After creation of Lake Mead, woundfin and Virgin River chub had a very limited geographic range, largely confined to the Virgin River mainstem downstream from La Verkin Springs to approximately Halfway Wash. This range has been significantly reduced due to red shiner colonization of the Virgin River as well as decreases of instream flows. Red shiner moved up from Lake Mead rapidly displacing native fish in the Virgin River through competition and direct predation. By the late 1980s, the only portion of woundfin and Virgin River chub historic habitat not occupied by red shiner was the Ash Creek to Washington Fields Diversion reach. Although limited numbers of woundfin and Virgin River chub are periodically present in downstream reaches, the only consistently viable populations are present in the 26.3 km (16.3 mi) reach of the Virgin River mainstem between Ash Creek downstream to the Washington Fields Diversion

The limited distribution of woundfin and Virgin River chub populations reduce their ability to respond to stochastic change and makes them particularly vulnerable to catastrophic environmental events. The continued persistence of woundfin and Virgin River chub within this limited distribution threatened by a variety of environmental and human induced factors. Limiting factors include water quality conditions, high water temperatures and clear water associated with low summer flows, predation and competition from nonnative fish, and late summer flow events. Populations are particularly susceptible to episodic spike flows and associated adverse water quality events during late summer low flow and high temperature periods. Runoff and sediment transported by flash events can rapidly reduce dissolved oxygen levels resulting in direct mortality, displacement of fish, and modification of thermal refuge areas. High flow events can also reduce resource and habitat availability through scouring and sediment deposit, and can modify highly productive nursery habitats limiting young-of-year survival and recruitment. In addition, high flow events in late summer can displace a high percentage of larval fish downstream into reaches occupied by red shiner, thus removing or severely limiting annual recruitment.

Woundfin and Virgin River chub population abundance in the Ash Creek to Washington Fields Diversion reach are highly variable and fluctuate with water year. Generally, low water years associated drought reduce abundance of woundfin and Virgin River chub populations, and limit successful reproduction and recruitment. Conversely, high water years with extended spring runoff triggers reproduction and the resulting higher summer flows enhance survival and recruitment. Drought periods with below average water years result in depressed population numbers and distribution of woundfin and Virgin River chub. The persistence of woundfin and Virgin River chub during these poor water years is dependent upon ongoing cooperative intensive management actions (e.g., water releases, hatchery propagation, stocking) to maintain populations and enable population response during favorable conditions. Short lived woundfin are highly susceptible to prolonged low flow periods while the longer life span of Virgin River chub allows populations to withstand low water years and respond during good water years. Thus, Virgin River chub are not as susceptible to stochastic and catastrophic events and populations are better able to respond following population declines.

For the last 15 to 20 years, woundfin and Virgin River chub populations remained low during low water years and responded with large reproduction events and recruitment during high water years (e.g., 2005, 2011). However, despite extremely low water years from 2012 through 2015, woundfin populations in the Ash Creek to Washington Fields Diversion reach responded with reproduction and recruitment in 2015, resulting in unexpectedly high fall and subsequent spring population numbers. This woundfin population increase was likely the result of intensively managed water releases by the Washington County Water Conservancy District to offset high summer water temperature extremes through the pumpback system, increased turbidity, controlled sediment releases, and hatchery stocking. Implementation of these actions through the Virgin River Program has stabilized population declines and maintained woundfin and Virgin River chub populations between Ash Creek and Washington Fields Diversion. Additional partnerships in the lower Virgin River are needed to assist with rotenone treatments, restoration projects, and fish barriers. The continued cooperation between the Washington County Water Conservancy District, local interests, and State and Federal agencies through implementation of the Virgin River Program is necessary to maintain woundfin and Virgin River chub populations within their limited geographic range.

EB/CE Source:
U.S. Fish and Wildlife Service. 2020. Virgin River Fishes, Woundfin (*Plagopterus argentissimus*) and Virgin River Chub (*Gila seminuda*) 5-Year Review: Summary and Evaluation. Utah Field Office, West Valley City, Utah. 140 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 2,922,018 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,582,410 acres, 88.378%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Ptychocheilus lucius	Colorado pikeminnow	215

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Increasing population(s)
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Colorado pikeminnow is endemic to the Colorado River basin, where it was once widespread and abundant in warm-water rivers and tributaries. Wild populations of Colorado pikeminnow are found only in the upper basin of the Colorado River (above Lake Powell). Three wild populations of Colorado pikeminnow are found in about 1,090 miles of riverine habitat in the Green River, upper Colorado River, and San Juan River sub-basins.

At the time of listing, habitat losses were documented but the threats to Colorado pikeminnow were poorly understood and distribution and abundance of the species were not well known. The decline of the species was probably a combination of threats, including direct loss of habitat, changes in flow and temperature, and blockage of migration routes by the construction of large reservoirs. In addition, interaction with non-native fish may have had a decimating effect in waters not affected by dams. For example, the Colorado pikeminnow was first listed as endangered following a period of dam construction throughout the Colorado River Basin. Total Colorado pikeminnow habitat lost to reservoir inundation in the upper basin is about 435 miles, including Flaming Gorge on the Green River (99 mi), Lake Powell (199 mi on the Colorado River and 75 mi on the San Juan River), and Navajo Reservoir on the San Juan River (62 mi). Cold-water releases have eliminated most native fishes from river reaches immediately downstream of dams. Adult Colorado pikeminnow are long-distance migrators to and from spawning sites; 10 barriers are identified in the upper basin upstream of Glen Canyon Dam within occupied habitat of Colorado pikeminnow. Maintenance of streamflow is important to the ecological integrity of large western rivers. Flow recommendations have been developed for some river systems in the Upper Colorado River Basin that identify and describe flows with necessary magnitude, frequency, duration, and timing to benefit the endangered fish species. Flows necessary to restore and maintain required habitats of Colorado pikeminnow mimic the natural hydrograph and include spring peak flows and summer–winter base flows. Flow recommendations have been developed that specifically consider flow habitat relationships within occupied habitat of Colorado pikeminnow in the upper Colorado River. Streamflow regulation and associated habitat modification are identified as primary threats to Colorado pikeminnow populations. Various efforts have been undertaken to ameliorate these effects, including but not limited to flow management, fish passage, and avoidance of entrainment at diversions (e.g., screens).

Colorado pikeminnow populations in the upper basin live sympatrically with about 20 species of warm-water, non-native fishes that are potential predators, competitors, and vectors for parasites and diseases. Channel catfish and northern pike have been identified as the principal non-native threats to sub-adult and adult Colorado pikeminnow in the upper basin. A Strategic Plan for Non-native Fish Control was developed for the Upper Colorado River Basin. Control of the release and escapement of non-native fishes into the main river, floodplain, and tributaries is a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous non-natives from riverside features. Annual flooding of the river can inundate riverside ponds potentially containing large numbers of green sunfish (*Lepomis cyanellus*), black bullhead (*Ameiurus melas*), largemouth bass (*Micropterus salmoides*), and other non-native fishes that may escape to the river during high flows. Some efforts have been made to reduce competiion and predation by controlling non-native fish, although the recovery criteria addressing this concern has not yet been fully met.
The potential role of pesticides and pollutants in suppressing populations of Colorado pikeminnow is not well understood. Pesticides find their way to the Colorado River from agricultural runoff, and other pollutants in the system include petroleum products, heavy metals (e.g., mercury, lead, zine, copper), nonmetals (i.e., selenium), and radionucleides. Potential spills of petroleum products threaten wild populations of Colorado pikeminnow. All States have hazardous-materials spills emergency-response plans that provide a quick cleanup respons

EB/CE Source:
U.S. Fish and Wildlife Service. 2011. Colorado Pikeminnow (*Ptychocheilus lucius*) 5 Year Review: Summary and Evaluation. Denver, Colorado. pp. 28.

U.S. Fish and Wildlife Service. 2002. Colorado Pikeminnow (*Ptychocheilus lucius*) Recovery Goals: Amendment and Supplement to the Colorado Squawfish Recovery Plan. pp. 111.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Colorado pikeminnow does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 83,428,052 acres
% of range in California (i.e., where CalPUR data is available): 2%
Range overlap with Federal lands: 54,912,906 acres, 65.821%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

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Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Rhinichthys osculus lethoporus	Independence Valley speckled dace	268

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
At the time of listing, individuals of the species were known to occupy one spring system within the Warm Springs Complex on private land in Independence Valley, Elko County, Nevada (Service 1989). The exact location of this spring system within the Warm Springs Complex was not identified. The most recent surveys of distribution are those conducted by the U.S. Geological Survey (USGS) from 2006 to 2008 (Johnson et al. 2009). Distribution data from these surveys were not available for the Service's 2008 5-year review (Service 2008). These surveys found the species distributed throughout the Warm Springs marsh, but rare or nonexistent near the spring outflows where non-native largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) were present (Johnson et al. 2009).

The primary threats identified in the 2008 5-year review for the present or threatened destruction, modification, or curtailment of habitat or range were limited distribution and habitat manipulation (Service 2008). Habitat manipulation continues to be a threat.The Warm Springs Complex is under private ownership with no long-term management plan or conservation easement and could be subject to intensive cattle grazing and modifications to the spring systems and marsh (Service 2008). The current habitat conditions are unknown, as Federal and State biologists have not surveyed or accessed the private property on which the Warm Springs Complex is located since 2008.

Disease and predation were considered threats to the population in the 2008 5-year review (Service 2008). Disease has not been assessed nor documented; however, the establishment of non-native fish in the Warm Springs Complex spring systems and marsh may provide an avenue for diseases to be introduced (Minckley and Deacon 1968). Surveys conducted by USGS (Johnson et al. 2009) documented the presence of piscivorous non-native fish (largemouth bass and bluegill) in specific portions of the Warm Springs Complex. As noted in the 2008 5-year review, non-native fish have been known to cause several problems when introduced into native fish habitat (Taylor et al. 1984, Moyle 2002). Given that no Federal or State wildlife agency control or eradication measures have been implemented for non-native fish at the Warm Springs

Complex prior to or since 2008 (J. Petersen, Nevada Department of Wildlife, pers. comm. 2013), predation continues to be a threat. However, the current magnitude of this ongoing threat is unknown due to a lack of survey data to determine whether or not the non-native species have increased in abundance and/or expanded their distributions.

Other factors identified in the 2008 5-year review that remain as threats include vandalism, catastrophic events (drought and wildfire), and climate change (Service 2008). Groundwater withdrawal was considered a threat in the 2008 5-year review; however, we no longer believe groundwater withdrawal to be a threat due to lack of information suggesting that groundwater withdrawal is occurring or will occur in the near future. Preliminary USGS data presented in the 2008 5-year review suggested that individuals were more widespread within the Warm Springs Complex than previously reported (Rissler et al. 2001). Data published after the 2008 5-year review was completed confirmed that limited distribution within the species' historical habitat is no longer a threat to this species. USGS found individuals distributed throughout the Warm Springs marsh except where non-native fish were present (Johnson et al. 2009).

EB/CE Source:
U.S. Fish and Wildlife Service. 2013. Independence Valley Speckled Dace (*Rhinichthys osculus lethoporus*) 5 Year Review: Summary and Evaluation. Reno, Nevada. pp. 16.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 1,325,764 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,001,731 acres, 75.559%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Rhinichthys osculus nevadensis	Ash Meadows speckled dace	264

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The species occurs primarily on Federal lands.

From the 1990 Recovery Plan:
Hydrographically isolated basins which the species occupies in southern Nevada include the Amargosa River, White River, Meadow Valley Wash, Moapa River, and Colorado River (Miller 1984). Manipulation of springs and their outflows reduced the number of populations so that speckled dace are presently found only in the Bradford Springs, Big Spring, Tubbs Springs, and Jackrabbit Spring (Williams and Sada 1985). The population in Jackrabbit Spring was estimated at zero and 11 in 1982 and 1983, respectively, and the population in Big Spring was estimated at 15 and 13 in these same two respective years (Williams and Sada 1985). Speckled dace populations continued downstream some distance from both of these springs when these estimates were made, however, no estimate of population size in these streams was attempted. Tubbs Spring spring pool population was estimated at 35. No population estimates have been made in Bradford Springs. The total population size of Ash Meadows speckled dace is estimated at 500.

Disturbance and alteration of habitat has increased over time. Marshlands were burned, and later land was tilled, springs diverted, and crops were produced. Large-scale disturbance began in the early 1960s when approximately 2,000 acres of Carson Slough was mined for peat, eliminating one of the largest marshes in Nevada (Soltz and Naiman 1978). Athough early surveys had not defined the distribution of Ash Meadows endemic species in upper Carson Slough, comparisons of early and recent collection records show that habitats of this and other species were eliminated by this mining (Hall 1935, Miller 1948, Soltz and Naiman 1978, Knight and Clemmer 1987). Introduction of non-native plants, fish, and other species collectively reduced plant and animal populations by displacement through competion for food and space, and/or predation (Miller 1943, Beatley 1977 a, b; Reveal 1978 a, b, c; Soltz and Naiman 1978, and othe.rs). Springs were dried and diverted, eliminating several populations (Soltz and Naiman 1978, Ono et al. 1983). A number of public agencies and private organizations have been involved with conservation programs in Ash Meadows since the 1950s. For example, approval of the Ash Meadows Habitat Management Plan by the Bureau initiated a number of more recent conservation programs on public domain lands (USBLM 1980). The Bureau has withdrawn from mineral entry 2,681 acres of land within Warm Springs pupfish essential habitat and surrounding Jack Rabbit and Big Springs. This area includes critical habitat for the Ash Meadows speckled dace and other species.

2021 5-Year Review
The 1990 recovery plan documented this subspecies to occur in four springs (Bradford, Big, Jackrabbit, and Tubbs), and identified seven other historic springs (Fairbanks, Rodgers, Kings Pool, Point of Rocks, Forest, Longstreet, and Crystal springs) where the species should be repatriated (Service 1990). Today, nonnative predatory fishes (western mosquitofish, Gambusia affinis) and crayfish (red swamp crayfish, Procambarus clarkii) remain on the Refuge, and in habitats co-occurring with the Ash Meadows speckled dace (Service 2020, unpubl.). Despite attempted mitigation of aquatic invasive species and improvements to habitats, the subspecies regularly occurs (over the last decade) at only three springs on the Refuge (Bradford, Big, and Jackrabbit springs), and only sporadically and in small numbers at several other springs (e.g., Rodgers, Tubbs, Longstreet, etc.). The species-wide distribution of Ash Meadows speckled dace remains extremely limited today.

Abundance of this species is highly variable across the spring locations and fluctuates over time in conjunction with flowing water connectivity in response to precipitation and nonnative fishes. Recent estimates of population size are difficult to compare, especially in light of changing habitat conditions during stream restoration that is ongoing on the Refuge, and the varied protocols used to sample fish over time. Still, total capture estimates from 2012–2019 range from several individuals (1-10 fish) at all sites to several hundred fish at Bradford Springs (Service, unpubl.). At present, the Refuge is unable to survey annually due to staffing, which oftentimes results in surveys that only occur every 2-3 years, a frequency difficult to determine trends in population size. Overall, Ash Meadows speckled dace is generally uncommon compared to the co-occurring Ash Meadows Amargosa pupfish.

The specific concern for groundwater extraction has heightened in recent years with new levels of understanding regarding the level of connectivity of the aquifer feeding springs of Ash Meadows. The hydrogeology of the region has received even more attention given the ongoing demands for water in the desert (i.e., pumping) and the likely reduced springflow as a consequence of climate change. The USGS report of Halford and Jackson (2020) represents the most recent literature available that expands on the basic notion of nearby pumping affecting Ash Meadows. The Ash Meadows discharge area occurs at the terminus of a hydrologically significant feature referred to as the “megachannel” (Winograd and Pearson 1976). The megachannel is a 80 km (50 mi) long by 40 km (25 mi) wide area of fractured carbonate rock that has estimated transmissivities spanning from 20,000 to 2,000,000 ft2 /d (Halford and Jackson 2020). High estimated transmissivities and confined aquifer conditions cause groundwater pumping signals to propagate large distances 24–32 km (15–20 mi) in short timespans (less than 2 yrs) within the megachannel. Therefore, pumping from carbonate rock in the megachannel can significantly impact water levels and spring discharges in the Ash Meadows discharge area. Halford and Jackson (2020) specifically determined that groundwater pumping from within the central Amargosa Desert, at Indian Springs, and at the Nevada National Security Site can capture discharge from springs within the Ash Meadows discharge area. Further discussions between the FWS and the USGS are planned for 2021 that include conducting aquifer tests to estimate the level of drawdown of the aquifer and the effects on the springs.

Significant habitat renovation among historic habitats for Ash Meadows speckled dace has been completed at Crystal, Fairbanks, Jackrabbit, Kings Pool and Point of Rocks, Longstreet, and Rodgers springs across the Refuge (Ash Meadows Natural Resource Management Plan [AM NRMP] in review). While all of these habitats received physical improvements (e.g., barrier removal, channel restoration, native plant revegetation, etc.), only Fairbanks and Jackrabbit springs additionally received treatment for aquatic invasive species (AM NRMP in review). As both additional habitat improvements and removal of aquatic invasive species are still needed, the status of Ash Meadows speckled dace has not substantially improved overall.

EB/CE Source:

U.S. Fish and Wildlife Service. 2021. Ash Meadows Speckled Dace (*Rhinichthys osculus nevadensis*) 5-Year Review: Summary and Evaluation. Southern Nevada Ecological Services Field Office, Las Vegas, Nevada. 9 pp.

U.S. Fish and Wildlife Service. 1990. Recovery Plan for the Endangered and Threatened Species of Ash Meadows. Reno Fish and Wildlife Office, Reno, Nevada. 130 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Ash Meadows speckled dace does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 9,864,452 acres

% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 9,674,070 acres, 98.070%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Rhinichthys osculus oligoporus	Clover Valley speckled dace	265

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The destruction, modification or curtailment of its habitat or range was identified as a threat at the time of listing because of concerns about limited distribution and habitat manipulation due to irrigation practices (Service 1989). Neither the species nor their habitat were known before settlers moved into the area and began manipulating springs to facilitate irrigation. Therefore, precise limits of the historically occupied habitat are unknown. Information gathered about other speckled dace occupying other springs within northern Nevada indicates that speckled dace are likely to have occupied all of the streams and wetlands maintained by local spring discharges. The quantity of suitable habitat was likely not large for these dace since the springs they inhabit are small.

For all three populations of the species, manipulations of habitats downstream from reservoirs have restricted the species to the reservoir and a small section of outflow immediately downstream of them. Initial surveys in 1934 indicated that the springs occupied by this species had already been significantly altered, and that this alteration had presumably occurred many years prior (Hubbs et al. 1974). The outflows were impounded in small reservoirs prior to being distributed to various irrigated pastures. The ditched outflow habitats downstream from these reservoirs fluctuate from watered to dry depending upon the amount of water diverted from the reservoir for irrigation. Continued manipulation (i.e., drawdown) of these reservoirs, and associated reductions in water levels and flow regime in the outflow habitats, continues to prohibit the long-term presence of the species downstream from reservoirs and is primarily responsible for the scarcity of the species in these outflows (Vinyard 1984; Rissler and Scoppettone 2006; Petersen 2009, 2010, 2011). In 2011, the ranch property on which Clover Valley Warm Spring and its outflows occurs (Warm Creek Ranch) was purchased by a private landowner who has proposed converting the existing cattle ranch to a sanctuary for wild horses captured from Federal lands in Nevada. (530,000 ac) of surrounding public lands administered by the BLM. In early 2012, the Service learned that the privately owned property on which Bradish Spring and its outflows occurs was for sale.

Additionally, disease and predation were listed as threats to populations at the time of listing (Service 1989) and are still considered threats. A number of diseases are known to occur naturally in other speckled dace populations in the Great Basin, but these are not believed to have a substantial impact on population viability. To date, disease (whether foreign or naturally-occurring) has not been documented in populations.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Clover Valley Speckled Dace (*Rhinichthys osculus oligoporus*) 5 Year Review: Summary and Evaluation. Reno, Nevada. pp. 25.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 1,030,740 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 773,035 acres, 74.998%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Scientific Name:	Common Name:	Entity ID:
Rhinichthys osculus thermalis	Kendall Warm Springs dace	227

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Kendall Warm Springs dace's entire habitat occurs on property administered by the U. S. Forest Service (USFS), Bridger-Teton National Forest. The species is endemic to one stream (984 feet in length) that originates from a series of thermal springs and seeps. The stream ends in a waterfall and empties into the Green River in Sublette County, Wyoming. The dace's entire habitat occurs on property administered by the U.S. Forest Service (USFS), Bridger-Teton National Forest. The species is believed to occupy their entire historic range (Kaya et al. 1992; Hubbs and Kuhne 1937).

Primary threats at the time of listing were a limited distribution, habitat manipulation, and small population size. Additional threats identified since the time of listing are potential catastrophic habitat loss due to manipulation or pollution of the aquifer that supplies the springs, degradation in habitat quality from potential oil and gas development, and potential non-native species introductions. The following threats could result or have resulted in the destruction, modification, or curtailment of the habitat or range of the dace (USFWS 2007): bathing and the use of soaps, detergents, sunscreen, and bleaches; deleterious effects of research efforts; future oil and gas development potentially authorized in the future by the BLM; presence of livestock (historic threat currently precluded by fencing); increased recreational use of the area; reservoir construction/water impoundments; catastrophic wildfires; acid rain; herbicide/pesticide use; and climate change.

Other potential stressors include disease, predation, inadequate enforcement of certain regulatory mechanisms, toxins, and other natural events, among others. Because there is only one population, found in one geographic area, any detrimental impacts that are negatively affecting the population are affecting the entire population.

EB/CE Source:
U.S. Fish and Wildlife Service. 2015. Kendall Warm Springs Dace (*Rhinichthys osculus thermalis*) Revised Recovery Plan. Cheyenne, Wyoming. pp. 75.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 134,242 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 133,656 acres, 99.564%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Scientific Name:	Common Name:	Entity ID:
Tiaroga cobitis	Loach minnow	273

Family: Cyprinidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Loach minnow face a variety of threats throughout their range in Arizona and New Mexico, including groundwater pumping, surface water diversions, impoundments, dams, channelization, improperly managed livestock grazing, wildfire, agriculture, mining, road building, residential development, and recreation.

These activities, alone and in combination, contribute to riparian habitat loss and degradation of aquatic resources in Arizona and New Mexico. Changes in flow regimes are expected to continue into the foreseeable future. Groundwater pumping, surface water diversions, and drought are reducing available surface flow in streams occupied by the loach minnow. These conditions are ongoing, but drought conditions are worsening and there are at least two large diversion projects in the planning stages that may result in further water withdrawals on the Verde and Gila Rivers. Reduced surface flow in streams can decrease the amount of available habitat by eliminating flowing portions of the stream used by the two species.

In addition, stream channel alterations, such as diversion structures and channelization of streams, affect the flow regimes, substrate, and sedimentation levels that are needed for suitable loach minnow habitat. Impacts associated with roads and bridges, changes in water quality, improper livestock grazing, and recreation have altered or destroyed many of the rivers, streams, and watershed functions in the range of the loach minnow. While fish kills are less common now than in the past, water quality issues exist in several streams, and can include contamination by cadmium, lead, nitrates, beryllium, mercury, and total dissolved solids. These contaminants can have adverse effects on the prey base of the species and can be either sublethal, affecting their overall health or ability to reproduce, or can be lethal to loach minnows. Construction and maintenance at bridges, improper livestock grazing, wildfire, and recreation may also remove or reduce vegetation, which can impact water temperatures. With increased temperatures, the loach minnow may experience multiple behavioral and physiological changes at elevated temperatures, and extreme temperatures can result in death. Decreases in precipitation and increases in temperatures due to climate change and drought are likely to further limit the areas where loach minnow can persist by causing further decreases in surface flows and potentially increases in temperature.

The combined impacts of decreased flows, increased sedimentation, increased temperatures, and impaired water quality diminish the amount of habitat available and the suitability of that habitat in some areas. These impacts are further exacerbated by predation by and competition with non-native species and other factors. The reduced distribution and decreasing numbers of sloach minnow make the species susceptible to natural environmental variability, including climate conditions such as drought. However, research indicates that it is the interaction of individual factors such as non-native fishes and altered flow regimes that is causing a decline of native fish species. Native fishes are unable to maintain a competitive edge in areas where resources are already limited, and these resources are likely to become more limited due to water developments and drought. Increased water demands are likely to further limit the areas where loach minnow can persist.

EB/CE Source:
U. S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Endangered Status and Designations of Critical Habitat for Spikedace and Loach Minnow. 77(36):10810-10932.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Loach minnow does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 15,496,060 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 8,612,485 acres, 55.579%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Integration and Synthesis Summary: Fishes (Gasterosteiformes)

Scientific Name:	Common Name:	Entity ID:
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	232

Family: Gasterosteidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread,
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
In 1917, the species was reported to be abundant in the Los Angeles, San Gabriel, and Santa Ana River systems of the Los Angeles Basin. These rivers and streams have either been reduced to concrete-lined drains or severely altered, and by the time it was listed, the species' range had been reduced to three populations (i.e., Soledad Canyon, San Francisquito Canyon, and Santa Clara River at Del Valle). Additional populations were discovered after listing in Bouquet Canyon, Los Angeles County; San Antonio Creek and Santa Maria River, Santa Barbara County; and the Shay Creek vicinity, San Bernardino County. Currently, the unarmored threespine stickleback are limited to Soledad Canyon, Bouquet Canyon, Santa Clara River, San Antonio Creek, and the Shay Creek vicinity.

All of the threats identified in the UTS recovery plan (Service 1985), remain matters of concern. Of the three applicable factors, we believe that the threats discussed under Factor A pose the greatest risk to the species. The ongoing effects of urbanization, eutrophication, stream channelization, addition of water, groundwater removal, and water quality, are the most critical threats to the habitat of the species; substantial reduction or elimination of these threats is not expected in the near future. Based on the record of urban growth during the past several decades, it is reasonable to conclude that within the foreseeable future, there is a high probability of habitat loss and alteration that would greatly reduce the population size of the species. However, the rate of habitat loss has slowed from historical levels. Restoration efforts are beginning to reverse the trend, but are unlikely to produce a substantially increased and stable habitat base for the species in the foreseeable future.

2021 5-Year Review
Currently, unarmored threespine sticklebacks occur in most of the locations identified in the 2009 5-Year Review. An additional location has been established in Fish Canyon Creek, another

tributary of the Santa Clara River. Also, a potential previously unrecognized unarmored threespine stickleback site may occur in Pine Valley Creek, San Diego County.

Currently, the threats identified in the 2009 5-Year Review are on-going, with the addition of increased climate-related threats, including severe drought and flooding, and large-scale wildfire. The drying-out of wetted areas occupied by unarmored threespine sticklebacks creates a mortality risk from desiccation or terrestrial predators as they become stranded. Heavy flooding can flush and scour occupied habitat resulting in habitat alteration and extirpations. Debris flows, resulting from wildfire and major rain events that bring large quantities of sediment into a watershed, can also substantially alter or destroy suitable habitat for unarmored threespine sticklebacks, resulting in extirpations. A recent synthesis of climate change effects for the Los Angeles area (Hall et al. 2018, entire) projects increasing temperatures under all scenarios, and greater likelihoods of extreme storms and drought.

Since the 2009 5-Year Review, unarmored threespine stickleback rescues have been undertaken at multiple sites, including Soledad Canyon, San Francisquito Canyon, Fish Canyon, and San Felipe Creek, due to severe drought, severe flooding, and/or debris flow events following largescale wildfires.

EB/CE Source:

U.S. Fish and Wildlife Service. 2021. Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office, Ventura, California. 21 pp

U.S. Fish and Wildlife Service. 2009. Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office, Ventura, California. 37 pp

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 1,410,497 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 948,709 acres, 67.261%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Integration and Synthesis Summary: Fishes (Osmeriformes)

Scientific Name:	Common Name:	Entity ID:
Hypomesus transpacificus	Delta smelt	305

Family: Osmeridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened, Five-Year Review Recommendation (10/10/2019): Uplist to Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Delta smelt are endemic to the San Francisco Bay and Sacramento-San Joaquin Delta Estuary (Delta) in California. Delta smelt have been in decline for decades, and numbers have trended precipitously downward since the early 2000s. In the wet water year of 2011, the Fall Mid-Water Trawl (FMWT) index for delta smelt increased to 343, which is the highest index recorded since 2001. It immediately declined again in 2012 to 42 and continued to decline in 2013 and 2014, when the index was 18 and 9, respectively. A new all-time low was reached in 2015 with an index of 7. Eleven of the last 12 years have seen FMWT indexes that have been the lowest ever recorded, and the 2015-2016 results from all five of the surveys analyzed in this review have been the lowest ever recorded for the delta smelt.

The primary known threats cited in the 12-month finding to reclassify the delta smelt from threatened to endangered (75 FR 17667; April 7, 2010) are: entrainment by State and Federal water export facilities; summer and fall increases in salinity due to reductions in freshwater flow and summer and fall increases in water clarity; and effects from introduced species, primarily the overbite clam and *Egeria densa*. Additional threats include predation, entrainment into power plants, contaminants, and the increased vulnerability to all these threats resulting from small population size. Since the 2010 warranted 12-month finding, we identified climate change as an additional threat. One of the two power plants within the range of the delta smelt that used water for cooling has shut down, and power plants are no longer thought to be a threat to the population as a whole. We have identified a number of existing regulatory mechanisms that provide protective measures that affect the stressors acting on the delta smelt.

EB/CE Source:
U.S. Fish and Wildlife Service. 1996. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. Portland, Oregon. 195 pp.

U.S. Fish and Wildlife Service 2010a. 5-Year Review, Short Form Summary, Species Reviewed: Delta Smelt (*Hypomesus transpacificus*). 5 pp.

U.S. Fish and Wildlife Service 2010b. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to Reclassify the Delta Smelt From Threatened to Endangered Throughout Its Range. Federal Register 75:17667-17680.

U.S. Fish and Wildlife Service 2016a. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notification of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register 81:87246- 87272.

U.S. Fish and Wildlife Service 2016b. Species Assessment and Listing Priority Assessment Form for the Delta smelt, *Hypomesus transpacificus*. Region 8. 59 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Delta smelt does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 16,224,887 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 7,025,312 acres, 43.300%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Spirinchus thaleichthys	Longfin smelt	11262

Family: Osmeridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Candidate
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The longfin smelt is found along the Pacific coastline from California to Alaska, USA. The Bay-Delta population (DPS) has experienced declines since the 1980s. Relative abundance indices for longfin smelt have generally declined further since 2004 (abundance has been very low since 2000).

The primary threat to the Bay-Delta longfin smelt is reduced freshwater flows. In the Bay-Delta, freshwater flow is strongly related to the natural hydrologic cycles of drought and flood. As California's population has grown, demands for reliable water supplies and flood protection have grown. In response, local, state, and federal agencies have built dams and canals and captured water in reservoirs to increase capacity for water storage and conveyance, resulting in one of the largest anthropogenic water systems in the world (Nichols et al. 1986, p. 569). Operation of this system has altered the seasonal pattern of freshwater flows in the Bay-Delta. Storage in the upper watershed of peak runoff and release of the captured water for irrigation and urban needs during subsequent low flow periods result in a broader, flatter hydrograph with less seasonal variability in freshwater flows into the estuary (Kimmerer 2004, p. 15).

In addition to the system of dams and canals built throughout the Sacramento and San Joaquin River basins, the Bay-Delta is unique in having the largest water diversion system on the west coast. The State Water Project (SWP) and Central Valley Project (CVP) each operate two water export facilities in the Delta (Kimmerer and Nobriga 2008, p. 2). In total, an estimated 39% of the estuary's unimpaired flow is consumed upstream or diverted from the estuary (Cloern and Jassby 2012, p. 8). Water operations are regulated in part by the California State Water Resources Control Board (SWRCB) according to the Water Quality Control Plan (WQCP) (SWRCB 2000, entire). The WQCP limits Delta water exports in relation to Delta (the Export/Inflow, or E/I ratio). Operations are also regulated by both the Service's and National Marine Fisheries Service (NMFS)'s current Biological Opinions (BOs) for the long-term operation of the CVP & SWP (USFWS 2008, NMFS 2009). These restrictions are also thought to provide protections for longfin smelt. Additionally, the State of California has been experiencing drought conditions which further decreased freshwater flows. Physiological stress from warm water temperatures and additional related impacts may occur through changes in the availability and distribution of habitat. These habitat impacts may occur as a result of (1) changes in the timing and availability of freshwater flow into the estuary due to reduced snowpack and earlier melting of the snowpack; (2) sea level rise and saltwater intrusion into the estuary; (3) effects associated with increased water temperatures; and (4) effects related to changes in frequency and intensity of storms, floods, and droughts.

Channel maintenance dredging in the Bay-Delta is an ongoing periodic disturbance of longfin smelt habitat. Dredging and other channel disturbances potentially degrade or remove spawning habitat and suction dredging can entrain fish and eggs. Other factors affecting the continued existence of the Bay-Delta Distinct Population Segment (DPS) of longfin smelt are entrainment losses due to water diversions, food web changes caused by introduced species and contaminants, and possibly, physiological or behavioral impairment from contaminants.

There are several examples of pesticides issues that have been recognized. In 2014, over 21 million pounds of pesticides were applied within the five-county Bay-Delta area, and Bay-Delta waters are listed under the Clean Water Act section 303(d) as impaired for several legacy and currently used pesticides (California Department of Pesticide Regulation 2016, p. 1). Contaminants have been identified in the delta, including high ammonium concentrations and other pesticides. Concentrations of dissolved pesticides vary in the Delta both temporally and spatially (Kuivila 1999, entire). For example, several areas of the Delta, particularly the San Joaquin River and its tributaries, and the tributaries of the Yolo Bypass, are impaired due to elevated levels of diazinon and chlorpyrifos, which are toxic to some aquatic organisms at low concentrations (MacCoy et al. 1995, pp. 21–30). The effects to longfin smelt can be direct or indirect (effects that reduce the food supply of the longfin smelt). Pyrethroid insecticides are of particular concern because of their widespread use, and their tendency to be genotoxic (DNA damaging) to fishes at low doses (in the range of micrograms per liter) (Campana et al. 1999, p. 159). In addition, pyrethroids may interfere with nerve cell function, which could eventually result in paralysis (Bradbury and Coats 1989, pp.377–378; Shafer and Meyer 2004, pp. 304–305). Indirect effects to longfin smelt through the food web have been documented. Additionally, complex mixtures of contaminants spanning many different classes can be common in regions heavily influenced by agricultural or urban environments. The threats discussed above are ongoing and likely to continue into the future.

EB/CE Source:
U.S. Fish and Wildlife Service. 2016. Species Assessment Form for the *Spirinchus thaleichthys* (San Francisco Bay delta population)

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the longfin smelt does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 13,799,960 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 6,921,701 acres, 50.157%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by

allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Integration and Synthesis Summary: Fishes (Perciformes)

Scientific Name:	Common Name:	Entity ID:
Eucyclogobius newberryi	Tidewater goby	306

Family: Gobiidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (3/13/2014): Downlist to Threatened
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

From 2007 5-Year Review:
While individual populations may be periodically extirpated under natural conditions, a metapopulation is likely to persist through colonization or recolonization events that establish new populations (Levins 1970, Hanski and Gilpin 1991, Wells and Richmond 1995, Hanski and Simberloff 1997).

Habitat loss and other anthropogenic factors have resulted in the tidewater goby now being absent from several localities where it historically occurred. Drought conditions, when combined with anthropogenic water reductions (diversions of water from streams, excessive groundwater withdrawals), have degraded coastal and riparian ecosystems and have created extremely stressful conditions for most aquatic species, including the tidewater goby. Drought can have dramatic negative effects on tidewater gobies, at times decreasing their populations to very low levels (perhaps to the point where they are undetectable) and at the extreme, extirpating populations. We state in the final listing rule for the tidewater goby (59 FR 5494; February 4, 1994) that formerly large populations of tidewater gobies had declined in numbers because of the reduced availability of suitable lagoon habitats (San Simeon Creek and Pico Creek in San Luis Obispo County), while others disappeared when the lagoons dried (Santa Rosa Creek, San Luis Obispo County). Despite the tidewater goby's negative response to the extreme drought of 1987–1992, when normal rainfall patterns returned, the species either recolonized localities that had been dry or numbers increased in localities where drought conditions had reduced numbers to an undetectable level.

Some of the threats to the tidewater goby may be exacerbated under certain conditions where the individual threats may not otherwise be severe. While any likely combination of threats will have an additive effect on the species in a particular location, any of the threats combined with drought would appear to pose the greatest risk to the tidewater goby. A more dramatic cumulative effect resulting from drought may be due to upstream diversion or withdrawal of water from drainages. Where water may be limited due to upstream uses before it can reach tidewater goby habitat and create the brackish conditions the species requires, even a small period of drought is likely to cause the species' habitat to dry up; this is especially of concern at smaller watersheds. If the drought is extended, the return of tidewater gobies to that locality would be dependent on proper functioning of the metapopulation dynamics that allow recolonization from adjacent refugia, as we conclude happened at the end of the drought in the late 1980s and early 1990s in California. The same principle applies to those localities where threats such as water pollution, upstream barriers, and disease or parasites may be a limiting factor in the tidewater goby's numbers. Because adequate water supply is critical to the species' life cycle, large declines in water in the tidewater goby's habitat are likely to exacerbate threats that are not limiting alone.

EB/CE Source:
U.S. Fish and Wildlife Service. 2007. Tidewater Goby (*Eucyclobius newberryi*) 5 Year Review: Summary and Evaluation. Ventura, California. pp. 50.

Overall Vulnerability: ☐ **High** ☐ **Medium** ☒ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Tidewater goby does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 8,926,592 acres
% of range in California (i.e., where CalPUR data is available): 93%
Range overlap with Federal lands: 3,203,877 acres, 35.891%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to

periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Crystallaria cincotta	Diamond darter	6557

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The species is extremely rare, present in a single declining population.

Threats include sedimentation and siltation from a variety of sources, discharges from activities such as coal mining and oil and gas development, pollutants originating from inadequate wastewater tratment, habitat changes and isolation caused by impoundments, and direct habitat disturbance. These threats are ongoing and severe and occur throughout the species' entire current range. In the case of gas development and instream disturbances associated with gas transmission lines, we expect this threat to increase over the next several years as shale gas development continues to intensify.

Some of the threats to the species could work in concert with one another to cumulatively create situations that potentially impact the diamond darter beyond the scope of the individual threats. For example, the reach of the Elk River inhabited by the diamond darter is threatened by numerous sources of habitat and water quality degradation, including multiple sources of coal mining, oil and gas development, and inadequate sewage treatment. All these threats likely reduce the amount and quality of the diamond darter's remaining available habitat and are sources of chronic and continued degradation of its habitat. These threats also likely reduce the amount of forage available to the species, reduce the fitness of remaining individuals, and decrease breeding success and survival of young.

These chronic threats likely affect the ability of the diamond darter population in the Elk River to grow and thrive, making it less resilient to potential acute threats such as accidental spills and catastrophic events. In a review of population and stream responses to various types of disturbances. The one remaining diamond darter population is small and occurs in one reach of a single river that is already affected by multiple chronic sources of degradation. Thus, the current remaining population has very little resiliency and a very limited ability to recover from additional individual disturbances.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Diamond Darter. Federal Register 78(144):45074-45095.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Diamond Darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 979,860 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 70,638 acres, 7.209%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is

limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma boschungi	Slackwater darter	239

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The slackwater darter is rare, sporadically distributed, and known from only six tributary streams to the south bend of the Tennessee River in the southwestern Highland Rim of the Nashville Basin in Tennessee and northern Alabama (Boschung and Nieland 1986; Etnier and Starnes 1993). The slackwater daiier is predominately a migratory species and occurs in non-breeding and breeding habitat (Boschung 1979a; Boschung 1979b; Boschung and Neiland 1986). Some populations of slackwater daiiers may require the non-breeding habitat to flood while other populations at other sites may not (Rakes 2006 pers. comm.), indicating that some populations may not require the traditional "slack water" habitat. Surveys (Johnson 2006, Dinkins and Daniel 2003; Johnston and Hartup 2002, 2001) indicate several historical spawning and breeding habitat sites have been destroyed or damaged and are not being used by slackwater darters, and that reproductive success and recruitment may be declining. Specifically, 5 of 31 historical sites have been lost or degraded to a point that they no longer provide suitable habitat for slackwater darters (U.S. Fish and Wildlife Service 1984; Drennen 2003 pers. observ.; McGregor, 2004 pers. comm.). Surveys in 2001, 2002, and 2004 indicate declines in actual numbers of individuals (Johnson and Hartup 2001, 2002; McGregor, 2004 pers. comm.).

Threats to the populations in Alabama and Tennessee have not decreased substantially and, in some cases, have increased. For example, Swan Creek in Alabama has been severely altered in the past decade. Much of the forest alongside the stream has been removed and heavy impacts to the stream bank continue to occur, resulting in channel modifications and the complete loss of in-stream aquatic vegetation. Repair and replacement of bridge crossings on the Natchez Trace Parkway, at sites known to have remnant populations of slackwater darters, have the potential to add significant sedimentation to Lindsey and Threet Creek in Lauderdale County, Alabama (Dinkins and Daniel 2003). Cattle impacts on slackwater dmier spawning habitat have increased significantly. For example, the Dodd site in Middle Cypress Creek, Wayne County Tennessee, has been seriously impacted by cattle degrading bank sides and stream bottoms and consuming streamside vegetation (Drennen 2005 pers. observ.). Reducing threats to the habitat would be accomplished through a broad application of measures that focus on protecting stable natural stream channels and riparian zones, and protecting or improving water quality and quantity by reducing sedimentation caused by urbanization and other anthropomorphic occurrences.

The Tennessee Rivers Assessment Project (1998) scored the Buffalo River watershed in Lawrence County, high as fully supporting designated uses assigned to it by the Water Quality Control Board. Nevertheless, degradation of water quality by sedimentation is believed to be a significant factor in the disappearance of slackwater darter populations from their historic habitat. Based on qualitative information obtained from visual threats and cursory surveys of the species, the cunent condition of slackwater darter habitat, suggest that the habitat of the slackwater darter may be declining. However, with adequate best management practices such as erosion and sediment control, along with maintaining of winter "slack water" areas, there is a high potential to recover the species.

EB/CE Source:
U.S. Fish and Wildlife Service. 2008. Slackwater Darter (*Etheostoma boschungi*) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 15.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Slackwater darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 2,101,265 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 50,506 acres, 2.404%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Etheostoma chienense	Relict darter	313

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (8/30/2019): Downlist to Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Relict Darter is endemic to the Bayou de Chien system in Fulton, Graves, and Hickman counties, Kentucky (Figure 1) (Burr and Warren 1986, Piller and Burr 1998). At the time of listing in 1993, the species was known only from the Bayou de Chien mainstem and Jackson Creek. The species was considered to be most abundant in Jackson Creek and a limited reach of the headwaters of Bayou de Chien near the town of Water Valley in Graves County (Webb and Sisk 1975, Warren and Burr 1991, Warren et al. 1994). Piller and Burr (1998) documented the species' presence at 16 of28 sites surveyed, including 6 new sites in Graves and Hickman counties. The species was most commonly collected in the middle and headwater reaches of the system, where it was described as "abundant" in Jackson Creek and "common" at four Bayou de Chien sites. Relict Darters or nests were also observed at sites on South Fork Bayou de Chien, Cane Creek, Sand Creek, and two unnamed tributaries; however, the species' summer and fall distribution was limited to the Bayou de Chien mainstem, Jackson Creek, and South Fork Bayou de Chien. In July 2017, a second population of the species was discovered in Little Bayou de Chien in Fulton County

The Relict Darter continues to be threatened by three of the Service's five listing factors: the present or threatened destruction, modification, or curtailment of its habitat or range (Factor A), the inadequacy of existing regulatory mechanisms in protecting against habitat alteration or destruction (Factor D), and other natural or manmade factors affecting its continued existence (Factor E). While habitat threats remain and current regulatory mechanisms have been inadequate to prevent all of these impacts, we conclude that habitat threats in Jackson Creek and Bayou de Chien have decreased from a magnitude level of high to a magnitude level of moderate. We base our conclusion on observed trends of abundance and mean density in Jackson Creek and Bayou de Chien, our estimates of the species' population size in both streams, the ample evidence of reproduction and recruitment in both streams, and our repeated observations of these conditions during major survey efforts in 2011-2012 and 2017-2018.

In addition to these factors, threats to the species' habitat have been reduced, and in some cases eliminated, by multiple habitat protection projects (e.g., cattle exclusion, riparian plantings) in Jackson Creek and Bayou de Chien. The Service continues to work with its partners to implement additional projects in these watersheds. With respect to Factor E, the species' linear distribution and limited range within the Bayou de Chien watershed continue to make it vulnerable to stochastic events (e.g., drought or toxic chemical spills) that could cause the extirpation of the species from portions of Bayou de Chien, Jackson Creek, or Little Bayou de Chien. The species' discovery in Little Bayou de Chien offers some protection against catastrophic events that could lead to the species' extinction (e.g., improved redundancy); however, the Little Bayou de Chien population appears to be small relative to Bayou de Chien and Jackson Creek (i.e., lower resiliency), and habitat conditions are not as favorable for the species. In addition to the species' limited range, genetic analyses indicate low genetic diversity for the species, suggesting a reduced ability to adapt to changing environmental conditions and greater vulnerability to local extirpations.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Relict Darter (*Etheostoma chienense*) 5 Year Review: Summary and Evaluation. Frankfurt, Kentucky. pp. 37.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Relict darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 1,088,351 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 6,260 acres, 0.575%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Etheostoma etowahae	Etowah darter	315

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Etowah darter persists in stream reaches where it was known to occur when the species was listed, and additional populations have been located in three other tributaries, including one below Allatoona Dam. Etowah darters are fairly numerous in the Etowah mainstem headwaters and several tributary systems. Populations are highly vulnerable to local extirpation when uplands within the immediate upstream watershed began to urbanize, even when the amount of impervious surface is relatively low

The Etowah listing document identifies the primary causes of habitat destruction, modification, or curtailment as: (1) impoundments that result in habitat loss, population extirpation, fragmentation, and changes in the thermal regime below dams that favors predatory fishes; (2) siltation associated with timber clearcutting, clearing of riparian vegetation, and construction, mining, and agricultural practices that allow dirt to enter streams; (3) increased development and land clearing that increases siltation from erosion, accelerates runoff, allows transport of pollutants into the Etowah River system, and requires additional road and landfill infrastructure; (4) bridges, railroad crossings, and other stream crossings that are potential sites for spills of toxic material due to vehicle accidents, deliberate dumping, and other means; and (5) pollution from other point and nonpoint sources such as municipal and industrial waste discharges, agricultural runoff, poultry processing plants, and silvicultural activities.

None of these threats have been eliminated in the 20 years since the Etowah darter was listed, although the Service and numerous other partners have worked extensively with local governments, developers, and private landowners in the basin to reduce the impacts of urbanization and associated infrastructure on listed fishes and their habitat. Although threats described in the listing package have not been eliminated, they have been reduced. The two reservoirs proposed in the Etowah were sited following U. S. Army Corps of Engineers/Service/EPA protocols and are located on lower priority streams, where impoundment will have less impact on aquatic communities, genetic exchange, and fish passage. Ordinances have been passed by most local governments in the basin that require wider buffers than State mandated (50-100 ft) on streams adjacent to construction activities. Buffer requirements for forestry lands, although voluntary, are strongly encouraged. The State continues to refine the Georgia Erosion and Sedimentation Control Act and the Clean Water Act's National Pollution Discharge Elimination System (NPDES) permitting process to reduce erosion, sedimentation, and stormwater discharges from construction sites. Post-construction stormwater is regulated in some Etowah basin counties by the Metropolitan North Georgia Water Planning District's post-construction stormwater ordinance. These efforts have reduced the amount of runoff and turbidity allowed downstream of construction sites, though implementation of protective measures often is inadequate and enforcement for violations is inconsistent.

Several of the projects specifically described in the listing document as threats have been completed. The reservoir on Yellow Creek began construction in 1997, and now impounds 330 acres in Cherokee and Dawson Counties. The 577-acre Eagle Point Landfill on the Etowah River in Forsyth County opened in 2002, with a disposal footprint of 167 acres; the facility currently is being expanded. The rock quarry proposed on Stamp Creek in Bartow County has not been built, and the portion of the Northern Arc proposed in the Etowah basin (i.e., the I-75 to SR 371 connector described in the listing document) is not likely to be constructed due to urban development along the Arc's proposed route.

Research conducted on threats to Etowah River fish during development of the draft Etowah River Habitat Conservation Plan (HCP) (www.etowahhcp.org) identified 6 stressors to benthic fishes in the Etowah basin: sedimentation, hydrologic alteration, extensive riparian buffer loss, contaminants (heavy metals, pesticides, etc.), movement barriers, and channelization/piping of streams. The most significant source of these stressors was identified as stormwater runoff from impervious surfaces. Other sources of these stressors include construction, channel erosion, road and utility stream crossings, dams/impoundments, point-source discharges, water withdrawals, agriculture, forestry, and historic land use (Wenger and Freeman 2007).

The Etowah River basin, which lies on the north edge of the Atlanta metropolitan area, has experienced rapid growth over the last decade. Most of the six primary stressors and their sources are related to this rapid urban development. The recession has slowed land clearing activities and may have altered future development patterns in the basin (e.g., delayed urban sprawl, less dense development in the more distant counties from Atlanta). However, threats associated with urbanization are likely to increase in magnitude as the economy improves, and it is unlikely that forestry, agriculture, or other threats typical of rural environments will ever again be primary stressors.

The most recent database of NPDES-permitted point sources lists 96 wastewater discharges in the Etowah. These include wastewater treatment plants, mines, and industrial facilities. Non-point sources are more difficult to pinpoint. Pesticides are frequently found in streams draining agricultural land uses, with herbicides being the most commonly detected (McPherson et al. 2003). Many agricultural streams still contain DDT and its degradation products (Zappia 2002). Pesticides also are heavily used in urban and suburban areas, and many of these find their way to streams and groundwater (Schueler 1995). A comparison of agricultural and urban groundwater quality in the Mobile Basin (which includes the Etowah Basin) found a greater variety and frequency of pesticide compounds in the urban groundwater (Robinson 2003). Chlordane and other now-banned organochlorine pesticides are still common in urban streams, including those in the Mobile Basin (Zappia 2002). Streets and parking lots can contribute large quantities of heavy metals that are largely derived from automobiles (Van Hassel et al. 1980, Bannerman et al. 1993). Oil and other hydrocarbons are also common constituents in urban runoff (Paul and Meyer 2001). It is generally accepted that most of the contaminants in stormwater are washed off in a "first flush" although there is evidence that, in highly urbanized watersheds, significant contaminants continue to be delivered after the first flush (Goonetilleke et al. 2005, Schueler 1994).

2021 5-Year Review
Since the previous review in 2014, the Etowah darter was found in one new HUC10 (Sharp Mountain Creek). Extensive surveys over the last 20 years had not detected the species in this location indicating that this may be a range expansion.

Development has continued since 2014 leading to forest conversion and increases in impervious surfaces. Although most of the impervious surface increases have not been in Etowah darter habitat, encroachment into those previously rural areas is getting closer.

Based on information regarding distribution, population status, and future threats we conclude that although the species, as a whole, has likely been stable since the previous 5-year review, impacts associated with new development and impervious surface continues.

EB/CE Source:
U.S. Fish and Wildlife Service. 2021. Etowah Darter (*Etheostoma etowahae*) 5-Year Review: Summary and Evaluation. Georgia Ecological Services Field Office, Athens, Georgia. 11 pp

U.S. Fish and Wildlife Service. 2014. Etowah Darter (*Etheostoma etowahae*), Cherokee Darter (*Etheostoma scotti*), and Amber Darter (*Percina antesella*) 5-Year Review: Summary and Evaluation. Georgia Ecological Services Field Office, Athens, Georgia. 11 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Etowah darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 1,064,617 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 173,907 acres, 16.335%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma moorei	Yellowcheek darter	6662

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Yellowcheek Darter is an endemic within the Little Red River and its four forks, Devils, Middle, South, and Archey Forks in Cleburne, Searcy, Stone, and Van Buren Counties, Arkansas (Robison and Buchanan 1988). It is believed to be extirpated from the main stem of the Little Red River by the inundation of Greers Ferry Lake. Population estimates prior to listing indicated a strong decline in population from 60,000 individuals in 1981 (Robison and Harp 1981) to 16,922 during 2003 and 2004 (Weston and Johnson 2005). No subsequent population estimates have been conducted to suggest a change in population status.

Efforts to stabilize Yellowcheek Darter habitat are ongoing. Implementation of BMPs for construction and maintenance of unpaved roads is beginning to show positive gains in reducing sedimentation in isolated areas of the watershed. Several natural gas companies implement Service BMPs for natural gas construction and maintenance and the slowing pace of natural gas infrastructure and drilling has helped reduce associated habitat threats. Private landowners have enrolled 5,956 hectares in Safe Harbor Agreements/Candidate Conservation Agreements with Assurances and The Nature Conservancy acquisitions have perpetually protected 9 km of river frontage in the Archey, South and Middle Forks. The cumulative impact of these and other conservation efforts in the watershed show great potential to restore habitat quality and quantity for the species.

Despite these conservation achievements, sustained work is necessary to address threats and restore natural stream stability, water quality and habitat conditions. Three of the five listing factors considered by the Service still pose threats to the Yellowcheek Darter: the present or threatened destruction, modification or curtailment of its habitat or range; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence. The species' habitat and range have been severely degraded and limited by a variety of human-induced impacts, such as habitat alteration from the construction of Greers Ferry Lake, sedimentation associated with mountainside rock mining, instream gravel mining, earthen dams, low water crossings, lack of adequate streamside buffers during timber harvests, and construction and maintenance of natural gas infrastructure and water diversion associated with natural gas fracking (C. Davidson, pers. comm. 2019). In 2018 ADEQ listed 44.3 km of the South Fork as impaired for pH and 12.4 km as impaired for dissolved oxygen concentrations (ADEQ 2018). Current regulatory mechanisms have been inadequate to prevent these impacts. The species continues to be impacted by poor water quality and habitat deterioration. Furthermore, the inundation of the lower reaches of the four forks is a newly identified threat and the isolation of populations by Greers Ferry Lake continues to threaten genetic stability.

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Yellowcheek Darter (*Etheostoma moorei* Raney and Suttkus 1964) 5 Year Review: Summary and Evaluation. Conway, Arkansas. pp. 22.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Yellowcheek Darter does occupy other aquatic habitats that accumulate potentially high levels of malathion, they can mitigate their potential exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

USAGE
 # acres in species range: 526,576 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 14,862 acres, 2.822%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma nianguae	Niangua darter	257

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Population size/location unknown
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
At the time of listing, the Niangua Darter was present in eight of the ten known watersheds in north-flowing Osage River tributaries. It is still considered extant in all eight populations comprising 269.5 stream miles (433.7 stream kilometers). However, pertinent to the studies mentioned earlier, the Missouri Department of Conservation (MDC) reduced the range-wide monitoring from all eight known populations to focused efforts in five specific watersheds as well as additional evaluations near low-water crossings conducted during the summer months. As a result, current Niangua Darter sampling efforts do not occur in the Sac River tributaries (North Dry Sac River, Bear and Brush creeks). Also, beginning in 2017, the sampling frequency in the five studied watersheds changed from two to three-year intervals. Detection comparisons have been made for three sampling years at all monitoring sites. Efforts since 2002 have helped to describe spatial and temporal trends in population densities, size structure, associated darter species diversity, and multi-scale habitat characteristics. The MDC has found no new viable populations despite continued survey efforts (USFWS 2017).

No new populations have been found; however, range extensions have been noted. Since the Niangua Darter was listed, the MDC has documented the following new Niangua Darter occurrences: downstream extension on the Little Niangua River (Camden Co.), downstream extension on the Niangua River (Dallas Co.), downstream extension on the Pomme de Terre River (Polk Co.), downstream extension on Tavern Creek (Miller Co.), discovery in Little Tavern Creek and Kenser Creek (Miller Co.), discovery in Little Wilson Creek (Polk Co.), and discoveries in Macks Creek and Fiery Fork (Camden Co.) (MDC 2012). MDC reported the five Niangua Darter populations being studied as steady or increasing (Westhoff and Decoske 2017). In contrast, the status of the three Niangua Darter population in the Sac River Basin (N. Dry Sac River, Brush and Bear creeks) is uncertain 3 due to no additional surveys being completed in these watersheds since the previous 5-year review.

Habitat conditions suitable for Niangua Darter populations are still negatively influenced by anthropogenic land-use activities and infrastructure. Streams supporting Niangua Darter populations are degraded through increased sediment loading and the continued use of low water crossings (USFWS 2017). Poorly designed low-water crossings can negatively impact aquatic organism passage and local habitat quality which can further impact population size and distribution. Efforts continue to replace low-water crossings with designs to improve both aquatic organism passage and habitat quality throughout the Niangua Darter range. Westhoff and Decoske (2016) reported that 20 road crossings, including 14 of the 32 crossings identified by Novinger et al. (2008) have been completed as of December 2016. MDC continues to provide comprehensive monitoring near these crossings to evaluate the biological and physical habitat responses. Additionally, the USFWS also contributed comments to the U.S. Army Corps of Engineers (USACE) in 2016 for the General Permit GP34M involving sand and gravel excavation activities to help reduce potential impacts to the Niangua Darter. Furthermore, a predicted increase in average water temperature (2–4 °C) throughout the Ozarks of Missouri may also negatively affect the Niangua Darter population (Faulkner 2015).

EB/CE Source:
U.S. Fish and Wildlife Service. 2019. Niangua Darter (*Etheostoma nianguae*) 5 Year Review: Summary and Evaluation. Columbia, Missouri. pp. 5.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Niangua darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 6,203,435 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 15,929 acres, 0.257%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Etheostoma nuchale	Watercress darter	229

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Population size/location unknown
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The watercress darter lives within the appropriate habitat of approximately 6.2 acres of spring pools and 7,900 feet of spring run in the five spring locations (calculated from Maptech 2002). Within Roebuck Spring, the watercress darter occurs in approximately 1.28 acres of spring pool and 3000 feet of spring run; in Tapawingo Spring, the watercress darter occurs in approximately 2 acres of spring pools and 600 feet of spring run; in Glenn Spring, the watercress darter occurs in approximately 0.1 acre of spring pool and 1800 feet of both the spring run and parts of Halls Creek; in Thomas Spring (Watercress Darter National Wildlife Refuge, WDNWR), the watercress darter occurs in approximately 2 acres of spring pools and 1000 feet of spring run; and in Seven Springs, the watercress darter occurs in approximately 0.1 acre of spring pool and 1500 feet of spring run (calculated from Maptech 2002). However, the habitat and the spring ecosystem conditions of the watercress darter continue to decrease in all five spring sites, particularly within the recharge areas necessary for the springs' groundwater and outflow (Drennen pers. ob. May 2009). Changes in quality and quantity of groundwater from the recharge area in all the spring sites are associated with the lack of, or poor use of, best management practices for urbanization, stormwater management, and sedimentation on adjoining nonprotected lands that drain the immediate recharge areas.

The watercress darter is vulnerable to non-point source pollution, urbanization, and changes in groundwater and surface water flow due to its localized distribution in five spring sites within two stream drainages. Since watercress darters are associated with spring ecosystems, spring water quality and quantity are essential for producing a flushing and cleansing effect of the spring pools and spring runs. Destruction or alteration of this water would significantly threaten and reduce the species' ecology, including spatial and temporal movements. Spring water may be impacted by site-specific spring head disturbances rather than overall spring drainage disturbances (Drennen 2004). Within the five watercress darter spring sites, all aquifer recharge areas are vulnerable to contamination from the land surface (Kopaska-Merkel et al. 2005). Spigner (1975) suggested that recharge to the Hartselle aquifer was reduced by paving of recharge areas near Irondale in Jefferson County so it is reasonable to believe that the Valley and

Ridge aquifer is also impacted by the same process. Non-point source pollution from land surface runoff can originate from virtually any land use activity and may be correlated with impervious surfaces and storm water runoff. Pollutants may include sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray water leakage, and petroleum products. These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the chemistry of subsurface and surface waters such that the habitat and food sources for species like the watercress darter are negatively impacted. Construction and road maintenance activities associated with urban development typically involve earth-moving activities that increase sediment loads into nearby aquatic systems through storm water runoff during and after precipitation events. Excessive sediment and increased turbidity can make the habitat of watercress darters and associated benthic fish species unsuitable for feeding and reproduction by covering and eliminating available food sources and nest sites. Sediment has been shown to wear away and/or suffocate periphyton (organisms that live attached to objects underwater and likely provide food items for species such as watercress darter), disrupt aquatic insect communities, and negatively impact fish growth, physiology, behavior, reproduction and survivability (Waters 1995, Knight and Welch 2001). Sediment is the most abundant pollutant in the Mobile River Basin (Alabama Department of Environmental Management 1996).

The diminutive range of the watercress darter is within the industrial areas of the city of Birmingham. Because of the watercress darter's limited range, the threat from surface and subsurface water quality and quantity degradation is potentially the greatest impact the species faces. Surface water contamination and increased water temperatures may be preventing the species from occupying potential habitats at the spring run confluences with parts of Village, Turkey, Valley, Nabors, and Hall's Creeks.

Since the listing of the species in 1970, recovery progress has been made for the watercress darter. Improvements include the establishment of an additional watercress darter population at Tapawingo Spring (1988), and the discovery of a new population of watercress darters at Seven Springs (2003). However, the removal of the dam at Roebuck Spring in September of 2008 destroyed about 57% of the watercress darter population at this site, increased mortality of the species by predation, reduced reproduction potential for the spring of 2009, and reduced the long-term viability of this genetically unique population. The Roebuck Spring population was the most robust population of the five spring sites. When considered in conjunction with the continued deterioration of water quality, both surface and subsurface waters, the watercress darters limited distributions and small populations render the species vulnerable to random natural or anthropogenic events such as droughts, spills and especially spring basin modifications.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Watercress darter (*Etheostoma nuchale*) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 24.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

 # acres in species range: 507,954 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 0 acres, 0.000%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma percnurum	Duskytail darter	308

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population,
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The duskytail darter has a limited geographic range, single population, and small population size, leaving the species vulnerable to localized extinctions from accidental toxic chemical spills or other stochastic disturbances and to decreased fitness from reduced genetic diversity.

As indicated in the Recovery Plan (USFWS 1994), impoundment, water withdrawal, urbanization, coal mining, toxic chemical spills, siltation, improper pesticide use, and streambank erosion remain threats to the duskytail darter species complex. Physical habitat destruction resulting from a variety of anthropogenic impacts such as siltation, disturbance of riparian corridors, and changes in channel morphology continues to plague the Tennessee and Cumberland River systems. Pollutants entering the Tennessee and Cumberland River systems may include sediments, fertilizers, herbicides, pesticides, animal wastes, pharmaceuticals, septic tank and gray water leakage, and petroleum products.

Common land uses within the Clinch-Powell watershed include urban, industrial, commercial, and residential development; livestock production; agricultural cropping including tobacco and corn; coal mining, reclaimed coal mined lands, and "abandoned" coal mined lands (i.e., lands affected by mining prior to the federal law that were not reclaimed properly); road and railroad networks; and silvicultural practices (US EPA 2002). These land use activities act as sources of stress to the duskytail darter by contributing sediment and contaminants into the watershed. Coal mining is occurring in the upper Clinch River watershed in Virginia, and coal fines in the upper river are moving downstream into Tennessee. A 585-megawatt coal powered electric generation facility is expected to be constructed along the Clinch River in Virginia City, Wise County, Virginia. Effluent discharge, run-off from fly ash storage, and other sources related to the operation of the facility could represent new threats to the Clinch River. Agriculture continues to threaten the duskytail darter in Copper Creek.
The Service along with The Nature Conservancy, local Soil Conservation Districts, the Natural Resources Conservation Service, Farm Service Agency, Clinch-Powell Resource Conservation and Development Council, and many State agencies and local partners are working together to

protect aquatic biodiversity in the Clinch-Powell watershed by providing monetary assistance in the form of cost-share programs to facilitate the protection and recovery of riparian corridors and the reduction and prevention of non-point source pollution on private lands.

2021 5-Year Review
Since the time of the recovery plan, four morphologically discrete species have been described from the duskytail darter species complex (Blanton and Jenkins 2008).

The duskytail darter populations in the Little River (marbled darter), Citico Creek (Citico darter), and Big South Fork (tuxedo darter) appear to be stable. Populations were reintroduced into Abrams Creek (Citico darter) and Tellico River (Citico darter) that also appears to be reproducing and stable. However, the duskytail darter has shown a marked decrease in both number of known sites and abundance in Copper Creek since 2008. In Copper Creek the species' range has declined to 14.5 river km (9 mi) and it is now restricted to only 2 of 10 historical sites (CFI 2018). Overall the complex occurs in 80.9 km (50.3 mi) of river, with 14.5 km (9 mi) associated with the marbled darter, 13.3 km (8.3 mi) the Citico darter, 38.6 km (24 mi) the tuxedo darter, and 14.5 km (9 mi) the duskytail darter.

Ongoing threats include coal mining, oil and gas exploration, agriculture, recreational activities, restricted range/small population size, and the species decline in Copper Creek.

EB/CE Source:

U.S. Fish and Wildlife Service. 2021. Duskytail darter (*Etheostoma percnurum*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 20 pp

U.S. Fish and Wildlife Service. 2012. Duskytail darter (*Etheostoma percnurum*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 25 pp

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 4,164,707 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,454,380 acres, 34.922%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma phytophilum	Rush darter	3525

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The rush darter has a limited geographic range and small population size. The existing populations are extremely localized, declining, and geographically isolated from one another, leaving them vulnerable to localized extinctions from intentional or accidental toxic chemical spills, habitat modification, progressive degradation from runoff (non-point source pollutants), natural catastrophic changes to their habitat (e.g., flood scour, drought), other stochastic disturbances, and to decreased fitness from reduced genetic diversity. The level of isolation seen in this species makes natural repopulation following localized unlikely (USFWS, 2011).

EB/CE Source:
U.S. Fish and Wildlife Service. 2011. Endangered and Threatened Wildlife and Plants; Endangered Status for the Cumberland Darter, Rush Darter, Yellowcheek Darter, Chucky Madtom, and Laurel Dace. Federal Register 76(153):48722-48741.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Rush Darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 2,556,614 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 348,707 acres, 13.639%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma rubrum	Bayou darter	244

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The bayou darter has been collected only from the Bayou Pierre River (from upstream at the Smyrna Bridge to downstream at Willow) and the immediate portions of the confluences of the Bayou Pierre River with: White Oak Creek, Foster Creek, and Turkey Creek (approximately 40 river miles (64 kilometers). Recent surveys suggest that a single stable population or a series of small subpopulations of bayou darters exists throughout the lower reach of the Bayou Pierre River extending downstream from Highway 18 to the confluence with the Little Bayou Pierre (Slack and Ross 2002). The bayou darter exhibits low genetic diversity which may be best explained by its small range and by recent genetic bottleneck (Slack et al. 2010). Recent surveys suggest that a single stable population or a series of small subpopulations of bayou darters exists throughout the lower reach of the Bayou Pierre River extending downstream from Highway 18 to the confluence with the Little Bayou Pierre (Slack and Ross 2002).

Since the discovery of the species in 1966, the bayou darter has experienced significant curtailment of range and habitat and is currently known only in specific sites. Population data suggests the species may be responding spatially to the dramatic changes caused by almost 50 years of headcutting through the Bayou Pierre River system. However, population data does not suggest that slight increases in population numbers correspond to improvement in the status of the bayou darter since listing under the Act in 1975. This phenomenon may be a shifting of the species to less impacted habitat above an ongoing habitat change and the re-colonization of habitat disturbed by the geomorphic change produced by the headcut. The latest inclusive population estimate of the Bayou Pierre River system was completed by Ross et al. (1989) with different river reach and tributary surveys and studies occurring sporadically since 1990. Specifically, changes in geomorphology and deterioration of water quality has increased along with new urbanization, agriculture, silviculture and continued pollution threats within the Bayou Pierre River system.

The species' limited distribution and small population size make it vulnerable to random natural or human-induced events such as toxic spills, vandalism, and sedimentation events caused by maintenance of existing road and bridge structures, fence lines, stormwater management pipes and risers, effluent discharge from small municipalities and pipeline crossings. Along with historical sand and gravel extraction and bankside agriculture within the watershed, geomorphic changes continue to add tremendous amounts of sediment to the river system.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Bayou Darter (*Etheostoma* rubrum) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 16.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Bayou darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 2,114,696 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 49,032 acres, 2.319%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic

habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Etheostoma scotti	Cherokee darter	269

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Cherokee darter occurs in most of the 26 Etowah tributary systems where it was known to occur when the species was listed and has been found, since being listed, in 20 additional Etowah River tributaries. Seventeen of the 20 new range tributary systems are small, and several drain directly into Lake Allatoona, which reduces the potential for genetic exchange between populations. The largest of the 20 tributaries located since the species was listed, Pettit Creek, drains the Cartersville area, which, until the recession, was rapidly developing commercially and residentially. Two of the other newly-identified Cherokee darter streams, Richland and Russell Creeks, are slated to be impounded as drinking water reservoirs, in addition to the two reservoirs that were constructed since 1997 on Cherokee darter streams. Research indicates that Cherokee darter population size declines when uplands within the immediate upstream watershed began to urbanize. Most of the Cherokee darter streams in the basin are vulnerable to this stressor. Cherokee darters tend to persist in many tributaries impacted by upstream development, but abundance of these populations declines with increasing upstream impervious surface.

The listing document identifies the primary causes of habitat destruction, modification, or curtailment as: (1) impoundments that result in habitat loss, population extirpation, fragmentation, and changes in the thermal regime below dams that favors predatory fishes; (2) siltation associated with timber clearcutting, clearing of riparian vegetation, and construction, mining, and agricultural practices that allow dirt to enter streams. (3) increased development and land clearing that increases siltation from erosion, accelerates runoff, allows transport of pollutants into the Etowah River system, and requires additional road and landfill infrastructure; (4) bridges, railroad crossings, and other stream crossings that are potential sites for spills of toxic material due to vehicle accidents, deliberate dumping, and other means; and (5) pollution from other point and nonpoint sources such as municipal and industrial waste discharges, agricultural runoff, poultry processing plants, and silvicultural activities.

None of these threats have been eliminated in the 20 years since the Cherokee darter was listed, although the Service and numerous other partners have worked extensively with local governments, developers, and private landowners in the basin to reduce the impacts of urbanization and associated infrastructure on listed fishes and their habitats. Although threats described in the listing package have not been eliminated, they have been reduced. The two reservoirs proposed in the Etowah were sited following Corps/Service/EPA protocols and are located on lower priority streams, where impoundment will have less impact on aquatic communities, genetic exchange, and fish passage. Ordinances have been passed by most local governments in the basin that require wider buffers than State mandated (50-100 ft) on streams adjacent to construction activities. Buffer requirements for forestry lands, although voluntary, are strongly encouraged. The State continues to refine the Georgia Erosion and Sedimentation Control Act and the Clean Water Act's National Pollution Discharge Elimination System (NPDES) permitting process to reduce erosion, sedimentation, and stormwater discharges from construction sites. Post-construction stormwater is regulated in some Etowah basin counties by the Metropolitan North Georgia Water Planning District's post-construction stormwater ordinance. These efforts have reduced the amount of runoff and turbidity allowed in streams downstream of construction sites, although implementation of protective measures often is inadequate, and enforcement for violations is inconsistent. Several of the projects specifically described in the listing document as threats have been completed. The reservoir on Yellow Creek began construction in 1997, and now impounds 330 acres in Cherokee and Dawson Counties. The 577-acre Eagle Point Landfill on the Etowah River in Forsyth County opened in 2002, with a disposal footprint of 167 acres; the facility currently is being expanded. The rock quarry proposed on Stamp Creek in Bartow County has not been built, and the portion of the Northern Arc proposed in the Etowah basin (i.e., the I-75 to SR 371 connector described in the listing document), is not likely to be constructed due to urban development along the Arc's proposed route.

Research conducted on threats to Etowah River fish during development of the draft Etowah River HCP (www.etowahhcp.org) identified 6 stressors to benthic fishes in the Etowah basin: sedimentation, hydrologic alteration, extensive riparian buffer loss, contaminants (heavy metals, pesticides, etc.), movement barriers, and channelization/piping of streams – the most significant source of these stressors was identified as stormwater runoff from impervious surfaces. Other sources of these stressors include construction, channel erosion, road and utility stream crossings, dams/impoundments, point-source discharges, water withdrawals, agriculture, forestry, and historic land use (Wenger and Freeman 2007). The Etowah River basin, which lies on the north edge of the Atlanta metropolitan area, has experienced rapid growth over the last decade. Most of the six primary stressors and their sources are related to this rapid urban development. The recession slowed land clearing activities and may have altered future development patterns in the basin (e.g., delayed urban sprawl, less dense development in the more distant counties from Atlanta). However, threats associated with urbanization are likely to increase in magnitude as the economy improves.

The most recent database of NPDES-permitted point sources lists 96 wastewater discharges in the Etowah. These include wastewater treatment plants, mines, and industrial facilities. Non-point sources are more difficult to pinpoint. Pesticides are frequently found in streams draining agricultural land uses, with herbicides being the most commonly detected (McPherson et al. 2003). Many agricultural streams still contain DDT and its degradation products (Zappia 2002). Pesticides also are heavily used in urban and suburban areas, and many of these end up in streams and groundwater (Schueler 1995). A comparison of agricultural and urban groundwater quality in the Mobile Basin (which includes the Etowah Basin) found a greater variety and frequency of pesticide compounds in urban groundwater (Robinson 2003). Chlordane and other now-banned organochlorine pesticides are still common in urban streams, including those in the Mobile Basin (Zappia 2002). Streets and parking lots can contribute large quantities of heavy metals that are largely derived from automobiles (Van Hassel et al. 1980, Bannerman et al. 1993). Oil and other hydrocarbons are also common constituents in urban runoff (Paul and Meyer 2001). It is generally accepted that most of the contaminants in stormwater are washed off in a "first flush" although there is evidence that, in highly urbanized watersheds, significant contaminants continue to be delivered after the first flush (Schueler 1994, Goonetilleke et al. 2005).

2021 5-Year Review
Since the previous review in 2014, construction of the Richland Creek Reservoir has been started and is almost completed. In 2017, the Russell Creek Reservoir was permitted, and construction is supposed to begin in 2021. The combination of these two projects result in the loss of more than 3 miles of Cherokee darter habitat. Additionally, 3.7 miles of Cherokee darter habitat was impacted by contaminants, resulting in the loss of more than 2000 Cherokee darters and an extirpation of part of the Flat Creek population that will likely require human intervention to reestablish.

Research indicates that Cherokee darter population size declines when impervious surface increases in close proximity. Most of the Cherokee darter streams in the basin are vulnerable to increasing impervious surface. Cherokee darters tend to persist in many tributaries impacted by upstream development, but abundance of these populations declines with increasing upstream impervious surface. The Service and partners have implemented a number of conservation and habitat restoration measures in the Etowah basin that benefit aquatic resources, but these currently are insufficient to protect the Cherokee darter across its range.

EB/CE Source:
U.S. Fish and Wildlife Service. 2021. Cherokee Darter (*Etheostoma scotti*) 5-Year Review: Summary and Evaluation. Georgia Ecological Services Field Office, Athens, Georgia. 11 pp

U.S. Fish and Wildlife Service. 2014. Etowah Darter (*Etheostoma etowahae*), Cherokee Darter (*Etheostoma scotti*), and Amber Darter (*Percina antesella*) 5-Year Review: Summary and Evaluation. Georgia Ecological Services Field Office, Athens, Georgia. 11 pp

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Cherokee darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 1,486,490 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 141,813 acres, 9.540%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma sp.	Bluemask (=jewel) darter	307

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Increasing population(s)
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The bluemask darter was listed because of its restricted range and a status survey conducted in 1990 and 1991 that revealed that the species had been extirpated from one stream, the Calfkiller River, in which it historically occurred. Municipal wastewater effluent, construction of several small impoundments, and associated sedimentation on the Calfkiller River may have contributed to the extirpation of the bluemask darter from that system. Impoundment of the Caney Fork River by Great Falls Dam may have effectively isolated the four remaining known populations.

The Recovery Plan (U.S. Fish and Wildlife Service 1997) contains a statement that recovery of the bluemask darter may not be possible because of its restricted historic and current range, and the short stream reaches from which it is currently known (with the exception of the Collins River). Since the recovery plan was written, no additional populations of the bluemask darter have been discovered in adjoining drainages. All individuals have been collected within the upper Caney Fork, Collins, and Rocky Rivers, and Laurel and Cane Creeks since 1990. Unless new populations are discovered or habitat quality in the Calfkiller River is improved to the point at which the species can be reestablished, achieving existing recovery criteria will be problematic. The entire known range of the bluemask darter continues to be affected by operation of Great Falls Dam and the presence of the reservoir. Natural recovery will continue to be precluded due to recurring habitat alterations from impoundment and the presence of the reservoir. Bluemask darters will continue to be unable to migrate and establish additional populations in tributary streams such as the Calfkiller River. Sedimentation, various other water quality impacts, and the potential for toxic chemical spills also remain threats to the bluemask darter.

2020 5-Year Review
Since completion of the previous 5-year review, the known distribution of the bluemask darter has been extended by 2.2 river km (1.4 mi) in Cane Creek (TVA 2019) and 8.5 river km (5.3 mi) in the Collins River (Mattingly et al. 2018). However, the bluemask darter continues to be affected by operation of Great Falls Dam and presence of the reservoir. Recovery will continue

to be difficult due to recurring habitat alterations from the effects of impoundment and the presence of the reservoir. Bluemask darters are likely unable to migrate and establish additional populations in tributary streams, such as the Calfkiller River. Sedimentation, other water quality impacts, and the potential for toxic chemical spills also remain threats to the bluemask darter.

EB/CE Source:

U.S. Fish and Wildlife Service. 2020. Bluemask darter (*Etheostoma akatulo*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 34 pp.

U.S. Fish and Wildlife Service. 2013. Bluemask darter (*Etheostoma akatulo*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 29 pp.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the bluemask darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 1,416,394 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1 acres, 0.000%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma spilotum	Kentucky arrow darter	10060

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
known from 47 streams in the upper Kentucky River basin in eastern Kentucky. These populations are scattered across 6 sub-basins, and are considered geographic populations by stream (as opposed to genetically separated from other populations). Based on surveys completed since 2006, extant populations of the Kentucky arrow darter are known from 47 streams in the upper Kentucky River basin in eastern Kentucky. These populations are scattered across 6 sub-basins. Numerous populations are identified as either extirpated, stable, or vulnerable.

The disjunct nature of some Kentucky arrow darter populations likely restricts the natural exchange of genetic material between populations and could make natural repopulation following localized extirpations of the species unlikely without human intervention. Populations can be further isolated by anthropogenic barriers, such as dams, perched culverts, and fords, which can limit natural dispersal and restrict or eliminate connectivity among populations (Eisenhour and Floyd 2013, pp. 82–83). Such dispersal barriers can prevent reestablishment of Kentucky arrow populations in reaches where they suffer localized extinctions due to natural or human-caused events. The localized nature and small size of many populations also likely makes them vulnerable to extirpation from intentional or accidental toxic chemical spills, habitat modification, progressive degradation from runoff (nonpointsource pollutants), natural catastrophic changes to their habitat (e.g., flood scour, drought), and other stochastic disturbances (Soule´ 1980, pp. 157–158; Hunter 2002, pp. 97–101; Allendorf and Luikart 2007, pp. 117–146). The Kentucky arrow darter's habitat and range have been impacted due to a variety of anthropogenic activities in the upper Kentucky River drainage. Resource extraction (e.g., coal mining, logging, oil/gas well development), land development, agricultural activities, and inadequate sewage treatment have all contributed to the degradation of streams within the range of the species (Branson and Batch 1972, pp. 513–516; Branson and Batch 1974, pp. 82–83; Thomas 2008, pp. 6–7; KDOW 2010, pp. 70–84; KDOW 2013a, pp. 189–214, 337– 376; KDOW 2013b, pp. 88–94). These land use activities have led to chemical and physical changes to stream habitats that have adversely affected the species.

One threat to the Kentucky arrow darter is water quality degradation caused by a variety of nonpoint-source pollutants. These include pollutants from coal mining, oil and gas exploration and drilling, and non-point source pollutants such as sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray water leakage, pharmaceuticals, and petroleum products. Severe degradation from contaminants, sedimentation, and physical habitat disturbance have contributed to extirpations of Kentucky arrow darter populations, and these threats continue to impact water quality and habitat conditions across the species' range. Sedimentation from surface coal mining, logging, agriculture, and land development negatively affect the Kentucky arrow darter by burying or covering instream habitats used by the species for foraging, reproduction, and sheltering. These impacts can cause reductions in growth rates, disease tolerance, and gill function; reductions in spawning habitat, reproductive success, and egg, larval, and juvenile development; modifications of migration patterns; decreased food availability through reductions in prey; and reduction of foraging efficiency. Furthermore, the threats faced by the Kentucky arrow darter are the result of ongoing land uses that are expected to continue indefinitely. We have determined that other natural and anthropogenic factors, such as geographical isolation, small population size, and climate change, are threats to remaining populations of the Kentucky arrow darter across its range. The severity of these threats is high because of the species' reduced range and population size, which result in a reduced ability to adapt to environmental change. Further, our review of the best available scientific and commercial information indicates that these threats are likely to continue or increase in the future.

EB/CE Source:
U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; Threatened Species Status for Kentucky Arrow Darter With 4(d) Rule. Federal Register 81(193):68963-68985.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Kentucky arrow darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 2,990,448 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,098,643 acres, 36.738%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

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Scientific Name:	Common Name:	Entity ID:
Etheostoma susanae	Cumberland darter	5719

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Cumberland Darter is endemic to a limited portion of the upper Cumberland River drainage, above Cumberland Falls, in Kentucky and Tennessee (Etnier and Starnes 1993, O'Bara 1988; Thomas 2007). No population estimates or status trends are available for the Cumberland Darter; however, survey results by Thomas (2007) and others indicate the species is now absent from much of its historical range and typically occurs in low densities in occupied streams. The species' current distribution is limited to 17 streams in Kentucky (McCreary and Whitley Counties) and Tennessee (Campbell and Scott Counties). These streams are clustered in 9 isolated stream systems (Bunches Creek, Youngs Creek, Laurel Fork (of Indian Creek), Cogur Fork, Indian Creek, Laurel Creek, Jellico Creek, Wolf Creek, and Laurel Fork (of Clear Fork), which are separated geographically by an average distance of 30.5 stream km (19 mi) (O'Bara 1988, O'Bara 1991, Thomas 2007). The species has been extirpated from seven historical streams, with five of these extirpations occurring since the 1980s. A detailed life history examination for the Cumberland Darter has not been completed; however, field observations and comparisons with related species suggest the Cumberland Darter spawns from April to June and has a maximum lifespan of three years.

Three of the five listing factors considered by the Service pose threats to the Cumberland Darter: the present or threatened destruction, modification or curtailment of its habitat or range; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence. The species' habitat and range have been severely degraded and limited by a variety of human-induced impacts such as sedimentation/siltation, disturbance of riparian corridors, and changes in channel morphology. Current regulatory mechanisms have been inadequate to prevent these impacts. Existing populations are extremely localized, and geographically isolated from one another; therefore, the species is vulnerable to localized extinctions from intentional or accidental toxic chemical spills, habitat modification, progressive degradation from land surface runoff, natural catastrophic changes to its habitat, and other stochastic disturbances. Consequently, the species is more likely to suffer loss of genetic diversity due to genetic drift, potentially increasing their susceptibility to inbreeding depression, decreasing their ability to adapt to environmental changes, and reducing the fitness of individuals.

Based on the best available scientific and commercial information available to the Service regarding the species' current status and past, present, and future threats, the species continues to be impacted by poor water quality and habitat deterioration resulting from stream channelization, reductions in riparian cover, stream channel instability, siltation caused by poor land use practices, and by other nonpoint-source pollutants. The limited distribution of populations also makes them vulnerable to toxic chemical spills and limits the natural genetic exchange between and within populations.

EB/CE Source:
U.S. Fish and Wildlife Service. 2018. Cumberland Darter (*Etheostoma susanae*) 5-Year Review: Summary and Evaluation. Kentucky Ecological Services Field Office, Frankfort, Kentucky. 28 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 599,004 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 396,373 acres, 66.172%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is

limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Percina antesella	Amber darter	293

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
When the species was listed in 1985, amber darters were known to occur only in a 33.5-mile reach of the Conasauga River mainstem, from the Tibbs Bridge crossing, Murray County, Georgia, upstream to the Tennessee Hwy 74 crossing, Polk County, Tennessee. A single amber darter was collected in the Etowah in 1980, but intensive searches in the early 1980's failed to locate additional individuals, and the listing document concluded that an Etowah population, if it existed, was very small. Since 1990, amber darters have been found in the Etowah River mainstem and several larger tributaries.

Results from repeated seine surveys conducted 1996-2008 at fixed sample sites in the Conasauga River documented a decline in the abundance and/or occurrence of a number of rare and sensitive fish species, including the amber darter. Results over this time period ranged from approximately 70 in 1996 and 2000 to around10 in 2005 and 2007 Amber darters were found in low abundance (1 individual) at only 4 sites during surveys in 2011-2012.

The species is considered to be decreasing in both the Etowah and Conasauga basins. Hagler and Freeman's (2014) analysis of 1998-2009 fish collection data at 10 Etowah mainstem shoals between the confluences of Amicalola and Sharp Mountain Creeks found a declining trend over time for amber darter numbers, although this decline may have slowed or reversed over the past five years, when urban development has been limited. The number of amber darters USGS and University of Georgia scientists collected 1996-2008 at seven fixed sites in the Conasauga mainstem downstream of TN Hwy 74 to Tibbs Bridge Road was highly variable annually, but showed a decreasing trend (Golder Associates 2010). Survey work completed 2011-2012 by Hagler and Freeman (2012) documented a continued downward trajectory for sites between Tennessee Hwy 74 and Tibbs Bridge Road, although no evidence of decline was noted at three sites in the upper Conasauga's Cohutta Wilderness.
Research conducted on threats to Etowah River fish during development of the draft Etowah River Habitat Conservation Plan (HCP) identified 6 stressors to benthic fishes in the Etowah basin: sedimentation, hydrologic alteration, extensive riparian buffer loss, contaminants (heavy

metals, pesticides, etc.), movement barriers, and channelization/piping of streams. The most significant source of these stressors was identified as stormwater runoff from impervious surfaces. Other sources of these stressors include construction, channel erosion, road and utility stream crossings, dams/impoundments, point-source discharges, water withdrawals, agriculture, forestry, and historic land use (Wenger and Freeman 2007). The Etowah River basin, which lies on the north edge of the Atlanta metropolitan area, has experienced rapid growth over the last decade. Most of the six primary stressors and their sources are related to this rapid urban development. The recession has slowed land-clearing activities and may have altered future development patterns in the basin (e.g., delayed urban sprawl, less dense development in the more distant counties from Atlanta). However, threats associated with urbanization are likely to increase in magnitude as the economy improves.

In the Conasauga watershed, land use in the upper basin has changed little over the past decade. The dominant land covers remain agriculture and forestry, and the headwaters of the basin are protected by extensive U.S. Forest Service land. Low density urban development has increased throughout the basin, but dense urban sprawl is concentrated downstream of known areas of high aquatic diversity. The major land use changes we identified in the basin over the past decade were (1) a large-scale shift to use of Roundup-ready seed for major row-crop products and (2) greater use of poultry litter to fertilize pastures and row crops (CindyAskew, Natural Resources Conservation Service, pers. comm., June 2008). These changes in land use could have significant impacts on Conasauga water quality because agricultural fields in the river's floodplain above Dalton are heavily ditched, facilitating transport of agricultural chemicals into stream systems. The Nature Conservancy (TNC) located hundreds of agricultural ditches in a 2008 survey of a 40-mi reach of the upper basin (Kathleen Owens, TNC, pers. comm. Feb. 2009). These ditches tend to bypass standard agricultural water quality best management practices, like riparian buffers or grass filter strips, and convey polluted runoff directly into the Conasauga River and its tributaries. In summary, destruction and modification of amber darter habitat in the Etowah River basin has been reduced, at least temporarily, due to (1) the continuing economic recession that has slowed growth and (2) ongoing Service and partner conservation actions in the basin. Existing development, poorly-designed/installed road and utility crossings, impoundments, and other human activities in the basin are still sources of chronic stress on these fishes. Resumption of rapid urbanization growth patterns, without implementation of adequate best management /practices to minimize impacts, would increase threats to the darters associated with increased stormwater runoff, sedimentation, riparian buffer loss, contaminants, movement barriers, and channelization/piping.

2021 5-Year Review

The 2019 Species Status Assessment for the amber darter describes current and emerging stressors to the Conasauga and Etowah populations, including excess nutrients and sedimentation caused by a lack or removal of riparian buffers and increased impervious surfaces, fish passage barriers, and declines in benthic macrophytes and habitat quality. The amber darter has become increasingly rare in the Conasauga River basin with no captures since 2017, which makes its continued viability in the system tenuous. While regulatory mechanisms that are protective of some amber darter habitat (primarily water quality) have improved, agriculture and forestry are fully or partially exempt from these regulations, and BMP implementation is limited. The species' limited geographic range, small population size, and increases in threats related to changes in water quality, quantity, and timing make it vulnerable to catastrophic events that could eliminate large portions of one or both populations.

EB/CE Source:

U.S. Fish and Wildlife Service. 2021. Amber darter (*Percina antesella*) 5-Year Review: Summary and Evaluation. Georgia Ecological Services Field Office, Athens, Georgia. 17 pp.

U.S. Fish and Wildlife Service. 2014. Etowah Darter (*Etheostoma etowahae*), Cherokee Darter (*Etheostoma scotti*), and Amber Darter (*Percina antesella*) 5-Year Review: Summary and Evaluation. Georgia Ecological Services Field Office, Athens, Georgia. 11 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 1,539,885 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 465,713 acres, 30.243%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering

sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Percina aurolineata	Goldline darter	298

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Population size/location(s) unknown
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The species is found sporadically in approximately 102 km (63 mi) of river reach, including parts ofthe Cahaba River, Little Cahaba River, and the Upper Coosa River watershed (i.e., the upper Coosawattee River, Ellijay River, Cartecay River, and Mountaintown Creek) (Boschung and Mayden 2004, Albanese et al. 2013).

Studies in general show that increased urbanization generally leads to declining water quality in streams and fish assemblages (Onorato et al. 2000, Anderson et al. 1995, Waters 1995, Weaver and Garman 1994). Honavar (2003) observed a negative correlation between water quality (sedimentation) and% relative abundance of crevice-spawning minnows and darters in the Cahaba River system in Alabama. Historically, point- and non-point source pollution have resulted in decreased water quality coinciding with extirpation of the blue shiner (*Cyprinella caerulea*) and other aquatic species from the Cahaba River (U.S. Environmental Protection Agency 2000, 1979; Sheppard et al. 1994; Pierson and Krotzer 1987; O'Neil 1984; Howell et al. 1982; Ramsey 1982). Impairment of aquatic life in the Cahaba River has been related to nutrient overenrichment compounded by sedimentation and extremes in prevailing hydrologic patterns as reflected in decreased diurnal dissolved oxygen fluctuations at Piper Bridge (the upper mid-range of the species).

Conversely, recent surveys in seven sites of the Locust Fork suggest improvement in the sampled river reach based on fair to excellent Index of Biological Integrity (IBI) scores (O'Neil, pers. comm., 2012). The Cahaba River has been the subject of intense scrutiny and enforcement activity due to sanitary sewer overload from 24 municipal and 16 private sewage treatment plants (Meyland et al.1998). During high flows, the Cahaba River has very high fecal coliform concentrations in certain river segments (Alabama Department of Environmental Management 2003). Changes in temperature and photoperiod appear to be the most important controlling factors in the regulation of reproductive cycles of fishes (Krotzer 1984). Excessive turbidity, caused by silt change temperature and photoperiod, adversely affects reproduction by preventing courtship and territorial displays and survivorship of eggs (Mayden 1989, Krotzer 1984).

Increased urbanization in the upper Coosawattee River and on the floodplain of Talking Rock Creek has resulted in a loss of the riparian zone (Powers 2008). Loss of riparian habitat may have a strong influence on local instream habitat by either reducing nutrient inputs to the stream or increasing erosion because of decreasing stream bank stability (Waters 1995).

Toxic leaks resulting from storm water runoff, such as gasoline and oil, are routinely documented flowing directly into the Coosawattee River upstream from the city of Ellijay (Freeman and Troth 1999). In general, perfluorinated chemicals (a family of fluorine-containing chemicals with unique properties to make materials stain and stick resistant; such as Teflon™ or Scotchgard®) within the Conasauga River system in Georgia are a threat to the fish diversity in the watershed (Konwick et al. 2008). The greatest density of Environmental Protection Agency regulated sites are located in the Ellijay area and represent a greater potential for environmental degradation than exists in other areas.

The species is threatened in Georgia by habitat loss and population fragmentation associated with Carters Lake and water quality impacts associated with poor land use (Powers 2008). Development is an emerging threat to the Coosawattee watershed where Gilmer County has had a 24% increase of population size between 2000 and 2009, and the Coosawattee River basin has had a corresponding 3.5% increase in constructed or built-on land and a 2.4% decrease in forest cover (Natural Resource Spatial Analysis Lab 2012 in Albanese et al. 2013). Increased urbanization leads to declining water quality in streams and fish assemblages (Onorato et al. 2000, Anderson et al. 1995, Weaver and Garman 1994) which, in the case of this species, may produce several isolated goldline darter populations. Isolation makes the populations more susceptible to environmental changes, such as decreased genetic diversity and reproduction. Flow in the lower Coosawattee River is regulated by releases from Carter Dam, potentially affecting the species (considered extirpated from this reach).

Improvements to the goldline darter condition since listing include: 1) protection in the Cahaba River National Wildlife Refuge in Alabama and protection of headwater streams and mainstem reaches by the Rich Mountain Wildlife Management Area in Georgia, and municipal and county planning (Coosa North Georgia Water Planning Council 2011, Etowah Habitat Conservation Plan Advisory Committee 2007); 2) site-specific improvements of connectivity and fish passage within the Cahaba River at the Marvel Slab and box car culverts in Shades Creek; 3) marginal water quality improvements and TMDL designations in the Cahaba River, Little Cahaba River, Shades and Schultz creeks in Alabama, and the Cartecay, Ellijay and Coosawattee Rivers, and Mountaintown Creek in Georgia; and 4) some increase in relative abundance of the species at site-specific reaches within the Cahaba River system.

Community action outreach groups strive to protect water quality and quantity through grass roots, non-profit conservation and other types of organizations. Organizations and institutions include Cahaba River Society (on going public monitoring and outreach of the watershed), Conasauga River Alliance (supports wise use of the Conasauga River system), Coosawattee

Watershed Alliance (supports wise use of the Coosawattee River system) and others, have published various watershed and specific reach management and conservation plans (e.g., Friends of Shades Creek 2008, Coosawattee Watershed Alliance 2008, Alabama Clean Water Partnership 2007, McKinney 2006, Cahaba River Society 2005). Community action groups have worked along with State and Federal agencies, city and county governments to help distribute information to the public and landowners, conduct inventories and surveys, and attempt to regulate actions that adversely affect water quality and quantity. Although outreach of the management plans for protecting water quality and quantity have occurred, the overall trend in water quality within the goldline darters' current range has shown minimal quantitative improvement.

EB/CE Source:
U.S. Fish and Wildlife Service. 2015. Goldline Darter (*Percina aurolineata*) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 23.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Goldline darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 2,346,066 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 669,393 acres, 28.533%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Percina aurora	Pearl darter	4431

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Pearl darter is historically known from localized sites within the Pearl and Pascagoula River drainages of Mississippi and Louisiana, based on collection records from 16 counties/ parishes of Mississippi and Louisiana. The quantified range of the Pearl darter, expressed in river miles, has not been well-defined by researchers (Slack et al. 2005, pp. 5–10; Ross 2001, p. 499; Ross et al. 2000, pp. 5–8; Bart and Piller 1997, pp. 3–10; Bart and Suttkus 1996, pp. 3–4, Suttkus et al. 1994, pp. 15–18). However, a recent reanalysis of collection records compiled from the Mississippi Museum of Natural Science (MMNS) (2016, unpublished data) estimates the species' historical range to be approximately 708 kilometers (km) (440 miles (mi)) in the Pearl River and 539 km (335 mi) in the Pascagoula River system, for a total historical range of 1,247 km (775 mi). Today, Pearl darters are thought to occur only in scattered sites within approximately 449 km (279 mi) of thePascagoula drainage, including the Pascagoula, Chickasawhay, Chunky, Leaf, and Bouie Rivers, and Okatoma and Black Creeks. In recent years, the species has been found sporadically within the Pascagoula, Chickasawhay, and Leaf Rivers. There have been no collecting attempts within the Bouie and Chunky Rivers, nor Okatoma and Black Creeks, in the last 15 years; thus, the status of populations in those systems is unknown.

The threats that affect the Pearl darter are important on a threat-by-threat basis but are even more significant in combination. Due to the loss of the species from the Pearl River system, the Pearl darter is now confined to a single drainage system. The species is continuing to experience water quality degradation from point and nonpoint source pollution in association with land-altering activities, discharges from municipalities, and geomorphological changes from past gravel mining. Increased sedimentation from the removal of riparian vegetation and extensive cultivation is thought to have led to the extirpation of the Pearl darter from the Pearl River drainage. Water quality degradation occurs locally from point and nonpoint source pollution in association with land surface, stormwater, and effluent runoff from urbanization and municipal areas.

Non-point source pollution appears to be a localized threat to the Pearl darter within the drainage. Non-point source pollution from land surface runoff can originate from virtually any land use activity, and may include sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray water leakage, oils and greases. Construction activities that involve significant earthworks typically increase sediment loads into nearby streams. Siltation sources include timber clear cutting, clearing of riparian vegetation, and mining and agricultural practices that allow exposed earth to enter streams. Practices that affect sediment and water discharges into a stream system change the erosion or sedimentation pattern, which can lead to the destruction of riparian vegetation, bank collapse, and increased water turbidity and temperature. Excessive sediments are believed to affect the habitat of darters and associated fish species, by making the habitat unsuitable for feeding and reproduction. Sediment has been shown to abrade and or suffocate periphyton, disrupt aquatic insect natural processes, and, ultimately, negatively affect fish growth, survival, and reproduction (Waters 1995, p. 55-62). Non-point source pollution is a more prevalent threat to the Pearl darter in areas outside those lands protected by The Nature Conservancy and other areas managed by the U.S. Forest Service and State of Mississippi where Best Management Practices (BMPs) are used. Increased sediment from a variety of sources, including geomorphological changes and bank instability from past habitat modification, appears to be the major contributor to water quality declines in this species' habitat. Localized sewage and waste water effluent also pose threats to this species and its habitat. The Pearl darter's vulnerability to catastrophic events, particularly the release of pollutants in its habitat from oil spills, train derailments, and hydraulic fracturing, is also a concern due to the abundance of oil wells, pumping stations, gas lines, and railways throughout its habitat, and the increased interest in alternative oil and gas collection methods in the area. The proposed damming of Big and Little Cypress creeks may decrease water flow and increase nutrients and sedimentation into the Pascagoula River. These threats continue to impact water quality and habitat conditions through much of this species' current range. Therefore, we conclude that habitat degradation is presently a moderate threat to the Pearl darter that is expected to continue and possibly increase into the future.

Outside of the areas protected or managed by the State and The Nature Conservancy, and despite existing authorities such as the Clean Water Act, pollutants continue to impair the water quality throughout much of the current range of the Pearl darter. State and Federal regulatory mechanisms have helped reduce the negative effects of point source and nonpoint source discharges, yet there is inconsistency in the implementation of these regulations and best management practices, which are not mandatory for all activities. Thus, we conclude that existing regulatory mechanisms do not adequately protect the Pearl darter from the impact of other threats.

Because the Pearl darter has a limited geographic range, small population numbers, and low genetic diversity, it is vulnerable to several other ongoing natural and anthropogenic threats. These threats include the loss of genetic fitness, susceptibility to spills and other catastrophic events, and impacts from climate change. These threats are current and are likely to continue or increase in the future.

EB/CE Source:
U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; Threatened Species Status for Pearl Darter. Federal Register 81(183):64857-64868.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 3,172,084 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 423,788 acres, 13.360%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Percina jenkinsi	Conasauga logperch	294

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Threats to Conasauga logperch habitat or range, at the time the species was listed, focused on three factors: the species' restricted range, potential reservoir projects in Conasauga logperch habitat, and changes in land use in the Conasauga basin. The Conasauga logperch was known only from a short reach of the Conasauga River when it was listed. Recent surveys have expanded the species' known range to include additional reaches of the Conasauga River mainstem and the Jacks River near its confluence with the Conasauga. However, the Conasauga logperch remains highly vulnerable to extinction and/or habitat destruction/degradation due to stochastic or anthropogenic events that degrade its habitat, including floods, drought, chemical spills, point-source contaminants, sewage spills, herbicides and pesticides, heavy metals, excess hormones and/or nutrients, and other factors. Development of successful Conasauga logperch captive propagation methods in 2011, coupled with the establishment of an ark population at Conservation Fisheries, Inc., reduces the likelihood of imminent extinction in the event of a catastrophic loss of the wild population, but is not a substitute for continued habitat protection and restoration.

The Dalton Lake and the Jacks River reservoirs identified in the listing document have not been built. Dalton Lake no longer was considered a viable water supply option when the final listing document was published. The Jacks River project was authorized for study by Congress in 1945, but not for further planning. A third reservoir, the River Road Reservoir, was constructed by Dalton Utilities offstream, in uplands adjacent to the middle portion of the Conasauga River in the late 1990s; it began withdrawing water from the Conasauga River to maintain reservoir water elevations, then releasing water during low flow periods for downstream withdrawal in 1999-2000. Dalton Utilities monitored aquatic communities and water quality from 1995 to 2006 to comply with their U.S. Army Corps of Engineers' Section 404 permit. These data did not indicate that reservoir operation, at least during the first few years post-construction, significantly impacted fish populations in shoals downstream of the reservoir, when compared to upstream reaches or to baseline conditions. The report, however, specifically excluded

Conasauga logperch from impact conclusions due to the limited number of individuals collected during the study (Golder Associates 2008).

Changes in land use, particularly on private lands that comprise 75% of the basin, could benefit or harm the Conasauga logperch, depending on the new land use. Currently, the river's 100-year floodplain downstream of the Cherokee and Chattahoochee National Forests is dominated by agriculture, although areas between ridgetops and floodplain are predominantly forested. Replanting cropped fields, livestock pastures, and chicken farms with native vegetation to create riparian buffers and forested floodplains likely would reduce sedimentation, increase large woody debris, moderate water temperature, and reduce transport of agricultural and urban chemicals into the Conasauga and its tributaries. Conversely, increased silviculture, road and bridge construction, stream channel modification, and conversion of agricultural lands to urban use could significantly affect the logperch and its habitat due to increased stormwater runoff from impervious surfaces, greater water turbidity and sedimentation, higher contaminant loads, and other changes in water quality and timing/magnitude of stream flows.

Multiple partners are working to reduce these threats to the Conasauga River system and restore degraded habitat and rare species. A major step was the 1995 formation of the Conasauga River Alliance by the Limestone Valley Resource Conservation and Development (RC&D) Council, funded by a Natural Resources Conservation Servise (NRCS) grant. The Alliance is a partnership of local citizens, businesses, conservation groups, and government agencies with a primary objective to identify threats to the river and develop cooperative solutions. In the Conasauga basin, NRCS, The Nature Conservancy, Conasauga River Alliance, Limestone Valley RC&D, the Service, and other partners are actively working with local farmers and other landowners to implement conservation provisions of the Farm Bill, Partners for Fish and Wildlife projects, and other stream protection and restoration programs. These and other efforts, at current levels, have not been sufficient to prevent apparent declines in Conasauga logperch and other aquatic species populations, including once-common fishes. Limited data from studies initiated in 2010 suggest a range of potential anthropogenic stressors, including elevated levels of glyphosate (e.g., Roundup), metals, estrogen compounds, testosterone, and nutrients in the river's sediments (Lasier et al. 2011). Study and evaluation of these stressors will continue, and results could allow prioritization and implementation of actions needed to protect the Conasauga logperch.
Given the low population numbers and geographically limited range of the Conasauga logperch, a wide range of events, both natural and anthropogenic, alone or in combination, could cause the species' extinction. Localized drought, chemical spills, floods that significantly alter habitat, or other catastrophic events could affect all or part of the logperch's limited range. Long-term, chronic threats include changes in land use that result in excess siltation of channel bottoms, reduced water quality, altered hydrology, loss of riparian buffers, and/or increased contaminant loads.

EB/CE Source:
U.S. Fish and Wildlife Service. 2011. Conasauga Logperch Five-Year Review: Summary and Evaluation. Athens, Georgia. pp. 19.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 592,242 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 294,666 acres, 49.754%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Percina pantherina	Leopard darter	238

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
In 1978, the leopard darter was federally listed under the ESA as threatened. Critical habitat was designated at the time, including portions of Black Fork Creek and the Glover, Little, and Mountain Fork Rivers. At the time of listing, four populations were known (Cossatot, Glover, Little, and Mountain Fork Rivers), all of which continue to persist in relatively low abundances, particularly when compared to population estimates for other short-lived darter species. The species has disappeared in the Cossatot downstream of Gillham Dam, as predicted in the 1978 listing. More recent monitoring surveys suggest that within the last 13 years leopard darter populations are stable to declining.

The species was listed primarily due to the loss of habitat through construction of reservoirs, which have eliminated numerous river miles within the Little River Basin and has altered flow dynamics, water quality, and habitat availability downstream of reservoirs where viable populations have disappeared. Although no new reservoirs have been constructed since the species was listed, current and future water demands may drive the desire for more to be constructed. One in particular, Lukfata Reservoir, was authorized for construction, but was never funded and in 2002 the reservoir was deauthorized by Congress. Impacts to water quality from agriculture, industry, gravel mining, and road construction were also identified as threats to the species. Poultry operations have recently increased within the watershed and clear cutting and gravel mining continues to occur. Roads and low water crossings are potentially a significant threat to the leopard darter, and additional research on the effects of increased sedimentation and low water crossing barriers is needed. More recently identified threats such as climate change and increased water demands further exacerbate potential impacts to the species. Significant information on the leopard darter's status, life history, and genetics has been gathered since listing. The species is known to occur in some larger tributaries of the Glover, Little, and Mountain Fork Rivers; however, their status in some of these tributaries has declined in recent years. Population size fluctuates from year to year, likely driven by precipitation, or lack thereof, and temperature. The species lives an average of 18 months, and most individuals spawn only once in their lifetime, leaving the species even more vulnerable to existing threats. Recent population genetics research suggests that the effective population size of the species is extremely low and has declined precipitously, suggesting that artificial immigration (moving individuals between drainages) may be necessary. A sufficiently large effective population size is essential to adapt to environmental change and maintain long-term population viability. These populations may be experiencing a bottleneck effect due to the small effective population size. Without genetic interchange, small, isolated populations could be slowly expiring, a phenomenon termed the extinction debt (Tillman et al. 1994). Even given the absence of existing or new anthropogenic threats, disjunct populations may be lost as a result of current below-threshold effective population size. Additionally, evidence indicates that general habitat degradation continues to decrease habitat patch size, further contributing to the decline of leopard darter populations. Fragmentation and isolation of small remaining populations of leopard darter are current and ongoing threats throughout its range and will continue into the future. Further, stochastic events may play a magnified role in population extirpation when small, isolated populations are involved.

The improvement of low water crossings that act as barriers to fish passage has been a primary focus of the Service in regards to leopard darter recovery. To date, over 100 river miles have been opened up to allow for improved passage through low water crossing structures. The Service continues to work with the U.S. Forest Service, logging industry, and county governments to improve fish passage throughout the Little River Basin.

EB/CE Source:
U.S. Fish and Wildlife Service. 2012. Leopard Darter (*Percina pantherina*) 5 Year Review: Summary and Evaluation. Tulsa, Oklahoma. pp. 47.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 2,306,425 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 341,649 acres, 14.813%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Scientific Name:	Common Name:	Entity ID:
Percina rex	Roanoke logperch	240

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (numerous)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Although the number of known populations has increased since the species was listed in 1989, the geographic range of the Roanoke logperch remains small and threats continue. Densities and abundance vary by population. The largest population is found in the upper Roanoke River. The presence of individuals in multiple tributaries in this system could act as sources in the event of extirpation in areas of the occupied mainstem. No trend data are available for this population. The Middle Roanoke River system appears to be sparsely population by the species; surveys have not been sufficient enough to determine relative population densities (Lahey and Angermeier 2006a) or trends. In the Pigg River population previous surveys suggest the species is rare, but more recent surveys indicate higher densities. Both population density and abundance appear to be increasing in the Pigg River watershed. Three populations are present in the Smith River watershed, some at densities similar to sites in the Roanaoke and Pigg Rivers. Overall the population in the Smith River appears to be stable. High densities have also been found in the Nottoway River population, and the species appears to be stable.

Factors that have adversely affected the Roanoke logperch in various locations include: turbidity and siltation, chemical spills and organic pollution, channelization, impoundments, and cold-water releases.

Upper Roanoke River: The best known and largest population, which inhabits the upper Roanoke from the City of Roanoke upstream into the North and South Forks, has been subjected to considerable stress from human uses in the basin, progressively more so in the downstream direction. The human population of the Greater Roanoke area (Roanoke, Salem, Vinton, and adjacent areas) is continuing to expand, stimulating additional development of the Roanoke Valley. The rest of the upper Roanoke basin is largely rural, with considerable crop and livestock farming. The valley is also a major thoroughfare, traversed by Interstate 81 and Routes 11, 220, and 460, and by the Noriolk and Western Railroad (Jenkins 1977). The water quality in the upper Roanoke River, from Salem downstream, has improved since 1970 as a result of installation of the Roanoke sewage treatment plant and reduction of wastes from other point sources. Non-point sources of pollution remain a problem, including large quantities of stormwater from streets and lawns, carrying nutrients, oil, metals, and other pollutants into the river. Relatively frequent spills of toxic chemicals have occurred in the Roanoke river in Salem and Roanoke. One of the most destructive spills resulted from the accidental discharge of more than 100,000 gallons of liquid manure (from a dairy farm storage tank) into a tributary of the South Fork of the Roanoke River. It is estimated that this spill killed 190,000 fish, including 300 Roanoke logperch. The numerous liquid manure storage facilities in the upper Roanoke drainage and other drainages supporting the Roanoke logperch represent a potential threat to the species. The morphology and hydraulics of the upper Roanoke River have been modified in numerous locations as a result of channelization or levee construction. In Roanoke and Salem, significant portions of the Roanoke River floodplain have been filled to support industrial parks and residential areas. Local farmers have also channelized small portions of the South Fork Roanoke River (Jenkins 1977). The upper Roanoke River population of the logperch will also be affected by a pending Roanoke County water supply project and a U.S. Army Corps of Engineers flood control project. The latter project, which has been the subject of a formal consultation between the Corps and the Service, will affect the logperch population within the boundaries of Roanoke City. A study has been initiated by the Corps to monitor impacts on the logperch resulting from project construction. The water quality of the North Fork of the Roanoke River is significantly degraded by silt washed from agricultural lands in the watershed. It is probable that the absence of the logperch from the upper and middle portions of the North Fork Roanoke is the result of historical habitat degradation (W.E. Ensign pers. comm.), and the results of the most recent comprehensive survey indicate that the species is continuing to decline in the North Fork Roanoke (Simonson and Neves 1986).

Pigg River: A 1975 discharge of copper sulfate and silver nitrate into a tributary (Furnace Creek) of the Pigg River caused a severe fish kill for about 37 kilometers (23 miles) downstream (James 1979), likely reducing or eliminating the logperch population in the Pigg River near Rocky Mount, Virginia. In addition, much of the Pigg River contains moderate to heavy silt deposits.
Middle Roanoke River: Prior to pollution from the greater Roanoke area, the midreach of the Roanoke probably had a logperch population that was contiguous with the upper Roanoke population (Jenkins 1977). Any population supported by this reach of the Roanoke would have been further reduced by the Smith Mountain/Leesville Reservoirs, a 92-km (57-mi) long pumped storage project completed in 1966 on Roanoke River. Although the reservoirs hold back much of the fine sediment from the upper Roanoke, the river below is fluctuating and often carries considerable silt from Piedmont tributaries below Leesville Dam. Taken together, these modifications appear to have eliminated any habitat suitable for the logperch.

Smith River System: The historical status of the Town Creek population is unknown. It probably extended into the Smith River prior to completion of Philpott Dam on the Smith River in 1953, three miles above the mouth of Town Creek (Jenkins 1977). Smith River now contains an excellent trout fishery, but is too cold for a population of *P. rex*. Town Creek is a warm, slightly to moderately silted stream in an agricultural valley, with one industry located in its middle section in the town of Henry, above the *P. rex* population. The industry is not known to have caused a stream pollution problem (Jenkins 1977). Upper Smith River, above the 15-mile long Philpott Reservoir, contains a small, isolated population of *P. rex*. Burkhead and Jenkins (1991) indicate that the upper Smith River population may be held at a low level by heavy metal and chlorinated effluents from an upstream fabric plant. This population was probably contiguous with the Town Creek population prior to construction of Philpott Dam. The ecological and geographic isolation of these two small populations may threaten their long-term viability. Nottoway River: Excessive siltation, generated by poor agricultural and logging practices, is a problem in this watershed. Because soils in this drainage are extremely erodible, excessive stream sedimentation has been a chronic problem (A.L. LaRoche in 11W). Siltation may be the most widespread threat to the logperch. Excessive silt deposition reduces habitat heterogeneity and primary productivity; increases egg and larval mortality; abrades organisms; and alters, degrades, and entombs macrobenthic communities (Burkhead and Jenkins 1991).

EB/CE Source:
U.S. Fish and Wildlife Service. 2007. Roanoke Logperch (*Percina rex*) 5 Year Review: Summary and Evaluation. Gloucester, Virginia. pp. 24.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 5,843,862 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 273,457 acres, 4.679%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

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Scientific Name:	Common Name:	Entity ID:
Percina tanasi	Snail darter	235

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened; Proposed for delisting due to recovery (86 FR 48953-48896; Sept. 2021)
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Snail darters have been periodically observed in ten tributaries entering the upper reaches of the Tennessee River, including the Holston River, French Broad River, Little River, Citico Creek, Hiwassee River, Ocoee River, Sewee Creek, South Chickamauga Creek, Sequatchie River, and Paint Rock River (Ashton and Layzer 2007; TVA 2008).

The Hiwassee River and French Broad River snail darter populations appear to be reproducing and stable. Six populations (Little River, Sequatchie River, Sewee Creek, Holston River, South Chickamauga Creek, and Paint Rock River) may be reproducing, but they are apparently small, with variable distribution.
Threats to the snail darter are primarily the result of activities that adversely impact the species' habitat. Sedimentation from various sources such as increased streambank erosion from barge traffic on the mainstem, agricultural activities, and development on tributaries to the mainstem pose potential threats to the species. Pollution from urban areas and non-point sources also threatens the snail darter by degrading water quality. All snail darter populations are subjected to such threats.

Poor habitat and water quality likely limit the abundance and distribution of snail darters in certain drainages. Many sites sampled for snail darters by Ashton and Layzer (2007) had limited riparian vegetation and aquatic macrophytes or silt covering the substrate and were unoccupied by snail darters. Other stressors are also of concern. Operation of towboats on the mainstem Tennessee River likely affects the snail darter by contributing to streambank erosion, increased turbidity in the water column, and sediment deposition on substrate. These disturbances may compel snail darters to relocate to less suitable habitat or restrict the respiration of larvae or juveniles in the near vicinity. The reach of the Holston River where snail darters have been observed and the related French Broad population are affected by cool water releases from Cherokee Dam as a result of thermal shock to snail darters during their spawning season. Hydro-

peaking releases from both Cherokee and Douglas Dams also make it difficult for snail darters to maintain their positions in the river due to rapidly fluctuating water levels, and they are carried downstream. Although much of the French Broad River in Tennessee flows through agricultural (cropland or pasture) lands, the lower reaches of the river flow through urban areas in the vicinities of Sevierville, Tennessee and Knoxville, Tennessee. Lands adjacent to the river are undergoing, or will likely undergo, development for single-family residences, subdivisions, golf courses, and other commercial facilities. Runoff associated with such development could adversely affect the snail darter and its habitat. Ashton and Layzer (2007) found little silt and abundant macrophyte-free gravel substrate at sites where the greatest numbers of snail darters were collected in the French Broad River. Cold water releases from the Appalachian Powerhouse also negatively affect the transplanted snail darter population on the Hiwassee River (TVA 2005). Ashton and Layzer (2007) found that most of the Little River was affected by siltation and lacked a contiguous riparian buffer. They noted that sites where snail darters did occur on the Little River had few macrophytes, little silt, and a predominantly intact riparian zone.
The lower 17 miles of South Chickamauga Creek (i.e., the entire reach in Tennessee) flows through the City of Chattanooga. Development and associated runoff continue to affect stream water quality, riparian and instream habitat, and the snail darter. Municipal and industrial discharges into the stream may also be affecting stream water quality, the snail darter, and its habitat. Ashton and Layzer (2007) indicated that much of South Chickamauga Creek was heavily silted and lacked a riparian zone at the time of their snail darter survey; all snail darters the authors collected occurred within a 2.8-mile reach, containing little silt and a well-established riparian zone.

The Sequatchie River primarily flows through rural lands. Agricultural activities may be affecting the snail darter and its habitat as a result of sedimentation, runoff containing pesticides and fertilizers, and livestock impacting the river. Coal mining in the drainage has also impacted the river and will likely continue to have negative effects on aquatic habitats and species that utilize them (Ashton and Layzer 2007). The snail darter population in the Holston River is likely being affected by development activities along the river in the vicinity of Knoxville. Potential upstream expansion of the population is likely inhibited by cold water releases from Cherokee Dam. The snail darter population in Sewee Creek has been affected primarily by sedimentation and runoff associated with agricultural activities. Effects of those activities are likely to continue.

2021 Proposed Rule; Delist Due to Recovery

The snail darter’s known range has greatly expanded since it was first discovered. At the time of listing in 1975, the species was only known from a small reach of the Little Tennessee River. By the early 1980s, new populations had been found or established in 10 widely dispersed locations, and in 1984, we reclassified the snail darter from an endangered to a threatened species (49 FR 27510; July 5, 1984), due largely to an increased number of populations and a considerable range expansion. Since 2010, populations in an additional two reservoirs and three tributaries have been discovered (Simmons 2019). As a result, snail darters are now considered extant in seven mainstem reservoirs of the Tennessee River (Fort Loudoun, Watts Bar, Chickamauga, Nickajack, Guntersville, Wheeler, and Pickwick) and 12 tributaries in the Tennessee River watershed

(Holston River, French Broad River, Little River, Hiwassee River, Ocoee River, South Chickamauga Creek, Sequatchie River, Paint Rock River, Flint River (two individuals), Elk River, Shoal Creek (one individual), and Bear Creek). We consider the snail darter extirpated from the Little Tennessee River mainstem, Citico Creek, and Sewee Creek, and never established in the Nolichucky River.

EB/CE Source:

USFWS 2021. Endangered and Threatened Wildlife and Plants; Removing the Snail Darter form the List of Endangered and Threatened Species; Proposed Rule. 86 Federal Register 167 (September 1, 2021): 48953-48968.

U.S. Fish and Wildlife Service. 2013. Snail Darter (*Percina tanasi*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 25 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE

 # acres in species range: 7,316,290 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,089,729 acres, 14.895%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Integration and Synthesis Summary: Fishes (Amblopysidae)

Scientific Name:	Common Name:	Entity ID:
Amblyopsis rosae	Ozark cavefish	260

Family: Amblyopsidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Population size/location unknown
Number of Populations: Multiple populations (numerous)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
There are 41 Ozark cavefish caves and wells in Arkansas, Missouri, and Oklahoma that are considered active. These are distributed throughout 8 counties including Benton County in Arkansas; Greene, Jasper, Lawrence, Newton, Christian, Barry, and Stone Counties in Missouri; and Delaware and Ottawa Counties in Oklahoma.

Overall, threats are stable to increasing at 40 of 41 active sites. Threats at caves/wells and within recharge zones include human entry, agriculture, and urbanization/development. At the 41 active sites, agriculture is the primary threat. As lands are converted from forest to pasture, valuable canopy cover for ground temperature regulation and soil moisture retention is lost. Chemicals and fertilizers are applied which rapidly infiltrate during precipitation events into groundwater systems.As animal production sites generally occur on well-drained slopes, potentially high levels of biological and chemical contaminants are rapidly transported, which can influence Logan Cave waters. Metals and other contaminants pass through poultry/livestock and can reach groundwater through land application of wastes.

At the 41 active sites, urbanization/development is suggested as another primary threat in recharge zones. As development increases, areas that allow natural infiltration and percolation are lost or significantly diminished. As impervious surfaces increase, storm water directed to engineered or natural outlets no longer finds natural groundwater flow paths. Existing regulatory mechanisms regarding the protection of groundwater resources are limited. Of the 41 active cavefish sites, 16 sites are either gated or fenced in an attempt to reduce direct human disturbance. Transportation and pipeline routes can cause sediment and other contaminants to enter the groundwater system. Leaks and spills along roadways occur and threaten groundwater. A recent spill of 60,000 gallons of gasoline in Benton County, Arkansas immediately went underground. Arkansas Department of Environmental Quality conducted well and spring water quality sampling and found no evidence of the fuels’ groundwater dispersal. Spill residue may resurface during significant precipitation events whereby it is flushed from karst conduits. Recent unpublished water quality studies at springs, wells, and streams in Arkansas, Oklahoma, and Missouri found numerous contaminants at low but detectable levels. Brown et al. (1998) found mean total coliform counts at baseflow of 500 MPN/100ml, and 20,000 MPN/100mL during storm events at Cave Springs Cave. Graening and Brown (2003) consistently found high levels of fecal coliform, excess nutrients, and metals in water, sediment, and tissue samples at Cave Springs Cave. They further identified beryllium, copper, selenium, and zinc at levels exceeding Arkansas MCL's for chronic and acute toxicity to aquatic life. As groundwater quality and quantity is influenced by increasing population growth in the Ozarks, cavefish conservation efforts targeted at this threat are essential to achieve species recovery.

EB/CE Source:
U.S. Fish and Wildlife Service. 2011. Ozark Cavefish (*Amblyopsis rosae* Eigenmann 1898) 5 Year Review: Summary and Evaluation. Conway, Arkansas. pp. 29.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

 # acres in species range: 6,582,619 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 383,402 acres, 5.824%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of

area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Integration and Synthesis Summary: Fishes (Salmonidae)

Scientific Name:	Common Name:	Entity ID:
Oncorhynchus aguabonita whitei	Little Kern golden trout	248

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Little Kern golden trout is a subspecies of rainbow trout in the family Salmonidae and endemic to the Little Kern River drainage in Tulare County. The Little Kern River drainage occurs primarily within the Golden Trout Wilderness of Sequoia National Forest. Smaller areas of the drainage occur in either Sequoia National Park or the Sequoia National Forest (Service 2003). Historically, the Little Kern golden trout occupied approximately 160 km (99.4 miles) of the Little Kern River and tributaries (Moyle 2002). By 1973, its range was greatly reduced to five headwater streams (upper Soda Springs Creek, Deadman Creek, lower wet meadows creek, Willow Creek, and Fish Creek) and an introduced population in Coyote Creek, or approximately 10% of its historical range (Christenson 1984, Moyle 2002).

At the time of listing, the range of the Little Kern golden trout was reduced to six headwater streams in the Little Kern River drainage, or a reduction of approximately 90% of their historical range. This range reduction was mostly notably due to the presence of introduced salmonids, and, to some extent, habitat loss associated with grazing, logging, and mining activities among other anthropogenic activities (off-highway vehicle route proliferation, road building, etc.). Habitat loss due to anthropogenic disturbance has been greatly reduced due to the protections of Little Kern golden trout critical habitat area associated with the Golden Trout Wilderness. However, while grazing management has improved, grazing still regularly occurs within the critical habitat boundary of the Little Kern golden trout and streams are not routinely fenced to minimize detrimental effects of grazing on Little Kern golden trout habitat.

By far, the greatest historical threat to the Little Kern golden trout was loss of genetic diversity through hybridization with introduced coastal rainbow trout populations (*O. mykiss*). Severely introgressed Little Kern golden trout populations and the competitive influence of non-native brook trout on Little Kern golden trout populations have been reduced through chemical treatments within the drainage and the subsequent restocking of Little Kern golden trout hatchery broodstock progeny. However, several streams continue to show moderate and even high levels of introgression including Upper Mountaineer Creek, Alpine Creek, Jacobson Creek, South Mountaineer Creek, Shotgun Creek, Peck's Canyon Creek, Lion Creek, Tamarack Creek, Little Kern River at Burnt Corral, Lower Maggie Lake, and Silver Lake. The source of genetic contamination is not fully understood. Some authors have implicated the 1997 Deadman Creek hatchery broodstock as being contaminated with rainbow trout alleles prior to stocking (Bagley et al. 1999), while other authors have suggested hold over introgressed populations after chemical treatment or illegal introductions (Stephens 2007). Regardless of the mechanisms, introgressed Little Kern golden trout populations continue to persist in the Little Kern River drainage. The reintroduction history of the Little Kern golden trout into the drainage after chemical treatment has led to significant genetic structuring coupled with low levels of heterozygosity, an indication of inbreeding. Gene flow between subpopulations has been greatly reduced due to barrier construction and/or founder effects and genetic drift associated with restocking efforts. Reduced gene flow between populations, and more generally, reductions in genetic heterogeneity resulting from reintroductions and founder effects decrease the adaptive potential of Little Kern golden trout subpopulations, while also making their long term persistence and ability to recover from stochastic events tenuous.

Impacts to the Little Kern golden trout from climate change are not fully understood. Predicted outcomes include increased stream water temperatures, decreased stream flow especially during base flow periods, and more generally, changes in the annual hydrograph.

These impacts may exacerbate the current threats to the Little Kern golden trout and affect their long term persistence.

EB/CE Source:
U.S. Fish and Wildlife Service. 2011. Little Kern Golden Trout (*Oncorhynchus mykiss whitei*) 5 Year Review: Summary and Evaluation. Sacramento, California. pp. 32.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Little Kern golden trout does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 803,927 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 694,539 acres, 86.393%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Oncorhynchus apache	Apache trout	220

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (numerous)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Historically, Apache trout occupied streams and rivers in the upper White, Black, and Little Colorado River drainages in the White Mountains of east-central Arizona. Currently, 28 pure Apache trout populations exist within its historical range in Gila, Apache, and Greenlee Counties of Arizona, on lands of the Fort Apache Indian Reservation (FAIR) and Apache-Sitgreaves National Forest (ASNF).

Watershed alterations related primarily to forestry, livestock grazing, reservoir construction, agriculture, road construction, and mining were identified as causes for reduction of Apache trout habitat in the White Mountains of Arizona (USFWS 1983). Such alterations damage riparian vegetation and streambank morphology and stability, which increases stream erosion and can ultimately result in higher sediment loads. In addition, introductions of non-native trout (i.e., brook and brown trout) have led to competition for resources and predation, or hybridization with rainbow trout or cutthroat trout. Collectively, these factors have varied in intensity, complexity, and damage depending on location, ultimately reducing the total occupied range and the ability of Apache trout to effectively persist at all life stages.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Apache Trout (*Onchorhynchus apache*) Recovery Plant (Second Revision). Albuquerque, New Mexico. pp. 84.

U.S. Fish and Wildlife Service. 2010. Apache Trout (*Onchorhynchus apache*) 5 Year Review: Summary and Evaluation. Pinetop, Arizona. pp. 8.

Overall Vulnerability: ☐ **High** ☐ **Medium** ☒ **Low**

 # acres in species range: 3,076,065 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,352,800 acres, 43.978%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Oncorhynchus clarki stomias	Greenback cutthroat trout	222

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Some of the threats identified in the 1998 Recovery Plan continue at a low level, and for the most part their impacts are limited to specific populations and do not occur at a range-wide level. Low level threats include the ongoing negative effects of past mining operations on water quality; the impacts of grazing, logging, and road and trail construction and use on riparian habitat and streambanks, causing increased erosion, sediment deposition, and in turn elevated water temperatures and higher turbidity; and the co-occurrence of non-native salmonids with greenback populations. Regulatory and land management agencies have the ability to improve habitat conditions and eliminate or minimize these threats by cleanup and remediation of old mine sites; by implementing conservation measures to avoid streamside habitat degradation while approving new grazing, logging, and road and trail construction proposals; by moving existing roads and trails away from streamside habitats and rehabilitating disturbed riparian habitats; and by creating barriers to protect greenbacks from non-native salmonid populations, and removing non-natives from protected areas above such barriers. All of these positive activities are ongoing throughout the subspecies' range and are implemented based on agency priorities and funding levels on an annual basis.

The potential risk of catastrophic wildfire to destroy habitat, or the potential for fish to be killed by fire retardants used to fight wildfires, has increased since 1998. Although the effects of a wildfire could be catastrophic on an individual stream, potentially causing extirpation of greenbacks within it, it is unlikely that one, or even several, large fires would have adverse effects on the subspecies as a whole given the dispersed nature of populations. Habitat destroyed by fire could be rehabilitated and greenbacks could be restocked over time. However, of greatest concern is the potential for a catastrophic event, such as a high severity fire or an accidental drop of fire retardant, to extirpate one of the few remaining historic native populations, especially if that population's genetic material has not been replicated elsewhere in a stream or fish hatchery. Other threats identified in the Recovery Plan, or newly emerging since 1998, may prove to have a more moderate or higher degree of impact than initially described, or have broader impacts on the subspecies rangewide in the foreseeable future. These include the potential effects of global climate change. Modeling to predict effects of climate change, particularly at a localized level, is still developing, but there is already some evidence that lower elevation trout populations could be adversely affected by warmer temperatures and lower precipitation levels. However, high elevation populations may benefit from increased temperatures, at least for the short term. Human population growth along the Front Range of Colorado, in combination with a drier climate, may result in significantly increased water demands from streams and lakes occupied by greenbacks. Most greenback populations are located upstream of water diversions, and occur within USFS and NPS lands. Although greenbacks appear to have some protection from whirling disease at present due to their locations above barriers and colder water temperatures, the disease may become more widespread with warming temperatures. However, silt substrate is necessary to support tubeficid worms, which could take a long time to develop in these watersheds that are currently granitic in nature, with low levels of organic materials. Other aquatic invasive species also may become more widely distributed. For subspecies such as greenback, which already occurs in high-elevation tributary streams and lakes, the ability to shift their range in response to climate change and invasive species may be limited.

As discussed above, fragmentation and isolation of small populations is already a concern, and this may become more pronounced under the effects of climate change.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Greenback Cutthroat Trout (*Oncorhynchus clarki stomias*) 5 Year Review: Summary and Evaluation. Lakewood, Colorado. pp. 47.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 32,159,055 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 17,269,057 acres, 53.699%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT

modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	233

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The historical range of the species has been significantly reduced over the past 200 years due to anthropogenic impacts. The species currently occupies approximately 8.6% of their historical stream habitat and 46.8% of their historical lake habitat; however, only two of the lakes have self-sustaining populations. Since the mid 1990's, the species has been introduced/established in 12 new waters, have remained in 147 streams, and have been extirpated from 32 streams.

Populations have been and continue to be impacted by non-native species interactions, habitat fragmentation and isolation, degraded habitat conditions, drought, and fire. Non-native fish co-occur with the species in 36.4% of currently occupied stream habitat and all currently occupied historical lake habitat except for Walker Lake. Most populations that co-occur with non-native species are decreasing and the majority of population extinctions that have occurred since the mid 1990's have been caused by non-native species. Additionally, non-native fish occupy habitat in nearly all unoccupied historical stream and lake habitat, making repatriation of the species extremely difficult.

The majority of populations are isolated and confined to small habitats (width) and short stream lengths. These factors reduce gene flow between populations, and reduce the ability of populations to recover from catastrophic events, thus threatening their long-term persistence and viability. The literature suggests that to ensure long-term persistence, populations should consist of more than 2,500 individuals, occupy at least 8 km (5 mi) of habitat, and have no non-native species present. Currently, only 28.2% of conservation populations occupy habitat greater than 8 km (5 mi) in length and over 83% of currently occupied streams have fewer than 94 fish/km (150 fish/mi).

Pyramid and Walker Lakes are important habitat for the lacustrine form of the species. Conditions in these lakes have deteriorated over the past 100 years and continue to decline, most dramatically in Walker Lake. The present or threatened destruction, modification, or curtailment of habitat and range continues to be a significant threat and, in some instances, is increasing in magnitude and severity.

Recreational fishing for the species is regulated and augmented by hatcheries; however, harvest from recreational fishing in the Western Lahontan Basin appears to pose a threat to recovery because it impedes our ability to establish recovery populations, to understand the life history needs of lacustrine populations, and to identify the actions needed to achieve recovery. Other occupied waters are either closed to fishing or have catch-and-release regulations. While individuals in small streams may be vulnerable to overharvest, most occupied habitats are in remote areas and receive little fishing pressure. Scientific and educational sampling is controlled by State and Tribal permitting processes and new, non-lethal techniques have been developed for genetic analyses. Overutilization for commercial, recreational, scientific, or educational purposes is not believed to be a significant threat at this time except for priority recovery waters in the Western Lahontan Basin. Whirling disease is currently not a threat; however, it has the potential to become more widespread due to warmer waters that could result from climate change. Brown and brook trout are known piscivores; however, the extent to which these non-native species prey on the Lahontan cutthroat trout is unknown. Most historical waters in the western portion of the range, including lakes, and to a more limited extent in the Quinn River watershed and North Fork Little Humboldt River subwatershed, are occupied by brown trout. Brook trout are the most common non-native salmonid that co-occur with the species and are found in nearly every major historical Lahanton cutthroat trout watershed. Lake trout are known to prey on the species.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*) 5 Year Review: Summary and Evaluation. Reno, Nevada. pp. 199.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Lahontan cutthroat trout does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 62,932,804 acres
% of range in California (i.e., where CalPUR data is available): 9%

Range overlap with Federal lands: 48,670,091 acres, 77.337%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Oncorhynchus clarki seleniris	Paiute cutthroat trout	223

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Paiute cutthroat trout are known from a single drainage in the Sierra Nevada range in east-central California. The presumed historical distribution was limited to 17.8 km (11.1 mi) of habitat in Silver King Creek (Alpine County), from Llewellyn Falls downstream to barriers in Silver King Canyon, as well as the accessible reaches of three small, named tributaries: Tamarack Creek, Tamarack Lake Creek, and the lower reaches of Coyote Valley Creek downstream of barrier falls (Service 2004, p. 12). Paiute cutthroat trout occupy approximately 37.8 km (23.5 mi) of habitat in five widely distributed drainages. Four self-sustaining populations are now established outside their historical watershed. Currently, no individuals occur within the historical range of the taxon. It is difficult to fully characterize the abundance of the species. Like most wildlife populations, numbers of the species fluctuate annually due to biotic and abiotic factors. Further, population estimation methods have varied by location, which means only general comparisons among the populations can be made. Moyle et al. (2011, pp. 2414–2422) consider this species as one of the most imperiled native fish in California due to loss of genetic diversity and habitat fragmentation. Evidence of loss of genetic diversity has been found in all the species' populations (Cordes et al. 2004, pp. 112–113).

All current populations are completely isolated from each other which does not allow for genetic exchange or recolonization after a disturbance. Apart from the isolation that habitat fragmentation causes, the short length of stream segments and small population sizes that they support are also of concern for the species. Stream length is important because trout move throughout stream networks searching for a variety of habitats necessary to complete their life cycle (i.e., spawning, rearing, migration corridors, refugium) (Baltz et al. 1991, pp. 173–175; Fausch and Young 1995, pp. 364–365; Young 1996, pp. 1405–1407; Muhlfeld et al. 2001, pp. 174–175; Schmetterling 2001, pp. 511–519; Hilderbrand and Kershner 2004, pp. 1043–1045; Schrank and Rahel 2004, pp. 1531–1536; Colyer et al. 2005, pp. 957–961; Neville et al. 2006, pp. 908–914; Umek 2007, pp. 13–28; Sanderson and Hubert 2009, pp. 332–335; Young 2011, pp. 945–949). The shorter the stream reach the more likely it is that one or more of the species required habitats is either missing or inadequate for completion of the species' life cycle. In contrast, longer stream reaches have more complexity and have a higher probability that no particular habitat type limits the population

Paiute cutthroat trout (PCT) populations continue to be threatened by interactions with non-native species, habitat fragmentation, and isolation. PCT have been extirpated from much of their historical habitat by non-native salmonids. Additionally, hybridizing salmonids are present downstream of all currently occupied habitat. PCT occupy stream habitat in five widely separated drainages and are primarily confined to isolated, short headwater stream reaches. These factors work to reduce gene flow between populations and reduce the ability of populations to recover from catastrophic events, thus threatening their long-term viability. The literature suggests that to ensure long-term viability, populations should consist of more than 2,500 individuals, occupy at least 9.3 km (5.8 mi) of stream habitat, and have no non-native species present. Currently, no population meets the minimum requirements.

Livestock grazing has been a past threat (Service 1985, pp. 20–21; 2004, pp. 41–42; Service 2008a, pp. 9–10); however, grazing has either been eliminated from occupied habitat or conservative grazing management objectives are in place for active grazing allotments. Non-native salmonids were identified as threats in the reclassification rule (Service 1975, pp. 29863–29864), both recovery plans (Service 1985, pp. 17–22; 2004, p. 43), and the 2008 5-year review (Service 2008a, p. 13).

Recreational fishing was a historical threat within the Silver King Creek drainage. Because small streams are vulnerable to overharvest, recreational fishing has been closed for populations of PCT in the Silver King Creek drainage and North Fork Cottonwood Creek. The other populations are open to fishing; due to their remote locations, recreational fishing does not pose a significant effect at this time. Scientific sampling of populations within the Silver King Creek drainage with electrofishing equipment occurs on an annual basis, but most populations are not sampled every year. Scientific and educational sampling is also regulated by State permitting processes and new, non-lethal techniques have been developed for genetic analyses. Overutilization was not identified as a threat in the 2008 5-year review (Service 2008a, p. 12).

Additional negative impacts will occur through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events. Water temperatures are expected to increase in the future; however, all occupied habitat is located above 2,438 m (8,000 ft) and thus, stream temperatures are not likely to rise above critical thresholds. Rising stream temperatures may increase their susceptibility to various diseases which are not current threats. Reductions in streamflow through changes in the hydrograph and drought are predicted to have a negative impact on populations because of the fragmented nature of the populations, the small size of occupied stream habitats, and the close association of recruitment and survival to stream flow. Although the species evolved in a fireprone environment, increases in wildfire frequency and severity due to increased fuel loads and effects from climate change (Westerling et al. 2006, p. 941) have increased the threats due to wildfire. Current wildfires are a larger threat to PCT because of the current fragmented and isolated state of occupied habitat (Haak et al.

2010, p. 47). Impacts associated with climate change will likely intensify the threats previously described.

EB/CE Source:
U.S. Fish and Wildlife Service. 2015. Paiute Cutthroat Trout (*Oncorhynchus clarkii seleniris*) 5 Year Review: Summary and Evaluation. Reno, Nevada. pp. 80.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

specific considerations were made for species that occur in Bins 3 and 4 and that they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Paiute cutthroat trout does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 1,995,543 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 1,801,146 acres, 90.258%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Oncorhynchus gilae	Gila trout	221

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (numerous)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Gila trout was once widespread in the upper Gila River Basin, but has declined because of hybridization with rainbow trout, predation by and competition with brown trout, and habitat degradation. The current distribution of Gila trout consists of 14 populations in headwater stream habitats. Miller (1950) documented changes in suitability of habitats for trout in the upper Gila River drainage. In 1898, Gila trout was found in the upper Gila River drainage in New Mexico from the headwaters downstream to the Mogollon Creek confluence. By 1950, water temperature in the Gila River at Sapillo Creek was considered too warm to support any trout species. The causes of habitat degradation were not reported. However, extensive logging and grazing throughout the upper Gila River drainage likely resulted in changes in habitat characteristics such as timing and duration of peak flows, length of perennially-flowing stream channel, base flow discharge, water temperature, and sediment loading (Rixon, 1905; Rich, 1911; Duce, 1918; Leopold, 1921; Leopold, 1924). Also, concentration of early logging impacts along stream bottoms (Rixon, 1905) may have resulted in long-term reduction of the availability of large woody debris in the stream channel, which has been identified as an important component of habitat of Gila trout (Stefferud, 1994). High-severity forest fires have caused the extirpation of three populations of Gila trout. The population in Main Diamond Creek was lost in 1989, the population in Burnt Canyon and South Diamond Creek was lost to fire in 1995, and the population in Trail Canyon was extirpated in 1996 (Propst et al., 1992; Brown et al., 2001).

Severe forest fires capable of extirpating or decimating fish populations are a relatively recent phenomena, resulting from the cumulative effects of historical or ongoing overgrazing by domestic livestock and fire suppression (Madany and West, 1983; Savage and Swetnam, 1990; Swetnam, 1990; Touchan et al., 1995; Swetnam and Baisan, 1996; Gresswell, 1999).
Other baseline stressors have also been identified. Historically, unregulated harvest of Gila trout likely contributed to the dramatically diminished distribution of the species by the 1960s (Rixon, 1905:50; Propst, 1994). Streams depleted of native trout were then stocked with hatchery-raised, non-native species to support recreational fishing. By the time regulations were implemented to limit the harvest of fish, the range of Gila trout had been reduced to several isolated headwater

streams. Mortality of Gila trout from illegal angling may pose a major threat to some populations. Brown trout, a non-native salmonid introduced to the U.S. from Europe, are naturalized throughout the historical range of Gila trout. Brown trout are highly piscivorus and may severely depress populations of Gila trout (Mello and Turner, 1980:27; U.S. Fish and Wildlife Service, 1987). The carrier of Bacterial Kidney Disease (BKD), the gram-positive bacterium *Renibacterium salmoninarum*, occurs in very low amounts of trout populations in the upper West Fork Gila River, including the Whiskey Creek population of Gila trout (J. Landye, U.S. Fish and Wildlife Service, pers. comm.). Although the carrier is present, there is no evidence of the disease in any population. Hybridization with rainbow trout is a major cause for decline and continued imperilment of Gila trout (Miller, 1950; Behnke and Zarn, 1976; David, 1976). Stocking of rainbow trout within the historical range of Gila trout began in 1907 (Miller, 1950:26). Although current stocking of rainbow trout is conducted only in stream segments that are not inhabited by Gila trout, rainbow trout have become naturalized throughout the range of Gila trout. Hybridization remains a prominent threat to Gila trout, as evidenced by loss of previously presumed pure populations (Iron Creek and McKenna Creek) and the detection of recent introgression of rainbow trout genes in the Mogollon Creek population (Leary and Allendorf, 1998). Hybridization is a threat to Gila trout because it results in erosion and loss of the unique genetic identity of the species, which represents its evolutionary history and local adaptation to the environments it inhabits.

Measures have been implemented to conserve the species, beginning with initial efforts to conserve Gila trout by the New Mexico Department of Game and Fish to propagate the species in the early 1920s. After the hatchery programs were abandoned, the New Mexico Department of Game and Fish implemented a policy of not stocking non-native trout into the streams that were known to be inhabited by Gila trout. In the 1930s, the Civilian Conservation Corps constructed log stream improvement structures in many streams on the Gila National Forest. Replicate populations of the Main Diamond Creek lineage were established in McKnight Creek, Sheep Corral Canyon, and Gap Creek by direct transfer of fish from wild populations. Substantial progress was made in the 1980s in renovating streams, constructing barriers, and establishing new populations of Gila trout. Barriers were constructed on Iron and Little Creeks (to reduce issues with non-native trout). Populations of Gila trout were established in Little Creek, Big Dry Creek, upper Mogollon Creek, and Trail Canyon by direct transfer of fish from wild populations and hatchery-reared stock. The 1990s saw continued expansion of the range of Gila trout. A population of Gila trout was discovered in Whiskey Creek, a small tributary to the upper West Fork Gila River. The Iron Creek population was replicated in Sacaton Creek. Main Diamond Creek lineage Gila trout were translocated from McKnight Creek back into Main Diamond Creek, following recovery of that stream from fire impacts. Main Diamond lineage Gila trout were also stocked in lower Little Creek. Upper Little Creek was stocked with Gila trout from Whiskey Creek to establish a replicate of that population. A second replicate population of the Spruce Creek lineage was established in Dude Creek, Arizona. However, forest fires continued to plague recovery efforts. For example, the South Diamond Creek and Burnt Canyon populations were extirpated by forest fire in 1995, and a fire in the Spruce Creek drainage prompted emergency evacuation of several hundred fish to ensure survival of that lineage.

A Memorandum of Understanding was developed in 2000 between the Apache-Sitgreaves National Forest, Arizona Game and Fish Department, U.S. Fish and Wildlife Service, Wildlife Conservation Council, Eastern Rocky Mountain Council of the Federation of Flyfishers, Old Pueblo Chapter of Trout Unlimited, and the Arizona State Council of Trout Unlimited (Arizona A.G. Contract No. KR001230-EQS, Forest Service Agreement No. 00-MU-11030121-005). The Memorandum of Understanding was developed to create a partnership for recovery of both Apache trout and Gila trout, as well as watershed restoration within the historic range of the two species on the Apache-Sitgreaves National Forest.

EB/CE Source:
U.S. Fish and Wildlife Service. 2021. Draft Revised Recovery Plan for Gila Trout (*Oncorhynchus gilae*). Albuquerque, New Mexico. pp. 173.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Gila trout does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 13,982,419 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 8,508,224 acres, 60.849%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering

sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Salmo salar	Atlantic salmon	10077

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Changes to natural environment at the Gulf of Maine's Distinct Population Segment (DPS) are ubiquitous. Both contemporary and historic land and water use practices such as damming of rivers, forestry, agriculture, urbanization, and water withdrawal have substantially altered Atlantic salmon habitat by: (1) eliminating and degrading spawning and rearing habitat, (2) reducing habitat complexity and connectivity, (3) degrading water quality, and (4) altering water temperatures. Atlantic salmon likely are impacted by degraded water quality caused by point and non-point source discharges. Non-point source discharges such as elevated sedimentation from forestry, agriculture, urbanization, and roads can reduce survival at several life stages, especially the egg stage. Sedimentation can (1) alter in-stream habitat and habitat use patterns by filling interstitial spaces in spawning gravels, and (2) adversely affect aquatic invertebrate populations that are an important food source for salmon. Acid rain reduces pH in surface waters with low buffering capacity, and reduced pH impairs osmoregulatory abilities and seawater tolerance of Atlantic salmon smolts. A variety of pesticides, herbicides, trace elements such as mercury, and other contaminants are found at varying levels throughout the range of the DPS.

In addition to the threats identified at the time of listing, additional information on two stressors is causing growing concern due to their effects on Atlantic salmon in the Gulf of Maine: (1) the barriers to fish passage caused by culverts and other road stream crossings, and (2) climate change. Both of these threats are considered to be significant factors affecting the DPS.

Atlantic salmon conservation and restoration efforts have been underway for more than 150 years. The earliest efforts to restore and improve anadromous fish runs in New England rivers were driven by depletion of stocks through non-sustainable commercial fisheries, coupled with some habitat loss due to impassable dams. Pollution was also considered a factor in fish population declines. Subsequently, artificial propagation and fish culture programs were established at Craig Brook and Green Lake National Fish Hatcheries. These programs have allowed Atlantic salmon to survive during times that many of Maine's rivers were not suitable for salmon survival; they also allowed for maintenance of an economically important recreational fishery through the early 1990s. The hatchery programs are now essential in preserving the genetic integrity of the last remaining Atlantic salmon populations in the United States. Efforts to restore river habitats in order to support Atlantic salmon started with the recognition that dams without fish passage were a major threat to the species. A number of Federal laws were then enacted that contributed to Atlantic salmon conservation, including the Water Pollution Control Act of 1948, which subsequently became the Clean Water Act of 1972 (CWA), and the Anadromous Fish Conservation Act of 1965 (AFCA). The CWA significantly curtailed pollution that had once caused rivers and streams in Maine to be toxic to both humans and fish, while the AFCA provided resources to install fishways on most of the mainstem dams in the Penobscot River and remove or breach defunct dams in the Narraguagus, Machias, and Sheepscot Rivers. By all indications, these efforts were working to restore salmon, and in the early 1970s, Atlantic salmon returns began increasing. Through the mid-1980s, between 2,000 and 3,000 adult returns were being documented on the Penobscot fairly consistently. Although significant habitat improvements have been undertaken for many decades (e.g., Edwards dam removal), there was an emphasis shift after the mid-2000s. This included improving connectivity by locating and removing culvert barriers, removing dams when possible, and installing fishways when dam removal was not feasible. These efforts were exemplified by the removal of two mainstem hydroelectric projects and construction of a bypass at a third project on the Penobscot River. In addition, the Services and hydro developers in the Gulf of Maine DPS have worked together to craft plans for fish passage at hydro facilities. Downstream and upstream fish passage improvement projects and fish passage studies are now underway at many hydro projects within the designated critical habitat area for Atlantic salmon. The conservation efforts of the past century, largely driven by regulatory measures, have afforded important conservation benefit to the Gulf of Maine DPS.

EB/CE Source:

U.S. Fish and Wildlife Service. 2009. Recovery Plan for the Gulf of Maine Distinct Population Segment of Atnaltic Salmon (*Salmo salar*). Hadley, Massachusetts pp. 90.

U.S. Fish and Wildlife Service. 2009. Endangered and Threatened Species; Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic Salmon. Federal Register 74(117):29344-29387.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Atlantic salmon does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 21,014,506 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 97,264 acres, 0.463%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Salvelinus confluentus	Bull Trout	301

Family: Salmonidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 4). Habitat components that particularly influence their distribution and abundance include water temperature, cover, channel form and stability, spawning and rearing substrate conditions, and migratory corridors (Fraley and Shepard 1989, p. 138; Goetz 1989, p. 19; Watson and Hillman 1997, p. 247). Large patches of these components are necessary to support robust populations.

The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of non-native species (63 FR 31647, June 10, 1998; 64 FR 17112, April 8, 1999). These impacts are described more fully in the various recovery plans and listing documents for the core areas by recovery unit, and are included here by reference. For example, in the Mid-Columbia Recovery Unit, the following was noted for the Wenatchee, Methow, and Entiat core areas (among other threats): "legacy and current management has led to 303d listed reaches with water quality degradation. Standards are frequently not met in [foraging, migration, and overwintering] areas. Irrigation returns, runoff, application of pesticides/herbicides/deicer impacts occur in adjacent [foraging, migration, and overwintering] and several spawning and rearing areas." Various restoration and recovery efforts are being undertaken in the core areas, although many of the threats are anticipated to continue in the future to varying degrees. Many threats are widespread, while others are more regional in nature. The review analysis indicated that 75 of the 121 (64%) core areas face either imminent, substantial, or moderate threats.

EB/CE Source:
U.S. Fish and Wildlife Service. 2008. Bull Trout (*Salvelinus confluentus*) 5 Year Review: Summary and Evaluation. Portland, Oregon. pp. 55.

U.S. Fish and Wildlife Service. 2010. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States. Federal Register 75(200):63898-64070.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Bull Trout does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 61,567,889 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 39,303,584 acres, 63.838%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is

limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Integration and Synthesis Summary: Fishes (Cottidae)

Scientific Name:	Common Name:	Entity ID:
Cottus paulus (=pygmaeus)	Pygmy sculpin	241

Family: Cottidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The only known population of this species is in Coldwater Spring and the spring run in Calhoun County, Alabama. Coldwater Spring is impounded by a low weir dam to form a pool of over 0.4 ha (1 ac), 0.6 to 1.2 m deep (2 to 4 ft.). Deterioration of water quality within Coldwater Spring's 90 square mile recharge area has increased, although water quality in the spring is still excellent. The pygmy sculpins' very limited distribution makes it vulnerable to random natural or human-induced events such as spills and groundwater contamination.

The threat from ground water degradation is potentially the most serious. Trichloroethylene is present in Coldwater Spring at low concentrations (Environmental Science and Engineering, Inc., 1986). This chemical is present in the subsurface water on the Depot in strong concentrations and may be moving through the aquifer to Coldwater Spring (Kangas 1987). However, the basis for attributing the entire pollution of Coldwater Spring to the Depot is not conclusive. There are low concentrations of other contaminants in the aquifer at the Depot which have not been reported from Coldwater Spring (Kangas 1987). Other sources within the 233 square km (90 square mi) recharge area may be contributing to pesticide levels in the spring. Surface water contamination may be preventing the sculpin from occupying potential habitat in Dry Creek. The sculpin occurs in the spring run to the confluence of Dry Creek and sometimes below this point in the spring water that has not mixed with water from Dry Creek (Williams 1968, McCaleb 1973).

EB/CE Source:
U.S. Fish and Wildlife Service. 2008. Pygmy Sculpin (*Cottus paulus*) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 13.

U.S. Fish and Wildlife Service. 1991. Recovery Plan for the Pygmy Sculpin (*Cottus pygmaeus*). Jackson, Mississippi. pp. 18.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Pygmy Sculpin does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 137,723 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 24,141 acres, 17.529%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–

4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	**Common Name:**	**Entity ID:**
Cottus specus	Grotto Sculpin	4248

Family: Cottidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The most substantial threats to the species come from the present or threatened destruction, modification, or curtailment of its habitat. Although no clear estimates of historical population numbers for the grotto sculpin exist to determine whether or not dramatic population declines have occurred in the past, two mass mortalities have been documented since the early 2000s. Both mortality events are thought to have been caused by point-source pollution of surface waters that recharge cave streams occupied by the grotto sculpin.

All of the recharge areas for known grotto sculpin habitat are considered vulnerable. It is believed that the primary threats to the species are habitat destruction and modification from water quality degradation and siltation. In particular, documentation that a suite of chemicals and other contaminants is continuously entering the groundwater above levels that can be harmful to aquatic life is especially concerning. Potential sources and vehicles for introduction of pollution likely are industrialization, contaminated agricultural runoff, sinkhole dumps, and vertical drains installed without appropriate best management practices. A variety of current- and legacy-use pesticides from agricultural runoff and sinkhole leaching, evidence of human waste from ineffective septic systems, and animal waste from livestock operations have been detected in grotto sculpin streams. These not only negatively affect the grotto sculpin directly but also negatively affect the aquatic ecosystems and aquifer underlying the Perry County sinkhole plain.

Other factors include siltation beyond historical levels (which eliminate suitable habitat, reduce dissolved oxygen levels and increase contaminants that bind to sediments and reduce prey populations), predation from non-native fish, and stochastic events. These threats not only impact individual populations, but also decrease the viability of source populations and increase the likelihood of extirpation. Existing regulatory mechanisms provide little direct protection of water quality in grotto sculpin habitat, which is the most significant threat to the species.
2021 5-Year Review
The Grotto Sculpin is a highly restricted species that continues to be known from only five cave systems in two karst areas in Perry County, Missouri. Though some additional protections have

been afforded to the species since its listing in 2013, including protections under State law and local conservation plans, noncompliance and enforcement remain an issue. Full protection is also not afforded to habitat on private lands, especially sinkholes throughout the recharge area, which may lead to increased pollution exposure and siltation risk. This species exists in a fragile ecosystem and continues to face threats from water degradation and sedimentation, which may also be related to recent findings of high parasite prevalence and low preferred habitat availability. In addition, this species' restricted range and population isolation contributes to its vulnerability.

EB/CE Source:

U.S. Fish and Wildlife Service. 2021. Grotto Sculpin (*Cottus specus*) 5-Year Review: Summary and Evaluation. Missouri Ecological Services Field Office, Columbia, Missouri. 18 pp.

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Grotto Sculpin (*Cottus specus*) Throughout Its Range. Federal Register 78(186):58938-58955.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Grotto Sculpin does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 569,351 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 56,089 acres, 9.851%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Integration and Synthesis Summary: Fishes (Siluriformes)

Scientific Name:	Common Name:	Entity ID:
Ictalurus pricei	Yaqui catfish	259

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened, Five-Year Review Recommendation (5/30/2019): Uplist to Endangered
Distribution: Population size/location unknown
Number of Populations: Population size/location unknown
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The original range of forms referred to as Yaqui catfish in Mexico included the Rios Yaqui and Casas Grandes basins, from the latter of which it is apparently extirpated (Smith & Miller 1986, Propst & Stefferud 1994), south through the Rio Fuerte system (Miller 1976, 1978). Distribution in the Rio Yaqui basin was mapped in 1978 by Hendrickson et al. (1981). A population of Yaqui catfish stocked into the upper Santa Cruz River, AZ in 1899 (Chamberlain 1904) persisted until the late 1950s (Miller & Lowe 1964, 1967). It reportedly originated from Rio Sonora, from which basin the species is otherwise known from a single collection (Miller 1940). Other than from the Santa Cruz stocking, no records supported by specimens are known from the USA (Minckley 1973, 1985).

Yaqui catfish are believed to have been extirpated from the United States. Yaqui catfish was captured under permit from the Mexican Government from Rios Aros, Sonora,and Sirupa, Chihuahua in 1987 and 1990, respectively, and was under culture at Dexter National Fish Hatchery and Technology Center (Jensen 1993) in anticipation of future reintroduction. The fish is considered imperiled in Mexico, at least in the Rio Yaqui basin, due to habitat modification and loss and actual and potential hybridization with channel and blue catfishes, both of which are non-native (Hendrickson et al 1981; Miller 1989, Kelsch & Baca 1991). Post-1978 distributional records were provided by Campoy-Favela et al. (1989), who also commented on its reduced relative abundance and downward population trends in Mexico. According to Varela-Romero et al. 2011, "Baker et al. (2008) and files at the hatchery indicated, however, that some progeny were released, producing the three small, wild populations now known to exist in the United States: Twin Pond (San Bernardino National Wildlife Refuge) and House Pond (Slaughter Ranch), both in the Yaqui River Basin, and Big Tank (El Coronado Ranch) in the Sulphur Springs Valley drainage, all in Cochise County, Arizona. Baker et al. (2008) indicated it is fairly certain that populations in Twin Pond and Big Tank were pure *I. pricei*, but there was some concern as to whether the population in House Pond was contaminated by either the blue catfish

(*I. furcatus*) or channel catfish.”.Also, “[f]or *I. pricei*, given that the conservation backup once provided by captive stock of the United States Fish and Wildlife Service has been lost, remnants of that captive stock potentially persisting in areas of Arizona where it was introduced should be recaptured to reestablish the captive stock. That captive stock originated from areas in Mexico where we failed to find the Yaqui catfish in recent collections, and it (or a new stock from one of the rare remnant Mexican populations that appears to lack genetic introgression with *I. punctatus*) could be used to re-establish this species back into that part of its native range from which it has been extirpated.”

EB/CE Source:

USFWS 1984. Endangered and Threatened Wildlife and Plants; Final Rule To Determine the Yaqui Chub To Be an Endangered Species with Critical Habitat, and To Determine the Beautiful Shiner and the Yaqui Catfish To Be Threatened Species with Critical Habitat. Federal Register 49:34490-34497.

U. S. Fish and Wildlife Service. 1994. Yaqui Fishes Recovery Plan. Albuquerque, New Mexico. 48 pp.

Varela-Romero, A., Hendrickson, D.A., Yepiz-Plascenia, G., Brooks, J.E. and Neely, D.A. 2011. Status of the Yaqui catfish (*Ictalurus pricei*) in the United States and northwestern Mexico. Southwestern Naturalist 56: 277-285.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Yaqui catfish does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 687,752 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 119,226 acres, 17.336%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Noturus baileyi	Smoky madtom	258

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Increasing population(s)
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The smoky madtom is currently restricted to approximately 14.5 km (9 mi) of Citico Creek, 9 km (6 mi) of Abrams Creek, and approximately 5 km (3 mi) of the Tellico River (Throneberry 2009, Petty et al. 2011). Historically, the smoky madtom was only collected in Citico and Abrams Creeks and it was only known from Citico Creek at the time of listing (49 FR 43065). However, Conservation Fisheries, Inc. (CFI) has successfully reintroduced the smoky madtom into Abrams Creek, where the species has shown evidence of natural reproduction since 1996. In addition, populations in Abrams Creek have remained stable in the absence of stocking efforts since 2004. The Citico Creek population is increasing, and has recently become the source population for reintroductions into the Tellico River. Additionally, there is evidence of natural reproduction and successful recruitment of new year classes into the Tellico River.

Coal mining, logging, road and bridge construction and maintenance, toxic chemical spills, and siltation were identified as threats and remain threats today to the smoky madtom. Additional, ongoing threats to the smoky madtom include gravel dredging, water withdrawals, and agricultural practices. Physical habitat destruction resulting from a variety of anthropogenic impacts such as siltation, disturbance of riparian corridors, and changes in channel morphology continues to plague the Tennessee River watershed. The most significant of these impacts is siltation caused by excessive releases of sediment from activities such as agriculture, resource extraction (e.g., coal mining, silviculture), road construction, and urban development (Waters 1995). Activities that contribute sediment discharges into a stream system change the erosion or sedimentation pattern, which can lead to the destruction of riparian vegetation, bank collapse, excessive instream sediment deposition, and increased water turbidity and temperatures.

The smoky madtom has a limited geographic range and small population size, leaving the species extremely vulnerable to localized extinctions from accidental toxic chemical spills or other stochastic disturbances and to decreased fitness from reduced genetic diversity. Potential sources of such spills include potential accidents involving vehicles transporting chemicals over road crossings of streams inhabited by the madtoms and accidental or intentional release into streams of chemicals used in agricultural or residential applications. The smoky madtom are vulnerable to losses in genetic diversity and fitness due to small population size. Species that are restricted in range and population size are more likely to suffer loss of genetic diversity due to genetic drift, potentially increasing their susceptibility to inbreeding depression and decreasing their ability to adapt to environmental changes (Allendorf and Luikart 2007).

2020 5-Year Review
Currently, there are three Smoky Madtom populations in three tributaries of the Little Tennessee River in Tennessee. Smoky Madtom populations in Abrams Creek and Citico Creek are considered viable (Service 2019), and stocking efforts are now focused on the Tellico River population. Monitoring surveys since our last 5-year review indicate that populations remain stable, as demonstrated by continued persistence of Smoky Madtom in Abrams Creek, Citico Creek, and the Tellico River, and observations of natural reproduction and recruitment.

Based on our analysis, most suitable habitat for the Smoky Madtom occurs inside the Cherokee National Forest and the Great Smoky Mountains National Park. The presence of the species within these two large, federal landholdings has helped reduce threats from soil erosion, siltation, and water quality degradation because the Cherokee National Forest and Great Smoky Mountains National Park have management plans that help improve the health of the watersheds under their management.

Recreational activities impacting Smoky Madtoms continue to occur in Citico Creek and Abrams Creek, which may have severe negative effects on recruitment due to nest loss. While Cherokee National Forest and Great Smoky Mountains National Park have tried to reduce impacts from this threat by informing the public of the presence of federally listed species and prohibited activities, there is no information available indicating that this threat has been minimized or eliminated.

EB/CE Source:
U.S. Fish and Wildlife Service. 2020. Smoky Madtom (*Noturus baileyi*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 21 pp.

U.S. Fish and Wildlife Service. 2012. Yellowfin Madtom (*Noturus flavipinnis*) and Smoky Madtom (*Noturus baileyi*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, TN. 27 p.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Smoky madtom does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 870,583 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 566,354 acres, 65.055%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Noturus crypticus	Chucky madtom	7150a

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Single population
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The current range of the Chucky madtom is believed to be restricted to approximately a 1.8-mi (3-km) reach of Little Chucky Creek in Greene County, Tennessee. The range of the Chucky madtom has been reduced to only one stream due to fragmentation and destruction of habitat. Habitat fragmentation has subjected the small population to genetic isolation, reduced space for rearing and reproduction, reduced adaptive capabilities, and increased the likelihood of extinction (Burkhead et al. 1997, Hallerman 2003). Species that are restricted in range and population size are more likely to suffer loss of genetic diversity due to genetic drift, potentially increasing their susceptibility to inbreeding depression, decreasing their ability to adapt to environmental changes, and reducing the fitness of individuals (Soule 1980, Hunter 2002, Allendorf and Luikart 2007). It is likely that the only known Chucky madtom population is below the effective population size required to maintain long-term genetic and population viability (Soule 1980, Hunter 2002). Only 14 specimens of Chucky madtom have been collected in Little Chucky Creek since its discovery in 1991, and none have been collected since 2004 despite several targeted surveys. Effective population sizes may range from 500 individuals (Franklin and Frankham 1998) to 5,000 individuals (Lande 1995) to avious effects of genetic drift over several generations and ensure long-term survival. The long-term viability of a species is founded on the conservation of numerous local populations throughout its geographic range (Harris 1984). These separate populations are essential for the species to recover and adapt to environmental change (Harris 1984, Noss and Cooperrider 1994). The Chucky madtom is restricted to a single small population, and this level of isolation would make natural repopulation of Dunn Creek and any other areas of suitable habitat within its historical range virtually impossible without human intervention.

The Tennessee Valley Authority Index of Biological Integrity results indicate that Little Chucky Creek is biologically impaired (Middle Nolichucky Watershed Alliance 2006). Land use data from the Southeast Gap Analysis Program (SEGAP) show that land use within the Little Chucky Creek watershed is predominantly agricultural, with the vast majority being devoted to production of livestock (Jones et al. 2000). Given the predominantly agricultural land use within the Little Chucky Creek watershed, non-point source sediment and agrochemical discharges may pose a threat to the Chucky madtom by altering the physical characteristics of its habitat, thus potentially impeding its ability to feed, seek shelter from predators, and successfully reproduce.

The Chucky madtom is a bottom-dwelling (benthic) species; all benthic fishes are especially susceptible to sedimentation and other pollutants that degrade or eliminate habitat and food sources (Berkman and Rabeni 1987, Waters 1995, Richter et al. 1997). Etnier and Jenkins (1980) suggested that madtoms, which are heavily dependent on chemoreception (detection of chemicals) for survival, are susceptible to anthropogenic disturbances, such as organic chemical and sediment inputs, because the olfactory (sense of smell) “noise” these pollutants produce could interfere with a madtom's ability to obtain food, coordinate behavioral patterns, and otherwise monitor its environment. Degradation from sedimentation, physical habitat disturbance, and contaminants threaten the habitat and water quality on which the Chucky madtom depends. Sedimentation from agricultural lands could negatively affect the Chucky madtom by reducing growth rates, disease tolerance, and gill function; reducing spawning habitat, reproductive success, and egg (embryo), larva, and juvenile development; reducing food availability through reductions in prey; reducing foraging efficiency; and reducing shelter. Sediment is the most visible pollutant in the Little Chucky Creek watershed and one of the greatest threats to the Chucky madtom. Chucky madtoms are restricted to habitat with pea-sized gravel, cobble, or slab-rocks substrates not embedded by large amounts of silt (Burr and Eisenhour 1994, Burr et al. 2005); this habitat is sparse in Little Chucky Creek (Shute et al. 1997).

Predation may be occurring from piscivorous fishes native to Little Chucky Creek; other madtom species are preyed upon by black basses (Emmett and Cochran 2010). Recently, a yellowfin madtom (*Noturus flavipinnis*) was observed in the stomach of a Smallmouth bass (*Micropterus dolomieu*) in Abrams Creek (Dinkins 2014, pers. comm.). Non-native or introduced species are a potential threat to Chucky madtom. Virilis crayfish (*Orconectes virilis*) and Kentucky River crayfish (*Orconectes juvenilis*), both introduced species, are abundant in Little Chucky Creek and compete with Chucky madtoms for access to the little habitat that is available. Artificial nesting sites installed in Little Chucky Creek were almost all inhabited by crayfishes (CFI 2008, unpubl. data; Service 2009-2010, unpubl. data). Madtom embryos have been preyed on by crayfish (Mayden and Burr 1981) and analyses of the diet of stream-dwelling crayfishes show that 12% of the diet is fish (Taylor and Soucek 2010). Given the limited habitat available to Chucky madtoms in Little Chucky Creek, crayfish predation or competition for spawning habitat could have major impacts on Chucky madtom persistence and recovery.
Climate change has the potential to increase the vulnerability of rare species to random catastrophic events (e.g., McLaughlin et al. 2002; Thomas et al. 2004). Climate change is expected to result in increased frequency and duration of droughts and the strength of storms (e.g., Cook et al. 2004). Climate change could intensify or increase the frequency of drought events, such as the one that occurred in the southeastern U.S. in 2007. Thomas et al. (2004) report that the frequency, duration, and intensity of droughts are likely to increase in the southeastern U.S. as a result of global climate change. Stream flow is strongly correlated with

important physical and chemical parameters that limit the distribution and abundance of riverine species (Power et al. 1995, Resh et al. 1988) and it regulates the ecological integrity of flowing water systems (Poff et al. 1997).

The Chucky madtom and its habitats are afforded some protection from water quality and habitat degradation under the Clean Water Act (CWA) and by Tennesee Department of Environment and Conservation's (TDEC) Division of Water Pollution Control under the Tennessee Water Quality Control Act of 1977 (TWQCA, T.C.A. 69-3-101). Portions of the Nolichucky River in Greene County, Tennessee are listed as impaired (303d) by the TDEC due to pasture grazing, irrigated crop production, unrestricted cattle access, land development, municipal point source discharges, septic tank failures, gravel mining, agriculture, and channelization (TDEC 2012). However, Little Chucky Creek is not listed as "an impaired water" by the State of Tennessee (TDEC 2012). For water bodies on the 303(d) (impaired) list, States are required under the Clean Water Act to establish a Total Maximum Daily Load (TMDL) for the pollutants of concern that will bring water quality into the applicable standard. The TDEC has developed TMDLs for the Nolichucky River watershed to address the problems of fecal coliform loads, siltation, and habitat alteration by agriculture. However, population declines and degradation of habitat for this species are ongoing. Federal and State regulations alone have not been adequate to fully protect this species; sedimentation and non-point source pollutants continue to be a significant problem. Since listing, section 7 of the Act has required Federal agencies to consult with the Service when projects they fund, authorize, or carry out may affect the species. However, the lack of Federal authority or nexus over the many actions likely impacting Chucky madtom habitat has become apparent. Many of the threats (including those identified at the time of listing) involve activities that likely do not have a Federal nexus (such as water quality changes resulting from agriculture, water withdrawals, or logging on private lands) and, thus, may not result in section 7 consultation. Although the take prohibitions of section 9 of the Act do apply to these types of activities and their effects on the Chucky madtom, enforcement of the section 9 prohibitions is difficult since these violations may occur on private land, remote locations, or go unreported. The Service is not informed when many activities are being considered, planned, or implemented; therefore, we have no opportunity to provide input into the design of the project or to inform project proponents of the need for a section 10 permit.

Numerous partners are cooperating in efforts to implement agricultural best management practices in the Little Chucky Creek watershed by delivering various incentive programs to private landowners. These partners include the Greene County Soil Conservation District (GCSCD), Natural Resources Conservation Service (NRCS), Tennessee Valley Authority (TVA), Tennesee Wildlife Resources Agency, and the Service. The Service has completed Partners for Fish and Wildlife projects with local landowners along Little Chucky Creek, which have involved matching funds from TVA and technical assistance from GCSCD and NRCS. These projects involve installation of riparian fencing, creation of alternate water sources and development of hardened stream access points for cattle, and bank stabilization. Partners for Fish and Wildlife funds are sought annually for new habitat restoration projects in the watershed. The GCSCD and NRCS staff have been instrumental in helping the Service to deliver Partners for

Fish and Wildlife programs (types of projects mentioned above) in the Little Chucky Creek watershed and in delivering other conservation programs, including the Environmental Quality Incentives Program (EQIP), Tennessee Department of Agriculture's Agriculture Resource Conservation Fund (ARCF), and the Tennessee Landowner Incentive Program (LIP). In addition, the Land Trust for Tennessee and the Appalachian Resource Conservation and Development Council have purchased permanent conservation easements along Little Chucky Creek. These actions ensure that development will not occur along the creek.

EB/CE Source:
U.S. Fish and Wildlife Service. (undated). Species Biological Report for Chuck Madtom (*Noturus crypticus*). Southeast Regional Office, Atlanta, Georgia. 23 pp. (downloaded February 16, 2017, available at: https://www.fws.gov/cookeville/pdfs/10202016_Chucky%20Madtom_Species_Biological_Report.pdf)

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Chucky Madtom does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE
 # acres in species range: 130,873 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 487 acres, 0.372%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g., flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Noturus flavipinnis	Yellowfin madtom	247

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: Multiple populations (few)
Species Trends: Increasing population(s)
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
In 1983, the yellowfin madtom was only known from relatively small reaches of Citico Creek, Powell River, and Copper Creek. The yellowfin madtom was historically collected from six streams in the Tennessee River basin including Chickamauga Creek, Hines Creek, North Fork Holston River, Copper Creek, Powell River, and Citico Creek. The yellowfin madtom is extirpated from Chickamauga Creek, Hines Creek, and the North Fork Holston River. However, the Copper Creek, Powell River, and Citico Creek populations are stable to increasing in size. Conservation Fisheries, Inc. (CFI) has augmented the Powell River and Copper Creek populations in Virginia. In addition, CFI has recently begun stocking yellowfin madtoms into the Tellico River and has plans to evaluate potential reintroduction sites in the North Fork Holston River in Virginia. CFI has successfully reintroduced this species into Abrams Creek in the Great Smoky Mountains. A population was discovered in the Clinch River after publication of the recovery plan, and recent surveys have consistently located additional individuals.

As indicated in their Recovery Plans (USFWS 1983, 1985), coal mining, logging, road and bridge construction and maintenance, toxic chemical spills, and siltation were identified as threats and remain threats today to the yellowfin madtom. Additional, ongoing threats to the yellowfin madtom include gravel dredging, water withdrawals, and agricultural practices. Physical habitat destruction resulting from a variety of anthropogenic impacts such as siltation, disturbance of riparian corridors, and changes in channel morphology continues to plague the Tennessee River watershed.

The yellowfin madtom has a limited geographic range and small population size, leaving the species extremely vulnerable to localized extinctions from accidental toxic chemical spills or other stochastic disturbances and to decreased fitness from reduced genetic diversity. Potential sources of such spills include potential accidents involving vehicles transporting chemicals over road crossings of streams inhabited by the madtom and accidental or intentional release into streams of chemicals used in agricultural or residential applications. The yellowfin madtom is vulnerable to losses in genetic diversity and fitness due to small population sizes. Species that are restricted in range and population size are more likely to suffer loss of genetic diversity due to genetic drift, potentially increasing their susceptibility to inbreeding depression and decreasing their ability to adapt to environmental changes (Allendorf and Luikart 2007).

2020 5-Year Review
The Yellowfin Madtom is currently present in three tributaries of the Little Tennessee River in Tennessee (Abrams Creek, Citico Creek, and the Tellico River), the Powell River, the Clinch River, Copper Creek (a tributary of the Clinch River), and the North Fork Holston River.

Yellowfin Madtom populations in Copper Creek, Clinch River, and Powell River continue to experience threats from habitat degradation. In particular, the Yellowfin Madtom's range in Copper Creek has seen a precipitous decline since the last 5-year review, from a range of 62 km to 8 km, as impacts from agriculture have hampered population augmentation efforts in the upper reaches. The Service is also uncertain about the population trends in the Clinch River and Powell River because monitoring efforts have been inconsistent, partially due to the difficulties in properly sampling these large rivers.

Populations in Abrams Creek and Citico Creek experience reduced levels of threat, compared to other populations, and are protected through management of their watershed by Great Smoky Mountain National Park and Cherokee National Forest, respectively (Service 2019). While the population in the Tellico River is protected by Cherokee National Forest, population indices have remained low despite intensive stocking efforts, and it is unclear if the population would be able to sustain itself if stocking efforts are discontinued (Service 2019).

Since the last 5-year review, the Service and its partners started a propagation and reintroduction program in the North Fork Holston River; initial monitoring results for this population are encouraging, but more time and monitoring data are needed to assess the success of this effort.

EB/CE Source:
U.S. Fish and Wildlife Service 2020. Yellowfin Madtom (*Noturus flavipinnis*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, Tennessee. 23 pp.

U.S. Fish and Wildlife Service 2012. Yellowfin Madtom (*Noturus flavipinnis*) and Smoky Madtom (*Noturus baileyi*) 5-Year Review: Summary and Evaluation. Tennessee Ecological Services Field Office, Cookeville, TN.27 p.

Overall Vulnerability: ☐ **High** ☒ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Yellowfin madtom does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 4,615,166 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 917,739 acres, 19.885%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Noturus stanauli	Pygmy madtom	271

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The pygmy madtom was listed as an endangered species in 1993 due to habitat degradation from siltation and indirect effects of coal mining (Factor A), insufficient legal protections (Factor D), and population isolation from impoundments (Factory E) (50 FR 25758).

Currently, the pygmy madtom occupies a relict distribution of two disjunct (isolated) populations in the Duck River and the Clinch River, separated by over 600 river miles (1000 river kilometers (rkm)). There are no population estimates for the two populations, but fewer than 10 individuals have ever been collected in any individual survey, and no more than 100 individuals in total have been encountered by scientists. Pygmy madtoms are currently known to occupy about 72 river miles (116 rkm) of the Duck River and 2.5 river miles (4 rkm) of the Clinch River.

In 2007, the lower portions of the Holston River and the French Broad River were designated as areas suitable for Nonessential Experimental Populations (NEPs) for the pygmy madtom and 20 other aquatic species (72 FR 52434). At this time, no pygmy madtoms have been introduced into the NEP areas, but limited attempts have been made to propagate the species (USFWS 2018). These propagation efforts have provided important insight into the life history of the species but have not yielded sufficient numbers for reintroduction because of the difficulty in collecting broodstock. Since the recovery plan was published, the documented range of the pygmy madtom has expanded by 57 river miles (92 rkm) in the Duck River based on the discovery of an individual at river mile 89 (rkm 143) by a Tennessee Valley Authority stream monitoring crew (USFWS 2009). Additional studies have led to a better understanding of the pygmy madtom's microhabitat needs and distribution within known locations (USFWS 2018).

The pygmy madtom remains affected by habitat degradation and isolation by dams (USFWS 2018). Agricultural activities are still contributing to sediment input and water withdrawals in both the Duck and Clinch River systems. Additionally, there has been continued mining activity in the Clinch River watershed, and reclaimed mine sites continue to contribute sediment and leach pollutants in some areas. Large areas of potential habitat remain inundated by hydroelectric dams that also isolate the two populations of pygmy madtoms. A genetic study found that the two populations showed little divergence compared to other species with similar distributions; however, the isolation and small population sizes of the pygmy madtom increase the likelihood of loss of genetic diversity due to genetic drift (USFWS 2018). Furthermore, the disjunct nature of the two populations likely eliminates the possibility of natural recolonization after a localized extirpation event.

The 2009 5-Year Review also noted the following: Non-point source pollution from land surface runoff can originate from virtually any land use activity (such as coal mining and agricultural activities) and may be correlated with impervious surfaces and storm water runoff from urban areas. Pollutants entering the Clinch and Duck rivers may include sediments, fertilizers, herbicides, pesticides, animal wastes, pharmaceuticals, septic tank and gray water 9 leakage, and petroleum products. These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the chemistry of affected streams such that the habitat and food sources for species like the pygmy madtom are negatively impacted.

EB/CE Source:
U.S. Fish and Wildlife Service. 2009. Pygmy Madtom (*Noturus stanauli*) 5 Year Review: Summary and Evaluation. Cookeville, Tennessee. pp. 18.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for Pygmy Madtom (*Noturus stanauli*). Atlanta, Georgia. pp. 5.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the “Approach to the Effects Analysis” section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. Further investigation by EPA into Bin 3 and 4 estimated environmental concentrations indicate that the flow rates in these aquatic habitats are sufficient to dilute malathion concentrations to a level that will not cause toxic effects to the species.

USAGE
 # acres in species range: 968,013 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 40,845 acres, 4.219%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

Scientific Name:	Common Name:	Entity ID:
Noturus furiosus	Carolina madtom	5288

Family: Ictaluridae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Carolina madtom is a freshwater fish species endemic to the TarPamlico and Neuse River drainages in North Carolina. The species occurs in riffles, runs, and pools in medium to large streams and rivers with moderate gradient in both the Piedmont and Coastal Plain physiographic regions. The historical range of the Carolina madtom included streams and rivers in the Tar, Neuse, and Trent River drainages with the documented historical distribution in 11 management units (MUs) within three former populations. The Carolina madtom is presumed extirpated from 64% (7) of the historically occupied MUs. The analysis of species' current condition revealed that Carolina madtom abundance and distribution has declined considerably, with the species currently occupying approximately 26% of its historical range. The remaining populations are small and fragmented, only occupying a fraction of reaches that were historically occupied.

This decrease in abundance and distribution has resulted in largely isolated current populations. Evidence suggests that the range reduction of the species corresponds to habitat degradation resulting from the cumulative impacts of land use change and associated watershed-level effects on water quality, water quantity, habitat connectivity, instream habitat suitability, and predation by the invasive Flathead Catfish. The effects of climate change have begun to be realized in current Carolina madtom range and may have contributed to habitat degradation. In summary, the Carolina madtom faces a variety of threats from declines in water quality, loss of stream flow, riparian and instream fragmentation, deterioration of instream habitats, and expansion of the invasive predator Flathead Catfish.

EB/CE Source:
U.S. Fish and Wildlife Service. 2018. Species status assessment report for the Carolina Madtom (*Noturus furiosus*). Version 1.1. Atlanta, GA.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE

 # acres in species range: 4,506,653 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 4,216 acres, 0.09%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Scientific Name:	Common Name:	Entity ID:
Etheostoma osburni	Candy darter	8352

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The candy darter is a small, freshwater fish endemic to 2nd order and larger streams and rivers within portions of the upper Kanawha River basin, which is synonymous with the Gauley and greater New River watersheds in Virginia and West Virginia. The species is described as a habitat specialist, being most often associated with faster flowing stream segments with coarse bottom substrate (e.g., gravel, cobble, rocks, and boulders) that provides shelter for individual darters.

Candy darters are intolerant of excessive sedimentation and stream bottom embeddedness (the degree to which gravel, cobble, rocks, and boulders are surrounded by, or covered with, fine sediment particles). The available candy darter occurrence data, all of which were collected after the aquatic habitat in the region was degraded by widespread forest clearing in the late 1800s, indicate the species prefers cool or cold water temperatures, but that warm water conditions may also be tolerated. Candy darters are sexually mature at 2 years of age and live to a maximum age of 3 years. They are classified as brood-hiding, benthic spawners. Water temperature, excessive sedimentation, habitat fragmentation, water chemistry, water flow, and non-native competition likely influenced the species in the past, contributed to its current condition, and may continue to affect some individual populations in the future. Hybridization with the closely related variegate darter appears to be having, and will continue to have, the greatest influence on candy darter populations and its overall viability within the next 25 years.

EB/CE Source:
U.S. Fish and Wildlife Service. 2018. Species Status Assessment Report for the Candy Darter (*Etheostoma osburni*), Version 1.5. Hadley, MA.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

 # acres in species range: 2,915,385 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 902,260 acres, 30.948%

While we do not yet have R-Plot information for this species, it occurs in some of the same counties in West Virginia as the diamond darter, and we anticipate similar levels of risk to individuals and species where exposure occurs. We used the diamond darter as a surrogate for this species, based on life history description.

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Candy darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Scientific Name:	Common Name:	Entity ID:
Etheostoma trisella	Trispot darter	3069

Family: Percidae

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Declining population(s) – one or more populations declining
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The trispot darter is a freshwater fish found in the Coosa River System in the Ridge and Valley region. Currently, the trispot darter occupies approximately 20% of its historically known range. Like other members of the Ozarka subgenus, the trispot darter utilizes distinct breeding and non-breeding habitats (Williams and Robinson 1980, p. 153; Ryon 1981, p. 9 and 1986, p. 74). Approximately from April to October, the species inhabits its non-breeding habitat, which consists of small to medium river margins and lower reaches of tributaries with slower velocities (estimated to be 0.7 - 1 ft/second, 0.2 – 0.3 m/second) and is associated with detritus, logs, and stands of water willow though vegetation and detritus have not been found to be essential. In late fall, this migratory species shifts its habitat preference and moves toward spawning areas; this movement may be queued by temperature change, precipitation, and/or decreasing daylight hours (Ryon 1981, p. 13), with rainfall being the most likely trigger (Ryon 1981, p. 47). The fish move from the main channels into tributaries and eventually reach adjacent seepage areas where they will congregate and remain from approximately late November or early December to late April.

The major threat to this species is reduced connectivity between the non-breeding habitat and the breeding habitat during spawning season that may occur due to groundwater withdrawal, drought, or anthropogenic structures such as dams and improper road crossings. Increases in sedimentation likely impact the trispot darter by altering its food sources, reducing the complexity of its habitat needed for spawning, sheltering, and foraging, and reducing its fitness. Within the range of the trispot darter, sedimentation is occurring due to urban impacts in the Springville, Alabama and Dalton, Georgia areas, agricultural practices in the Conasauga River basin, and livestock access to streams in the Little Canoe Creek watershed. Hydrologic alteration has two components: (1) increases in storm flow frequency and intensity and (2) a decrease in base flows, which together create a “flashy” hydrologic regime. Activities that lead to hydrologic alteration include reservoir construction and operation, water withdrawals, and an increase in impervious surfaces as a result of urbanization. Reduced baseflows reduce the habitat available to fluvial specialists like darters (Armstrong et al. 2001, p. 6; Freeman and Marcinek 2006, p.

445). Groundwater withdrawal has been identified as a primary threat to the Arkansas darter, a fish in the same subgenus with similar life history traits (USFWS 2012, p. 70021). Increased streamflows caused by alteration can cause physical washout of eggs and larval fishes, stress on adults (Allan 1995, p. 314; Yang et al. 2008, p. 9 and 11), and negatively alter the stream's food web (Power et al. 1996, p. 889), affecting many fish species, including the trispot darter.

Removal of riparian vegetation can destabilize stream banks, increasing stream sedimentation and turbidity (Barling and Moore 1994, p. 544; Beeson and Doyle 1995, p. 989); reduce the stream's capacity for trapping and removing contaminants and nutrients from runoff (Barling and Moore 1994, p. 555; Peterjohn and Correll 1984, p. 1473; Osborne and Kovacic 1993, p. 255; 19 Vought et al. 1994, p. 346); increase water temperature (Brazier and Grown 1973, p. 4; Barton et al. 1985, p. 373; Pusey and Arthington 2003, p. 4); and increase light penetration to streams. There are numerous pastures where livestock have access to streams that have been identified as spawning habitat for the trispot darter in the Little Canoe Creek watershed (Lee Holt, USFWS, pers. comm., 2017). Contaminants, including metals, hydrocarbons, pesticides, and other potentially harmful organic and inorganic compounds, are common in urban streams and may be partially responsible for the absence of sensitive fish in those systems. These include wastewater treatment plants, mines, and industrial facilities. Non-point sources are more difficult to pinpoint. Pesticides are frequently found in streams draining agricultural lands, with herbicides being the most commonly detected (McPherson et al. 2003, p. 44). Increases in groundwater withdraw and drought can contribute to reduced connectivity, making it impossible for trispot darters to reproduce. Dams and reservoirs also reduce connectivity for this species by posing a physical barrier between populations and changing the habitat from a flowing stream to standing, impounded water; trispot darters are not found in standing, impounded water. Road crossings are another anthropogenic feature that can reduce stream connectivity and are ubiquitous within the range of the trispot darter. Impassable road crossings for the trispot darter can result in the fish not reaching their spawning grounds, not being able to get back to their non-breeding habitat after spawning, and losing genetic exchange within a management unit.

EB/CE Source: U.S. Fish and Wildlife Service. Species Status Assessment for the Trispot Darter (*Etheostoma trisella*). Ver 1.0. July 2017.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

Risk modifiers:

We described in the "Approach to the Effects Analysis" section of the main body of the Opinion the specific considerations we made for species that occur in bins 3 and 4 as they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Trispot darter does occupy other aquatic habitats that may be exposed to potentially high levels of malathion due to lower volume in those habitats, their overall risk of exposure to malathion is lowered through the use of aquatic habitats with higher flow or volume.

USAGE

 # acres in species range: 730,792 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 5,974 acres, 0.817%

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

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Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton (excluding use for the Boll Weevil Eradication Program), orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop). This will help reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.