Integration and Synthesis Summary: Amphibians (Terrestrial)

Scientific Name:	Common Name:	Entity ID:
Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	188

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); Declining population(s) – one or more populations declining
Species Trends: Unknown
Pesticides noted ☒

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

The primary factors that continue to endanger populations of the Santa Cruz long-toed salamander throughout its range include degradation, fragmentation, and loss of aquatic and upland habitats through agriculture, road construction, and urbanization. Roads, highways, buildings, walls, and fences may form complete barriers to dispersing Santa Cruz long-toed salamanders. Additionally, vehicular traffic frequently kills Santa Cruz long-toed salamanders attempting to cross roads and highways. Together, these factors result in genetically isolated subpopulations and mortality of Santa Cruz long-toed salamanders. The loss of upland habitat through urbanization reduces or eliminates terrestrial retreats such as viable root systems and small mammal burrows that are necessary for the subspecies during the non-breeding season. Santa Cruz long-toed salamanders are vulnerable to several predators. Eggs and larvae may be preyed upon by mosquitofish (Gambusia spp.) and crayfish. Other native and non-native predators feed on Santa Cruz long-toed salamander adults, metamorphs, larvae and eggs. Trematode infestations naturally occur in the subspecies, but their rate of incidence may be increased due to human-related factors such as reduced water quality. Chytrid fungus has been found to infect a number of amphibian populations that are declining, and has been confirmed in Santa Cruz long-toed salamanders in both Santa Cruz and Monterey Counties. Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, IPCC 2007). While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to the Santa Cruz long-toed salamander at this time. Degraded water quality through chemical contamination (e.g., pesticides, herbicides, petroleum products) and sedimentation via runoff reduces the growth or survival of salamander larvae (Semlitsch 2002). Methoprene, an insect growth regulator and larvicide, has been used at Valencia Lagoon and other ponds to control mosquito populations. Data on its effects on Santa Cruz long-toed salamanders are not available, but effects on other amphibians have been observed. Other insecticides (e.g., temephos) have caused reductions in growth rates of gray treefrog tadpoles and increased mortality rates in green frog (Rana clamitans) tadpoles (Sparling and Lowe 1998), and increased mortality rates in southern leopard frogs (Sparling 1998). The survival of many amphibians relies on an abundance of invertebrates, and any delay in insect growth could reduce the numbers and density of prey available to Santa Cruz long-toed salamanders. Efforts to protect the subspecies habitat have resulted in the protection of important aquatic and upland habitat areas, scattered throughout its range; however, urbanization and intensive agriculture have resulted in the fragmentation of protected habitats, likely preventing dispersal and migration of the Santa Cruz long-toed salamander within and between populations.

EB/CE Source: U.S. Fish and Wildlife Service. 2009. Santa Cruz Long-toed Salamander (*Ambystoma macrodactylum croceum*), 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, CA. U.S. Fish and Wildlife Service. 1999. Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) draft revised recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. vi. + 82 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:

Terrestrial Phase: Some individuals exposed to malathion at maximum rates from foraging on contaminated arthropods or from direct exposure to spray are anticipated to experience mortality on all use sites, with a greater chance of mortality or sublethal effects anticipated on use sites with higher allowable application rates (developed, developed open space, vegetable and ground fruit, orchards and vineyards). Mortality is not expected from exposure to spray drift.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses. We anticipate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 23% mortality of individuals and 1% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift.

DIRECT (all uses except mosquito control)	Terrestrial	Aquatic*
Use areas – mortality	23%	
Spray drift areas – mortality	No effects expected	

Sublethal – growth (G), reproduction (R) and behavior (B)	20% (G,R – low effects)	G – M R – L B – M
Direct spray or contact with contaminated media	Mortality expected if exposed	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	25% terrestrial invertebrates	
Spray drift areas - Prey item mortality	Up to 50% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	1%	
Sublethal	No effects expected	L
Indirect	76% terrestrial invertebrates	H

**Throughout the animal taxa groups, risk is identified as high (H), medium (M) or (L).*

Risk modifiers:

Allowable uses driving effects/other considerations: Developed and open space developed use sites account for the majority of effects anticipated.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Agricultural usage based on CalPUR data:

Use type	Risk to species on terrestrial use sites[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	646,157	75.80	0	0	5,6	H,M
Open Space Developed	D, I	82,874	9.72	4144	0.49	5,6	*, *
Developed	D, I	79,677	9.35	3984	0.47	5,6	M,L
Other Crops	D, I	24,232	2.84	0	0	5,6	H,H
Vegetables and Ground Fruit	D, I	13,006	1.53	13,006	1.53	5,6	H,H
Orchards and Vineyards	D, I	5,411	0.63	239	0.03	5,6	H,H
Wheat	D, I	4,757	0.56	0	0	5,6	H,H
Other Grains	D, I	3,403	0.40	4	<0.01	5,6	H,H
Pasture	D, I	2,599	0.30	3	<0.01	5,6	H,H
Corn	D, I	896	0.11	574	0.07	5,6	H,H
Rice	*	174	0.02	0	0	5,6	*,*
Other Row Crops	D, I	50	0.01	0	0	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects only*[3]		216,906	25.45	21,954	2.59		
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		216,906	25.45	21,954	2.59		
TOTAL[4]:		863,062	101.25	21,954	2.59		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 852,420 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 189,588 acres, 22%

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 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. We anticipate that, in many cases, these buffers will significantly 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 set the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Santa Cruz long-toed salamander. 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Santa Cruz long-toed salamander has a high vulnerability ranking due to its endangered status, limited distribution, small population size, low juvenile survival rates, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable aquatic and upland habitats from urbanization, invasive species, and agricultural impacts to habitat). Similarly, the species has a high risk ranking due to labeled uses across the range, including use area mortality (23%) and sublethal effects to growth and reproduction (20%). Effects to prey items from use sites, spray drift areas, and mosquito control are also estimated at 25%, up to 50%, and 76%, respectively. The species ranks as high risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage within the non-Federal portion of the range based upon more refined CalPur data (in which we have higher confidence) is limited to approximately 2.6% of the species range and we therefore anticipate that exposure of the Santa Cruz long-toed salamander would be low.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the CalPur usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Santa Cruz long-toed salamander based on standard practice and procedures. We anticipate effects to prey items through terrestrial invertebrate mortality associated with malathion use, spray drift, and mosquito adulticide uses and given the species vulnerability to urbanization and development.

Insecticide usage is specifically mentioned in the species 2009 5-Year Review, although malathion is not named among the examples of insecticides. Based on the CalPur usage data, we anticipate low levels of malathion and that small numbers of individual salamanders and their prey will be exposed to malathion over the duration of the Action. Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Santa Cruz long-toed salamander breeds in ephemeral ponds and spends most of its life history in coastal live oak forest. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Santa Cruz long-toed salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Santa Cruz long-toed salamander. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Santa Cruz long-toed salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Bufo houstonensis	Houston Toad	190

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic) Multiple populations (few)
Number of Populations: Multiple populations (few); Declining population(s)
Species Trends: Declining
Pesticides noted ☒

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

Historically, Houston toads ranged across the central coastal region of Texas with verified county reports in Austin, Bastrop, Brazos, Burleson, Colorado, Fort Bend, Harris, Lavaca, Lee, Leon, Liberty, Milam, and Robertson (Forstner and Dixon 2011, MacLaren and Forstner 2017). Houston toads disappeared from the Houston area (Harris, Fort Bend and Liberty counties) during the 1960-70s following an extended drought and the rapid urban expansion of the City of Houston. Overall trends for Houston toad abundance are declining across its range (McHenry and Forstner 2009; Forstner and Dixon 2011). Species authorities have provided a wide range of estimates for Houston toad subpopulation and census sizes throughout the years. Only the Bastrop County population has been surveyed consistently from year to year since the 1970s (Forstner and Dixon 2011). In the 1980s, surveyors reported observing 30 to 1,000 Houston toads per breeding pond in Bastrop County (Jacobsen 1983; Hillis et al. 1984). Thereafter, estimates of 2,000 Houston toads in all of Bastrop County were reported (Seal 1994). By 2003, Forstner (2003) estimated the number of Houston toads in Bastrop County to be between 100 and 200 individuals. During the 2011 Houston toad breeding/survey season, only 12 Houston toads were detected from extensive surveys in Austin, Bastrop, Burleson, Colorado, Lavaca, Lee, and Milam counties, as well as limited survey attempts in Leon and Robertson counties (Forstner and Dixon 2011; Dr. Michael Forstner, Texas State University, pers. comm. 2011). It is expected that Houston toads will soon be extirpated from Lee County, given population trends and habitat loss observed there since 2000 (Forstner and Dixon 2011).

Habitat loss and fragmentation continues to occur throughout the species' range. Fire suppression, conversion to agricultural pastures, residential development, and artificial impoundments have contributed to a very different ecosystem and landscape than when the Houston toad was first described in 1953. Early descriptions of Houston toad habitat (Kennedy 1962) differ from current survey and population monitoring results. Drought has been an additional stressor for the Houston toad for many years. Direct effects of drought on this species include dessication, loss of breeding sites, and loss of eggs or tadpoles resulting from pond evaporation. These effects may be exacerbated due to other threats (e.g., habitat fragmentation and degradation) (Forstner and Dixon 2011). Predation by red imported fire ants is an ongoing threat to the species. The distribution of the Houston toad appears to be naturally restricted as the result of specific habitat requirements for breeding and development. Small, sedentary species with restricted distributions, specialized habitat niches, and narrow climatic tolerances are especially sensitive to changes in habitat conditions (Welsh 1990, deMaynadier and Hunter 1998). These natural restrictions make them particularly vulnerable to the negative effects of human-induced changes that result in habitat loss, degradation, and fragmentation (Hillis et al. 1984). The 1984 recovery plan mentions the herbicide Atrazine as a potential threat to the species.

Conservation efforts have included development of Habitat Conservation Plans, Safe Harbor Agreements, and the purchase of land by Texas Parks and Wildlife Department for the conservation of the Houston toad. A captive assurance colony was begun in 2007 and has maintained several hundred adult Houston toads in captivity at the Houston Zoo since that time (HZI 2010-2019). In addition, captive propagation and headstarting since 2013 have resulted in population supplementation of Houston toads, principally at the Griffith League Ranch (GLR) in Bastrop County, on the order of a million eggs per year since the program gained full efficiency in 2016. Results have been promising, as captures of adult Houston toad at the GLR increased from 40 in 2016 and 63 in 2017, to 130 in 2018 and 126 in 2019 (Dr. Forstner 2016, 2017, 2018, 2019). However, these results are still short-term, subject to frequent stochastic events (e.g., multiple catastrophic wildfires within designated critical habitat within the last 10 years) and do not address losses of habitat and the species' representation in other parts of the range.

EB/CE Source: U.S. Fish and Wildlife Service. 2018. 5-year Review: Houston toad (*Anaxyrus* [formerly *Bufo*] *houstonensis*). U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas. 1 pp.

U.S. Fish and Wildlife Service. 2011. Houston Toad (*Bufo houstonensis*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas. 22 pp.

U.S. Fish and Wildlife Service. 1984. Houston Toad Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 73 pp.+iii.

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:

Terrestrial Phase: Individuals exposed to malathion on use sites with higher allowable application rates are expected to experience mortality. On these sites, we anticipate a high number of individuals exposed from foraging on contaminated arthropods would die. Mortality is not expected from exposure to spray drift. Effects related to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a low risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses. We anticipate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 3% mortality of individuals. While mortality of individuals from mosquito control efforts are not anticipated, this use is anticipated to result in 1% loss of prey.

DIRECT (all uses except mosquito control)	Terrestrial	Aquatic
Use areas – mortality	3%	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	7% (G, R – low effects)	G – M B – M R – L
Direct spray or contact with contaminated media	<1% mortality on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	14% terrestrial invertebrates	
Spray drift areas - Prey item mortality	Up to 45% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	M
Indirect	17% terrestrial invertebrates	H

Risk modifiers: The Houston toad is found in areas with sandy soils, and wooded areas (loblolly pine, and oaks) in nine counties east and northeast of Austin, Texas. Ephemeral ponds, rain pools, flooded field, and other shallow freshwater areas are used for breeding. Houston toads burrow into moist sand or hiding under rocks, leaf litter, logs, or in abandoned animal burrows in the forested areas to seek protection from winter cold (hibernation) and summer heat and drought (aestivation). Males call from shallow ravines, lakes, roadside ditches, ponds, temporary rain pools, flooded field, puddles, prairie potholes, and moist spots in residential areas. Breeding begins in January with egg-laying ranging from February to June. Although developmental rates depend on temperature and other factors eggs may hatch within seven days and tadpoles may remain in the breeding area for 40 to 80 days depending on environmental conditions. Toadlets may remain at the edge of the pond for seven to ten days. Young migrate away from breeding pools also similar routes of migrations used by adults. Adults may occupy upland areas and return to breeding areas during the breeding season. Houston toads feed on a variety of insects and other invertebrates. Tadpoles are known to ingest algae and pollen.

The Houston toad appears to consist of several subpopulations in somewhat geographically isolated patches that are interconnected through patterns of gene flow, extirpation, and recolonization.

Adults will migrate to wet areas for calling and breeding in ephemeral waters and wet areas, predators existing in permanent waters limit successful reproduction of the Houston toad. Adults and juveniles will disperse from these areas through other habitats which may experience differing pesticide exposures.

The Houston toad will migrate through agricultural, developed, and open space areas.

Allowable uses driving effects/other considerations: Overlap with open space developed, developed, and cotton are responsible for the majority of direct effects.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☒ High ☐ Medium ☐ Low

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

Use type	Risk to species on terrestrial use sites [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	I	824,590	16.57	343,466	6.90	5,6	H,M
Open Space Developed	D, I	229,819	4.62	11,491	0.23	5,6	*,*
Other Crops	I	116,339	2.34	0	0	5,6	H,H
Corn	I	98,041	1.97	4,101	0.08	5,6	H,M

[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 on terrestrial use sites [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	D, I	63,233	1.27	3,162	0.06	5,6	L,L
Cotton	D, I	59,057	1.19	53,705	1.08	5,6	H,H
Other Grains	I	58,858	1.18	58,858	1.18	5,6	H,M
Rice	D, I	38,669	0.78	5,309	0.11	5,6	*,*
Wheat	I	28,621	0.58	27,246	0.55	5,6	H,M
Orchards and Vineyards	D, I	2,505	0.05	1,966	0.04	5,6	H,H
Vegetables and Ground Fruit	D, I	722	0.01	722	0.01	5,6	H,H
Pasture	I	307	0.01	281	0.01	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects only*[3]		394,006	7.92	76,355	1.53		
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		696,171	13.99	166,841	3.34		
TOTAL[4]:		1,520,761	30.56	510,307	10.24		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself).

 # acres in species range: 4,976,348 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 22,332 acres, 0.45 %

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 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. We anticipate that, in many cases, these buffers will significantly 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 set the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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.

Species specific conservation 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 timing restrictions, use limitation areas, and wind speed/direction restrictions that are expected to further reduce effects to the Houston toad.

The following species-specific measures will be included in BulletinsLive! Two:

<u>For agricultural uses</u>

Within the use limitation area (geological formations[5]), between January and June, do not use within 50 ft (ground application) or 100 ft (aerial application) from the edge of habitat [for the species] AND use only when steady wind of at least 3 mph is blowing away from habitat [for the species][6].

<u>For Mosquito control uses</u>

Where feasible, avoid application. 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 office to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species (FWS points of contact and maps of designated critical habitat 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.

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[5] For this species, the underlying geologic formations have proved useful in identifying suitable habitat (e.g., geologic formations with deep, friable sands). These will be described for species via a link in *BulletinsLive! Two.*
[6] Land cover descriptions will be linked to the conservation measure to assist users in determining habitat types.

We anticipate these species-specific measures will reduce exposure and effects to the species for the following reasons:

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

Limiting malathion applications to specific seasons, months of the year, or time of day when the species is not active or otherwise engaged in a critical period of its life cycle (e.g. reproduction, migration, metamorphosis/emergence, etc.) will reduce malathion exposure and risk of adverse effects.

Limiting malathion applications to when winds are blowing away from use limitation areas is likely to reduce exposure to malathion. When effectively applied, we expect this use limitation could effectively prevent nearly all exposure to malathion from spray drift.

The Service evaluated these additional measures and concluded that, in addition to changes to the general labels, the measures will provide important protections for the species. Changes to the general labels (e.g. reduction in number of applications allowed per year, timing restrictions, habitat buffers, etc.) would further reduce potential impacts to the Houston toad and reduce take of 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 Houston toad. As discussed below, the vulnerability and risk are high for this species. However, we anticipate the likelihood of exposure to malathion is low, and the additional species-specific and general conservation measures described above will further reduce the likelihood of exposure, particularly for agricultural and mosquito control uses, which we identified as significant drivers for effects in our February 2021, draft biological opinion. Based on these changes, we do not anticipate species-level effects would occur over the duration of the Action.

The Houston toad has a high vulnerability ranking due to its endangered status, limited distribution, small population size, low juvenile survival rates, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable aquatic and upland habitats from urbanization, invasive species, and agricultural impacts to habitat). Similarly, the species has a (modified) high risk ranking due to labeled uses across the range and the Houston toad's extremely low numbers in the wild. Populations have continued to decline since the at least the 1990s and the isolated populations remaining are at risk from continued agricultural and development impacts. The species ranks as high risk, given its aquatic life history and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), and that individuals can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). While herbicides were specifically mentioned in the species' environmental baseline and cumulative effects discussion above, the estimated malathion usage data within the non-Federal portion of the species range is high (>10%).

While Houston toads are primarily found as a forest dwelling species today, early descriptions (see Brown and Thomas 1982) and recent research demonstrates that the species can persist and grow faster given the available prey resources in a mosaic of landscapes, particularly in more arthropod-rich grasslands (see Marsh and Forstner 2016). Houston toads are also highly mobile, particularly in the juvenile life stage (Forstner and Jackson 2009), which would tend to increase the risk of exposure to the largest number of individuals of the species (i.e., seasonally, most Houston toads alive, exist as highly mobile juveniles). It appears that agricultural conversion has limited the availability of suitable habitat (through both structural change and chemical contamination) and that malathion uses for agriculture and mosquito adulticide contributed to the continued decline of the species by limiting arthropod prey resources, particularly at forest edges and in otherwise productive grassland landscapes. We anticipate that applications of malathion would result in reductions of the Houston toad’s prey base through terrestrial invertebrate mortality associated with malathion on use sites (14%), spray drift (up to 45%), and mosquito adulticide uses (17%), and to a lesser degree through exposure of malathion through their prey items.

We also anticipate exposure to aquatic phases (e.g., egg and larval life stages) from runoff and spray drift and mortality and sublethal effects to individuals at natal ponds across the range. The aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses. That said, for aquatic life stages, the exposure pathway is more uncertain as any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to result in effects. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water) would generally reduce the concentration reaching the species’ occupied habitat. In addition, with the incorporation of the additional measures described above, including the general label rain restriction, the seasonal ground and aerial application buffers, and spray drift minimization, we expect the exposure risk to the species from agricultural uses of malathion will be reduced. Furthermore, the use limitation for mosquito control (which is anticipated to result only in small effects to prey) is anticipated to greatly reduce effects from this exposure pathway, as applications would either not occur in or near the species habitat, as described above, or where applications were needed to control mosquitos, additional efforts to minimize effects to individuals would be incorporated as needed.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Houston toad based on standard practice and procedures.

Due to their high vulnerability, with few scattered populations, small numbers of individuals within populations, and declining status, we anticipate that very low numbers of individual toads will be exposed to malathion over the duration of the Action and that such exposure will result in death and sublethal effects of some individuals where Houston toads come into contact with contaminated prey on certain use sites.

However, we anticipate the additional species-specific and general conservation measures above, including rain restrictions, aquatic habitat buffers, and reduced application number and reduced application rate, will further reduce the likelihood of exposure of the species, their prey, and their habitat. Implementation of species-specific measures will reduce the likelihood of exposure for agricultural use categories and provide additional protections against exposure for the critical peak of the breeding and dispersal period annually (i.e., January to June). Similarly, for mosquito adulticide uses, a use restriction across the range is being implemented through a species-specific measure. To reduce the likelihood of exposure from mosquito adulticide usage, a conservation measure will be implemented that restricts this use within the range of the toad. Mosquito control applicators who perform operations while avoiding the range of the Houston toad will be in compliance with this measure and no coordination will be required with FWS. If applications are needed to control mosquitos within the Houston toad’s range, such as due to a public health threat, the applicator must contact the local FWS field office to determine any needed measures to minimize exposure and effects to the species. Discussions at the local level may allow for greater flexibility and less restrictive measures based on site- or species-specific considerations, such as timing, species life history, and geographic or habitat factors. Coordination with FWS on measures to minimize exposure to listed species, including avoidance, is a recognized practice by mosquito control professionals. In its 2021 Best Practices for Integrated Mosquito Management, the American Mosquito Control Association (AMCA) instructs applicators with listed species in their treatment area to coordinate with FWS prior to application and maintain records of interactions. Discussions with the AMCA and anecdotal reports from FWS field offices indicate that this type of coordination is presently occurring to varying degrees for mosquito control applications in general. Applicators subject to this conservation measure will be required to maintain records of their interactions with FWS offices, allowing EPA to better track this coordination and its outcomes moving forward.

For the Houston toad specifically, there are prior large-scale efforts to avoid mosquito adulticide use across the range of the species (e.g., from FEMA following Hurricane Harvey in 2017). With the inclusion of the species-specific measure, we anticipate additional, finer scale, mosquito control district coordination will occur. Implementation of this measure will require coordination across suitable habitats within the range of the Houston toad, including in areas where releases of captive toads will continue to expand the occupied habitat of this species. Also, as the species is largely confined to forest in its present day distribution, we anticipate that exposure from truck-mounted or aerial mosquito control efforts will be limited. Similarly, much of the species’ existing habitat is in rural areas that are generally less likely to be sprayed for mosquito control than areas of high human population density. Together with these considerations, we expect that implementation of the species-specific restriction, on mosquito adulticide use within the habitat of the Houston toad as described above, will significantly reduce the likelihood of exposure through this pathway.

As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Houston toad when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Thus, we anticipate only small numbers of individuals of this species will experience mortality or effects to growth, reproduction, and behavior (i.e., through direct exposure or through contaminated prey) and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery Houston toad. After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Houston toad.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Batrachoseps aridus	Desert slender salamander	191

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), Unknown number of individuals
Species Trends: Unknown population trends
Pesticides noted ☐

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

The desert slender salamander is known from only two canyons on the lower desert slopes of the eastern Santa Rosa Mountains in Riverside, California. Though specific threats to the desert slender salamander were not identified in the listing rule, habitat loss due to erosion, fire, nonnative plants, groundwater pumping, overutilization for scientific purposes, disease, drought or climatological changes, and small population size were described in the Recovery Plan (USFWS 1982) and the previous 5-year review (USFWS 2009). Potential threats also included collection of individuals and disease. No threats have been ameliorated, though there is currently less concern associated with fire, groundwater pumping, and overutilization for scientific purposes. Erosion of the habitat remains the primary threat to this species at Hidden Palm Canyon. This population is presumed to be extant, though it has not been observed since 1997. The habitat at Hidden Palm Canyon is protected within a State ecological reserve that is owned by the California Department of Fish and Wildlife (CDFW). The second known population is presumed extant at Guadalupe Canyon, which is owned by the Bureau of Land Management (BLM) within the Santa Rosa Wilderness Area. Both canyons are encompassed within the Santa Rosa and San Jacinto Mountains National Monument area.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Desert Slender Salamander (Batrachoseps major aridus) (=B. aridus) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, CA.

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 risk of mortality for individuals exposed to malathion and risk of effects associated with loss of invertebrate prey exposed to malathion.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	No effects expected
Spray drift areas – mortality	No effects expected
Sublethal – growth (G), reproduction (R) and behavior (B)	No effects expected
Direct spray or contact with contaminated media	No effects expected
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	No effects expected
Spray drift areas - Prey item mortality	No effects expected
Plants affected (decline in growth)	No effects expected
MOSQUITO CONTROL	
Direct (mortality)	No effects expected
Sublethal	No effects expected
Indirect	No effects expected

Risk modifiers: The desert slender salamander is known from two locations, both on state or federally owned lands that afford the species additional protections or where additional coordination of pesticide use would be anticipated prior to use. The remote locations of these extant populations are also anticipated to make the use of pesticides extremely unlikely.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because terrestrial invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

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

We do not have prior usage data for the desert slender salamander given its distribution on remote portions of Federal lands. Therefore, there is not overlap information or estimated usage in the range from CalPur data or other data sources.

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself).

 # acres in species range: 29,812 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 29812 acres, 100%

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. We anticipate that, in many cases, these buffers will significantly 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 desert slender salamander. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The desert slender salamander has a high vulnerability ranking due to its endangered status, extremely limited distribution, small population size, susceptibility to stochastic events, and habitat loss due to erosion. However, the species has low risk and usage rankings due to its presence entirely on remote state or federally owned lands; we have not provided specific toxicity information should an individual or the species prey base be exposed to malathion.

We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range (100% based on the resolution of our overlap analysis), 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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the desert slender salamander based on standard practice and procedures. As with our Federal lands analysis, we anticipate only limited usage of malathion in the state-owned ecological preserve over the duration of the action. Likewise, the location of the species in remote canyons in designated wilderness would generally make the use of pesticides rare or infrequent. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers will further reduce the likelihood of exposure of the species, their prey, and their habitat. The desert slender salamander breeds and spends most of its life history in moist sheltered environments where its young develop directly from egg to juvenile without a free-swimming larval stage. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the desert slender salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications, which are expected to be very infrequent given the salamander's restricted remote canyon habitat. Thus, we expect exposure of individual salamanders and their food base 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 their food resources base. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the desert slender salamander.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the desert slender salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Phaeognathus hubrichti	Red Hills salamander	192

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; Unknown number of populations
Species Trends: Unknown population trends
Pesticides noted ☐

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

The number of known populations and the number of individual Red Hills salamanders within the range of the species is currently unknown due to the species secretive (e.g., fossorial) habits and islolated location of populations. The degree of threat to the Red Hills salamander persistence remains moderate. Timber operations have impacted habitat in the past (Jordan & Mount 1975, French & Mount 1978, Dodd 1988, 1991) and still occurs at some level. Timber corporations, timber management organizations, and individual landowners have also entered into landscape level conservation agreements with the Service to the benefit of Red Hills salamander. Other timber operators, while not requesting ITPs, have consulted with the Service and modified their timber harvest so that take will not occur. Permanent conversion of RHS habitat for residential or commercial development is presently not a major threat.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Red Hills Salamander (Phaeognathus hubrichti) 5-Year Review : Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Alabama Ecological Services Field Office, Daphne, Alabama. U.S. Fish and Wildlife Service. 1983. Red Hills Salamander Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 23 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 risk of mortality for individuals exposed to malathion on use sites with higher allowable application rates (i.e., developed, open space developed, orchards and vineyards) and risk of effects associated with loss of invertebrate prey exposed to malathion.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses. We anticipate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 1% mortality of individuals and 3% mortality to food resources on use sites, with additional loss expected from spray drift. Mosquito control is expected to result in 39% mortality of prey items.

DIRECT (all uses except mosquito control)	
Use areas – mortality	1%
Spray drift areas – mortality	No effects expected
Sublethal – growth (G), reproduction (R) and behavior (B)	2% (G, R – low effects)
Direct spray or contact with contaminated media	Mortality if exposed
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	2% terrestrial invertebrates
Spray drift areas - Prey item mortality	Mortality of terrestrial invertebrates
Plants affected (decline in growth)	N/A
MOSQUITO CONTROL	
Direct (mortality)	No effects expected
Sublethal	No effects expected
Indirect	48% terrestrial invertebrates

Risk modifiers: The Red Hills Salamander occurs in suitable habitat in the Red Hills physiographic province in Conecuh, Covington, Crenshaw, Butler, Monroe, and Wilcox Counties, Alabama. The boundaries of the Red Hills Salamander distribution are the Alabama River on the west to the Conecuh River on the east.

The Red Hills Salamander is a fossorial species found in areas of relatively undisturbed forested slopes and moist ravines with surface exposures of the siltstones, claystones, sandstones, and clays of the Tallahatta and Hatchetigbee geologic formations. The salamanders rarely leave their burrows and feed on invertebrates both inside and near the burrow entrance. The Red Hills Salamanders are typically more numerous on steep north-facing or shaded slopes and ravines under the shade of mature undisturbed forests. Given this species preference for mature undisturbed forest and limited movement the exposure to malathion would be limited except for the mosquito adulticide uses.

Red Hills salamanders live on steep slopes and are not expected to enter agricultural use sites. These salamanders could utilize managed forests, and open space developed, right-of-ways, and rangeland areas if suitable habitat was present.

Allowable uses driving effects/other considerations: Estimated sublethal effects, mortality, and prey base decline are based primarily on overlap with developed and open space developed use sites and assume that salamanders utilize all of these use sites within their range. Because suitable habitat (steep forested slopes) is likely limited to a portion of these sites only, these values are likely over-estimated.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito Control	I	173,492	47.95	0	0.00
Open Space Developed	D, I	8,158	2.25	408	0.11
Cotton	*	2,306	0.64	2,306	0.64
Other Crops	*	877	0.24	0	0.00
Developed	D, I	532	0.15	27	0.01
Other Row Crops	*	197	0.05	197	0.05
Other Grains	*	81	0.02	81	0.02
Wheat	*	34	0.01	34	0.01
Corn	*	7	<0.01	7	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		8,690	2.40	435	0.12
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		8,690	2.40	866	0.12
TOTAL[4]:		182,182	50.35	866	0.12

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself).

[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: 361,807 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 0 acre, <0%

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

CONSERVATION MEASURES

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 as initial residues degrade prior to the next application.

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 Red Hills salamander. As discussed below, the vulnerability and risk are medium for this species, but the likelihood of exposure to malathion is low given the anticipated usage, 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Red Hills salamander has a medium vulnerability ranking due to its threatened status, limited distribution, unknown population size and population trends, low juvenile survival rates, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable habitats from timber harvest). While the species is at risk if exposed (e.g., dermal exposure, consumption of contaminated arthropod prey), as described above, we anticipate Red Hills salamanders have a medium risk ranking from labeled uses across the range and the fact that the species is known to inhabit subterranean burrows on slopes in mature forest and riparian habitats and does not inhabit agricultural areas.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Red Hills salamander based on standard practice and procedures.

Estimated usage within the range is limited to less than 1% of the species range, and we anticipate that exposure of the Red Hills salamander would be low given its habitat preferences. Overlap of the species range with mosquito adulticide use is estimated at more than 39%; however, we anticipate this is likely overestimated, given the species preferred mature forest habitat and fossorial life history. Furthermore, we anticipate the additional conservation measures above, including residential use label changes, will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Red Hills salamander breeds and spends most of its life history in moist sheltered burrow environments where its young develop entirely from egg to adult. The residential use label changes are anticipated to reduce the likelihood of exposure from developed and open developed use sites by reducing environmental concentrations as initial residues degrade prior to the next application, which are expected to be very infrequent given the salamander's mostly mature, undisturbed hardwood forested habitat.

Thus, we anticipate only small numbers of individuals of this species will experience mortality or effects to growth, reproduction, and behavior (i.e., through direct exposure or through contaminated prey) and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Red Hills salamander. After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Red Hills salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Plethodon nettingi	Cheat Mountain salamander	198

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: Unknown population trends
Pesticides noted ☐

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

According to the most recent 5-year review, the current range of the Cheat Mountain salamander is described as extending over approximately 695 square miles from Blackwater River Canyon (Tucker County) in the north, south to Thorny Flat (Pocahontas County) and from Cheat Mountain in the west, and to Allegheny Front in the east. Within this overall range, distribution of the salamander is discontinuous and is restricted to the higher elevations of 12 mountains: Allegheny Front, Back Allegheny, Backbone, Cabin, Canaan, Cheat, Little Middle, McGowan, Rich (east), Mozark, Shavers, and Spruce.

At the time that the recovery plan was written, the Cheat Mountain salamander (CMS) was known to occur at 68 sites, and each of these site was referred to as a population (USFWS 1991). Currently, at least 80 disjunct populations (sites) have been identified (Pauley 2008a). However, direct comparisons of these numbers may be misleading. Subsequent surveys and habitat delineations determined that some of the sites identified in the recovery plan are actually connected. Conversely, some formerly contiguous populations are now functionally separate (e.g., as a result of ski slopes, pipeline rights-of-way), and there are no clear critieria as to what time period is required to elapse before they are designated as separate populations or how large or potentially unrestorable the barrier must be. In these situations, designating each of these disjunct areas as a "population" artificially gives the impression that additional populations have been found and that the species is recovering when, in fact, this is an indication of fragmentation and adverse effects. Due to the difficulty associated with quantifying population numbers or density, determination of relative population size has been tentatively based on habitat area. Pauley (2008a) define those populations that cover greater than one acre as "large." Assuming that the home range of the Cheat Mountain salamander is similar to that of the redback salamander, it is estimated that one acre would provide adequate space to support the home ranges of approximately 160 female salamanders. Sixty-six of the known populations fall into the large category (Pauley 2008a).

Habitat destruction and modification were the primary threats that led to the listing of the Cheat Mountain salamander. Historically, the large-scale timbering and burning that occurred throughout the salamanders' range in the last 100 years resulted in significant change and loss of habitat (FWS 1991). Habitat modifications continue to be the major factor affecting the salamander today, and can affect the species by 1) completely removing suitable habitat; 2) altering remaining habitat conditions and making the area less suitable to support the species; or 3) by fragmenting populations (Pauley 2008a, 2008c). As a result of land use management plans that are in place on federally-owned lands within the Monongahela National Forest and Canaan Valley National Wildlife Refuge, direct removal of salamander habitat occurs infrequently. However, salamander populations on private lands are subject to direct habitat loss and alteration due to logging and development and potentially from mining or energy development. Habitat alterations and fragmentation may increase the threat of inter-specific competion with redback salamanders and mountain dusky salamanders. Other threats include increased predation (due to fragmentation), chytrid fungus (*Batrachochytrium dendrobatidis*), climate change, drought, and acid precipitation/deposition (e.g., from coal-fired power plants).

EB/CE Source: U.S. Fish and Wildlife Service. 2010. Cheat Mountain Salamander (*Plethodon nettingi*) 5-Year Review : Summary and Evaluation. U.S. Fish and Wildlife Service, West Virginia Field Office, Elkins, West Virginia. U.S. Fish and Wildlife Service. 1991. Cheat Mountain Salamander Recovery Plan. Newton Corner, Massachusettes. 35 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: Mortality of Cheat Mountain salamanders exposed to malathion at maximum rates on use sites via foraging or from direct spray is expected. .

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses. We anticipate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 2% mortality of individuals and 8% mortality of individuals from mosquito control efforts.

DIRECT (all uses except mosquito control)	
Use areas – mortality	2%
Spray drift areas – mortality	<1%
Sublethal – growth (G), reproduction (R) and behavior (B)	2% (G, R – low effects)
Direct spray or contact with contaminated media	Mortality where exposed
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	

Use areas - Prey item mortality	2% terrestrial invertebrates
Spray drift areas - Prey item mortality	Up to 5%
Plants affected (decline in growth)	N/A
MOSQUITO CONTROL	
Direct (mortality)	8%
Sublethal	No effects expected
Indirect	10% terrestrial invertebrates

Risk modifiers:

Allowable uses driving effects/other considerations: Open space developed accounts for the majority of direct effects to the salamander, with contributions from developed and corn uses.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito Control	D, I	224,094	9.78	0	0.00
Pasture	D, I	577	0.03	577	0.03
Open Space Developed	D, I	33,752	1.47	1688	0.07
Developed	D, I	6,916	0.30	346	0.02
Corn	D, I	77	0.00	87	<0.01
Other Grains	D, I	152	0.01	53	<0.01
Other Crops	D, I	81	<0.01	0	<0.01
Wheat	D, I	34	<0.01	9	<0.01
Orchards and Vineyards	D, I	9	<0.01	9	<0.01
Vegetables and Ground Fruit	D, I	3	<0.01	2	<0.01

[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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Sub-TOTAL (D): *Other uses with direct effects only*[3]		41,602	1.81	2,771	0.12
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		41,602	1.81	2,771	0.12
TOTAL[4]:		265,697	11.59	2,771	0.12

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself).

 # acres in species range: 2,292,412 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,375,976 acres, 60%

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

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially 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.

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 Cheat Mountain salamander. As discussed below, the vulnerability and risk are medium for this species, but the likelihood of exposure to malathion is low given the anticipated usage, and the implementation of the general 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.

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 Action, we do not expect species-level effects to occur.

The Cheat Mountain salamander has a medium vulnerability ranking due to its threatened status, limited distribution, unknown population size and population trend, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable aquatic and upland habitats from timber harvest). Similarly, the species has a medium risk ranking due to labeled uses across the range, primarily from effects from mosquito adulticide use, including both direct exposure (8% mortality) and indirect (10% of terrestrial invertebrate prey). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). However, estimated usage is limited to less than 1% of the non-Federal portion of the species range, so that we anticipate that limited exposure of the Cheat Mountain salamander would result from effects to prey items through terrestrial invertebrate mortality associated with malathion on use sites (2%), spray drift (up to 5%), and mosquito adulticide (8%) uses.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Cheat Mountain salamander based on standard practice and procedures.

Given the higher elevation habitat preference of this species, we anticipate that the overlap from mosquito adulticide is an overestimate and that the anticipated effects from such exposure would be less than the approximate 9.8% overlap of the species range. Furthermore, we anticipate the additional conservation measures above, including residential use label changes, will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Cheat Mountain salamander breeds and spends most of its life history in moist environments within red spruce and deciduous forests at higher elevations in the Allegheny Mountains. The residential use label changes are anticipated to reduce the likelihood of exposure from developed and open space developed use sites by reducing environmental concentrations as initial residues degrade prior to the next application, which are expected to be very infrequent. The salamander's resides in relatively undisturbed forested habitat occurring primarily within protected areas of the Monongahela National Forest, as described in the most recent 5-year review for the species.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. We anticipate that the Action would not appreciably reduce the survival and recovery of the Cheat Mountain salamander. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the the Cheat Mountain salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Ambystoma cingulatum	Frosted Flatwoods salamander	199

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened, Five-Year Review Recommendation (Uplist to Endangered, 9/13/2019)
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 main threat to the frosted flatwoods salamander is loss of both its longleaf pine/slash pine flatwoods terrestrial habitat and its isolated, seasonally inundated breeding habitat. The combined pine flatwoods (longleaf pine-wiregrass flatwoods and slash pine flatwoods) historical acreage was approximately 32 million ac (12.8 million ha) (Wolfe et al., 1988; Outcalt, 1997). The combined flatwoods acreage has been reduced to 5.6 million ac (2.27 million ha) or approximately 18% of its original extent (Outcalt, 1997). These remaining pine flatwoods (non-plantation forests) areas are typically fragmented and degraded, with second-growth forests. Large tracts of intact longleaf pine flatwoods habitat are fragmented by roads and pine plantations. Most flatwoods salamander populations are widely separated from each other by unsuitable habitat. Land use conversions to urban development and agriculture eliminated large acreages of pine flatwoods in the past (Schultz, 1983; Stout and Marion, 1993; Outcalt and Sheffield, 1996; Outcalt, 1997). Wear and Greis (2002) identified conversion of forests to urban land uses as the most significant threat to southern forests. These authors predicted that the South could lose about 12 million forest acres (about 8% of its current forest land) to urbanization between 1992 and 2020. Flatwoods salamander breeding sites have also been degraded or altered. The number and diversity of these small wetlands have been reduced by alterations in hydrology, agricultural and urban development, incompatible silvicultural practices, shrub encroachment, dumping in or filling of ponds, conversion of wetlands to fish ponds, domestic animal grazing, and soil disturbance (Vickers et al., 1985; Ashton, 1992). Disease is currently unknown in natural populations of reticulated flatwoods salamanders. Exposure to increased predation by fish is a potential threat to the reticulated flatwoods salamanders when isolated, seasonally ponded wetland breeding sites are changed to, or connected to, more permanent wetlands inhabited by fishes that are not typically found in temporary wetlands. Red imported fire ants (*Solenopsis invicta*) are potential predators of reticulated flatwoods salamanders, especially in disturbed areas. Nonindigenous feral swine can significantly impact reticulated flatwoods salamander breeding sites through rooting. Invasive plant species such as cogongrass (*Imperata cylindrica*) threaten to further degrade existing habitat. Climate change, especially in combination with other stressors, is a daunting challenge for the persistence of amphibians (Walls et al. 2013). Sea level rise is becoming and will likely continue to increase as a threat to the extant populations of the frosted flatwoods salamanders (both species). Most of the remaining relatively resilient populations occur in very low lying areas within a short distance of the coast. Small population sizes, especially concentrated in small areas, are more susceptible to stochastic events that could negatively impact the entire population. Pesticides and herbicides may pose a threat to amphibians such as the reticulated flatwoods salamander, because their permeable eggs and skin readily absorb substances from the surrounding aquatic or terrestrial environment (Duellman and Trueb, 1986).

EB/CE Source: U.S. Fish and Wildlife Service. 2015. Reticulated flatwoods salamander (Ambystoma bishopi), 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Panama City Field Office, Panama City, Florida.

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: Frosted flatwoods salamanders are expected to experience direct effects (mortality) from malathion for individuals exposed and are expected to experience mortality effects via direct spray on use sites. The frosted flatwoods salamander is also at risk of effects associated with loss of invertebrate prey exposed to malathion. No effects are expected from consumption of contaminated food items.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses. The frosted flatwoods salamander is not expected to experience direct effects from exposure to malathion at maximum rates on use sites or from spray drift.

DIRECT (all uses except mosquito control)	Terrestrial	Aquatic
Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	No effects expected	G – M R – M B – L
Direct spray or contact with contaminated media	Mortality if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	18% terrestrial invertebrates	

Spray drift areas - Prey item mortality	Up to 64% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected from dietary items, but some likely to experience mortality if exposed to direct spray	
Sublethal	No effects expected	M
Indirect	58% terrestrial invertebrates	H

Risk modifiers:

Allowable uses driving effects/other considerations: No direct effects from dietary exposure, but some salamanders are anticipated to experience mortality if they were exposed to direct spray or contaminated media on use sites or from mosquito adulticide. This exposure is not considered in the calculations below.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	I	10,453,701	58.20	466,599	2.60	5,6	H,M
Open Space Developed	I	736,713	4.10	36,836	0.21	5,6	*,*
Cotton	I	615,377	3.43	43,674	0.24	5,6	H,H

[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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Pine Seed Orchards	I	551,743	3.07	37,436	0.21	5,6	*,*
Developed	I	464,241	2.58	23,212	0.13	5,6	L,L
Other Crops	I	297,172	1.65	0	0	5,6	H,H
Other Row Crops	I	238,907	1.33	22,844	0.13	5,6	H,H
Corn	I	144,571	0.80	1,911	0.01	5,6	H,H
Orchards and Vineyards	I	87,247	0.49	6,901	0.04	5,6	H,H
Other Grains	I	49,314	0.27	15,044	0.08	5,6	H,H
Wheat	I	13,047	0.07	2,450	0.01	5,6	H,H
Pasture	I	123	0.00	32	<0.01	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		0	0.00	0	0.00		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		3,198,456	17.81	190,341	1.06		
TOTAL[4]:		13,652,156	76.01	656,940	3.66		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in prey base effects from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 17,961,502 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 2,302,095 acres, 13%

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.

quatic 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. We anticipate that, in many cases, these buffers will 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 substantially 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 as initial residues degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 ground fruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 frosted flatwoods salamander. As discussed below, the vulnerability is high and the risk medium for this species, but the likelihood of exposure to malathion is low given the anticipated usage, 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The frosted flatwoods salamander has a high vulnerability ranking due to its status (threatened but with a proposal to uplist to endangered currently under review), limited distribution, declining population trend, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable aquatic and upland habitats from conversion of habitat to agricultural and urban use). Similarly, the species has a medium risk ranking due to labeled uses across the range, primarily from effects to invertebrate prey from spray drift and mosquito adulticide use, the latter including high indirect impacts (58%) to terrestrial invertebrate prey. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult).

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

Estimated usage is limited to 3.7% of the species range, occurring on the non-Federal portions of the range. 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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the frosted flatwoods salamander based on standard practice and procedures. We anticipate that limited exposure of the frosted flatwoods salamander would result from effects to prey items through terrestrial invertebrate mortality associated with malathion use, spray drift, and mosquito adulticide uses. As most of the known occurrences of the frosted flatwoods salamander exist on Federal lands (22 of 25 known populations), we anticipate that the overlap from mosquito adulticide is an overestimate and that the anticipated effects from such exposure would be much less than the approximate 58% overlap of the species range estimated from the usage data. Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The frosted flatwoods salamander breeds in ephemeral ponds and spends most of its life history in seasonally wet pine flatwoods and pine savannas. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the frosted flatwoods salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, and small effects to growth and reproduction from loss of the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the frosted flatwoods salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Plethodon shenandoah	Shenandoah salamander	200

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 Shenandoah salamander is a small terrestrial salamander found only within the boundaries of the Shenandoah National Park in Virginia. Habitat for the salamander consists of talus slopes, generally of northern aspect and above 2,600 feet (800 meters) elevation, on three mountains in Page and Madison counties: Hawksbill, The Pinnacles, and Stony Man (Highton and Worthington 1967).

Past effects of naturally-occurring fires, farming, and timbering operations (which occurred prior to the establishment of Shenandoah National Park in 1936) on the current limited distribution of the Shenandoah salamander are unknown. In its present environment, however, certain threats to this salamander's continued existence appear to be unrelated to human intervention: (1) competition with the aggressive and successful red-backed salamander (Plethodon cinereus), which confines *P. shenandoah* to a few relatively dry talus areas that are not occupied by this competitor (Thurow 1976, Jaeger 1974); and (2) eventual succession of this talus, through weathering and soil formation, to moister habitat, more suitable for occupation by red-backs (Jaeger 1970). Plethodon cinereus is widely distributed and completely surrounds each of the three isolates of *P. shenandoah* (Highton and Worthington 1967, W. Witt pers. comm.). It appears to be expanding its geographic range at the expense of several other species of salamanders (Highton 1972, Jaeger 1974). More recent threats to the Shenandoah salamander include defoliation of trees within its habitat, associated with outbreaks of gypsy moths (*Lymantria dispar*), hemlock woolly adelgids (*Adelges tsugae*), or other introduced forest pest species, and further debilitation of overstory vegetation, changes in soil chemistry, and direct impacts to the salamanders associated with acid deposition and other sources of air pollution. Use of herbicides on powerline right-of-ways within the vicinity of salamander habitat may have detrimental effects to the species. General recreation in the park, illegal camping, and fire management activities may also be threats to the species.

EB/CE Source: U.S. Fish and Wildlife Service. 1994. Shenandoah Salamander (Plethodon shenandoah) Recovery Plan. Hadley, Massachusettes. 36 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: The Shenandoah salamander is expected to experience direct effects from exposure to malathion (mortality) for individuals exposed and there is also risk of mortality to the salamander associated with loss of invertebrate prey items exposed to malathion.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

(Anticipated usage within the range based on past 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.

We do not have prior usage data for the Shenandoah salamander given its distribution on remote portions of Federal lands. Therefore, there is no overlap information or estimated usage in the range from CalPur data or other data sources.

 # acres in species range: 6,879 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 6,879 acres, 100%

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. We anticipate that, in many cases, these buffers will significantly 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 Shenandoah salamander. While this species has a high level of vulnerability, we anticipate very low levels of risk and usage over the duration of the Action. 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. Thus, we do not anticipate species-level effects, as described below.

The Shenandoah salamander has a high vulnerability ranking due to its endangered status, limited distribution, small population size, susceptibility to stochastic events, and habitat changes that may promote range expansion and compentition from the red-backed salamander. However, the species has a low risk ranking due to its presence entirely on remote federally owned conservation 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 Biological Opinion. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Shenandoah salamander based on standard practice and procedures. Likewise, the location of the species on higher elevations in the Shenandoah National Park would generally make the use of pesticides rare or infrequent. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Shenandoah salamander breeds and spends most of its life history in moist sheltered environments where its young develop directly from egg to juvenile without a free-swimming larval stage. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the

Shenandoah salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications though these are expected to be rare given the salamander's protected forest habitats within Shenandoah National Park.

Thus, we anticipate only small numbers of individuals of this species will experience effects to growth and reproduction from small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Shenandoah salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Ambystoma tigrinum stebbinsi	Sonora tiger salamander	201

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: Unknown population trends
Pesticides noted ☐

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

In 2002, at the time that the recovery plan had been finalized, the Sonora tiger salamander the species was known from 53 ponds in the San Rafael Valley of Arizona. Surveys conducted by Arizona Game and Fish Department demonstrate that Sonora tiger salamanders are found at relatively few sites (37 of 139 stock tanks sampled during 2001-2006), consistent with the findings of the recovery plan. As described in the recovery plan, these sites are all impoundments created as livestock waters that require periodic maintenance.

The historical habitats of the subspecies have either disappeared or are occupied by nonnative fishes with which Sonora tiger salamanders cannot coexist. Not enough years of survey data are available to assess population trends. Threats to Sonora tiger salamanders include the following: 1) restricted distribution, 2) disappearance of natural standing water habitat, 3) predation by non-native fish, bullfrogs, and crayfish, 4) genetic swamping by introduced, non-native barred tiger salamanders, 5) disease, 6) low genetic diversity, and 7) collection for bait or translocation by anglers.

EB/CE Source: U.S. Fish and Wildlife Service. 2007. Sonora Tiger Salamander (*Ambystoma tigrinum stebbinsi*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office, Phoenix, Arizona. U.S. Fish and Wildlife Service. 2002. Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) recovery plan. U.S. Fish and Wildlife Service, Phoenix, Arizona. iv + 67 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:

Terrestrial Phase: Sonora tiger salamanders exposed to malathion at maximum rates from consumption of terrestrial invertebrates on use sites with higher application rates (e.g., developed, open space developed) are expected to die. Effects due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	1%	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	1% (G, R – low effects)	G – M R – M B – M
Direct spray or contact with contaminated media	Mortality if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	1% invertebrates	
Spray drift areas - Prey item mortality	Up to 3%	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	No effects expected
Indirect	No effects expected	No effects expected

Risk modifiers:

Allowable uses driving effects/other considerations: Overlap with developed and open space developed use are responsible for almost all of the anticipated effects.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	N	0	0.00	0	0.00	5,6	*,*
Open Space Developed	D, I	6,454	1.01	323	0.05	5,6	*,*
Developed	D, I	2,516	0.39	126	0.02	5,6	M,M
Other Crops	I	852	0.13	0	0	5,6	H,H
Orchards and Vineyards	D, I	78	0.01	78	0.01	5,6	H,H
Pasture	I	59	0.01	56	0.01	5,6	H,H
Cotton	D, I	13	<0.01	8	<0.01	5,6	H,H
Corn	I	10	<0.01	10	<0.01	5,6	H,H
Vegetables and Ground Fruit	I	5	<0.01	5	<0.01	5,6	H,H
Other Grains	I	4	<0.01	4	<0.01	5,6	H,H
Wheat	I	2	<0.01	2	<0.01	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		9062	1.41	523	0.08		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		9994	1.56	611	0.10		
TOTAL[4]:		9994	1.56	607	0.10		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

[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: 640,933 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 401,045 acres, 63%

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 Sonora tiger salamander. As discussed below, even though the vulnerability is 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Sonora tiger salamander has a high vulnerability ranking due to its endangered status, limited distribution, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss of suitable natural habitats). The species has a low risk ranking from labeled uses across the range, with less than 1% estimated usage across the range. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult).

For aquatic life stages, any exposure from use sites applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low based on the usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

Estimated usage on non-Federal portions of the range is limited to less than 1% of the species range and estimated overlap of use with the species range is also low, at approximately 1.5%. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Sonora tiger salamander based on standard practice and procedures. Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Sonora tiger salamanders breed in ponds and spends most of its life history in moist crevices, animal burrows, and rotted logs in or around ponds. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Sonora tiger salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality or effects to growth and reproduction (i.e., through direct exposure or through contaminated prey) and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Sonora tiger salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Bufo hemiophrys baxteri	Wyoming toad	202

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 Wyoming toad formerly inhabited floodplain ponds and small seepage lakes associated with the Laramie River. Current distribution is limited to the Laramie Plains, specifically at the Mortenson Lake National Wildlife Refuge (Mortenson Lake) and two release sites created under a Safe Harbor Agreement. Limited habitat use has been studied at Mortenson Lake although specific life history remains unknown.

Primary threats at the time of listing (1984) were identified as a limited distribution, habitat manipulation (e.g., irrigation practices, draining of wetlands), pesticide use, disease, and small population size. Primary concerns today include limited distribution and a lack of suitable habitat available for reintroductions, disease (specifically chytridiomycosis, an infectious disease of amphibians caused by the pathogenic fungus, Batrachochytrium dendrobatidis), and small population size. Other concerns include irrigation practices, contaminants (fertilizers, pesticides), and predation.

The effects of pesticides on amphibians have been investigated in recent years in response to the major decline of amphibians worldwide. Although not confirmed, pesticides have been suspected as a cause of population declines of the Wyoming toad. Because the response to each chemical is species specific (Blaustein et al. 13 2002), there is a continuing need to monitor the effects of pesticides commonly used in or near habitat of the Wyoming toad. Any and all applications of pesticides in Albany County are closely coordinated and monitored with Albany County Weed and Pest Control (Dickerson 2013 pers. comm.). Several pesticides have been identified as being currently or historically used in Albany County, Wyoming, including malathion. Malathion is applied aerially on properties adjacent to the refuge and other sites within the Wyoming toad's historic range when adult mosquito populations are high. Low concentrations of malathion due to aerial drift have been documented on Wyoming toad reintroduction sites (Dickerson et al. 2003). The Service anticipates that the current level of malathion in the Laramie Basin is a moderate threat to the Wyoming toad.

EB/CE Source: U.S. Fish and Wildlife Service. 2015. Wyoming Toad Bufo hemiophrys baxteri now known as Anaxyrus baxteri Revised Recovery Plan, May 2015; Original Approved September 11, 1991. U.S. Fish and Wildlife Service, Cheyenne, Wyoming.

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:

Terrestrial Phase: We anticipate individuals exposed from foraging on contaminated arthropods or from direct spray on use sites with higher allowable application rates (e.g., developed and open space developed) to experience sublethal effects to growth and reproduction. Mortality is not expected from exposure to spray drift. Additional effects are also expected from loss of prey.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2 and 5 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	3.7% (G, R – low effects)	G – M R – M B – L
Direct spray or contact with contaminated media	Sublethal effects if exposed	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	6% terrestrial invertebrates	
Spray drift areas - Prey item mortality	Up to 3% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	

MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	M
Indirect	97% terrestrial invertebrates	H

Risk modifiers:

Allowable uses driving effects/other considerations: Overlap with developed and open space developed use sites account for all of the anticipated direct effects.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	I	185,933	96.69	184,361	95.87	2,5	H,H
Other Crops	I	4,079	2.12	4	<0.01	2,5	H,H
Developed	D, I	3,849	2.00	192	0.10	2,5	M,L
Open Space Developed	D, I	3,193	1.66	160	0.08	2,5	*,*
Nurseries	I	29	<0.01	29	<0.01	2,5	H,H
Pasture	I	25	0.01	25	0.01	2,5	H,H
Corn	I	9	<0.01	<1	<0.01	2,5	H,H
Other Grains	I	4	<0.01	4	<0.01	2,5	H,H
Wheat	I	1	<0.01	0	<0.01	2,5	H,H
Vegetables and Ground Fruit	I	1	<0.01	1	<0.01	2,5	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		7,042	3.66	352	0.18		

[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 on terrestrial use sites [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]		11,169	5.81	401	0.21		
TOTAL[4]:		197,103	100	184,762	96.08		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 192,304 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 7,945 acres, 4.13%

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. We anticipate that, in many cases, these buffers will 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 substantially 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

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

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, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Species specific conservation measures:

Where feasible, avoid application. 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 office to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species (FWS points of contact and maps of designated critical habitat 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.

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 Wyoming toad. As discussed below, the vulnerability and risk of mortality are high in the aquatic phase for this species, but we anticipate the likelihood of exposure to malathion to be low, and the implementation of the species-specific and general conservation measures described above are expected to further reduce the likelihood of exposure. EPA and the registrant have incorporated additional measures that are intended to be more protective of the species for agricultural and mosquito control uses, which we previously identified as significant drivers for effects in our February 2021, draft biological opinion. Based on these changes, we do not anticipate species-level effects over the duration of the Action.

The Wyoming toad has a high vulnerability ranking due to its endangered status, limited distribution, small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., pesticide use, loss of suitable natural habitats). The species has a high (modified) risk ranking due to high mortality of invertebrate prey items from mosquito adulticide use. Previously, despite conservation of the Wyoming toad's primary recovery sites, adjacent and nearby areas have been sprayed to control mosquitoes (Geraud and Keinath 2004), and low concentrations of malathion due to aerial drift have been documented on Wyoming toad reintroduction sites (Dickerson etal 2003). While the latter study concluded that concentrations were insufficient to elicit effects to adult toad survival or significantly affect prey, the study acknowledges shortfalls in drawing conclusions about effects to terrestrial prey items, and did not examine effects to aquatic life stages or to terrestrial juveniles. The species' extremely limited distribution makes it unusually susceptible to any stochastic or anthropogenic event, including exposure to malathion, which is noted as a moderate threat to the species (FWS 2015). Estimated usage is high at 96% of the species range and is estimated to account for significant mortality to invertebrate prey from mosquito adulticide use. Aside from mosquito adulticide use and usage, which is not anticipated to result in mortality of individuals (and only moderate sublethal effects for the aquatic life history phase, as described above), we anticipate that other uses and usage of malathion do not represent significant drivers for risk for the Wyoming toad. In addition, species specific measures, including restriction of use of malathion within the habitat of the species, will provide for avoidance and minimization of the risk to food base posed by mosquito adulticide usage.

For aquatic life stages, the exposure pathway is more uncertain as any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to result in effects. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would generally reduce the concentration reaching the species occupied habitat and during the several months of its life history when it is fully aquatic. However, the aquatic life stage vulnerability of this species is high and the risk is high for this species based on labeled uses. That said, we anticipate the species-specific and additional conservation measures above, including rain restrictions, aquatic habitat buffers and residential use label changes will further reduce the likelihood of exposure of the species, its prey, and its habitat.

To reduce the likelihood of exposure from mosquito adulticide usage, a conservation measure will be implemented that restricts this use within the range of the toad. Mosquito control applicators who perform operations while avoiding the range of the Wyoming toad will be in compliance with this measure and no coordination will be required with FWS. If applications are needed to control mosquitos within the Wyoming toad's range, such as due to a public health threat, the applicator must contact the local FWS field office to determine alternative measures to minimize exposure. Discussions at the local level may allow for greater flexibility and less restrictive measures based on site- or species-specific considerations, such as timing, species life history, and geographic or habitat factors. Coordination with FWS on measures to minimize exposure to listed species, including avoidance, is a recognized practice by mosquito control professionals. In its 2021 Best Practices for Integrated Mosquito Management, the American Mosquito Control Association (AMCA) instructs applicators with listed species in their treatment area to coordinate with FWS prior to application and maintain records of interactions. Discussions with the AMCA and anecdotal reports from FWS field offices indicate that this type of coordination is presently occurring to varying degrees for mosquito control applications in general. Applicators subject to this conservation measure will be required to maintain records of their interactions with FWS offices, allowing us to better track this coordination and its outcomes moving forward. For the Wyoming toad specifically, there is already ongoing coordination between the FWS and the Big Laramie mosquito control district, which is required to contact FWS prior to any application near the Mortenson Lake National Wildlife Refuge (Dickerson pers. comm.). This measure will expand upon that ongoing coordination to other suitable habitats within the range of the Wyoming toad where releases of captive toads continue to expand the occupied habitat of this species. We expect that the species-specific restriction, as described above, on mosquito adulticide use within the habitat of the Wyoming toad will significantly reduce the likelihood of exposure through this known pathway.

The Wyoming toad breed in ponds and spends most of its life history in short grass, abandoned animal burrows, and rotted logs in or around ponds, creeks and lakes. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Wyoming toad when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. We anticipate that the mosquito adulticide use restrictions will significantly reduce or preclude entirely application for mosquito adulticide applications so that we do not anticipate species-level effects to occur.

In summary, we expect effects to the Wyoming toad's prey base from malathion usage for mosquito adulticide will be significantly limited through incorporation of use restrictions. Thus, we expect exposure of individual toads and their 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 their prey base. Therefore, we do not anticipate that the proposed Action would appreciably reduce survival and recovery of the Wyoming toad.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Ambystoma californiense	California tiger Salamander (Sonoma DPS)	203

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 historical range of the Sonoma County California tiger salamander included the Santa Rosa Plain and Petaluma lowlands, an area approximating 100,000 acres. Prior to alteration of the Santa Rosa Plain by humans, the landscape contained numerous vernal pools scattered across an area dominated by oak savannah, and representing a large, mostly continuous mosaic of suitable upland and aquatic habitat. By the mid-1990s, it was estimated that vernal pool habitat on the Plain had been reduced by more than 80 percent (Patterson et al. 1994). Growth of the human population on the Santa Rosa Plain has taken place for over 100 years. For the past 20 years, the encroachment of high- and low-density urban growth into areas inhabited by the Sonoma County California tiger salamander has intensified and the loss of seasonal wetlands to development has led to population declines for the species. Voters in local municipalities have established urban growth boundaries for their communities. This action is intended to accomplish the goal of city-centered growth, resulting in conservation of rural and agricultural land uses between the urbanized areas. Nevertheless, areas within the defined urban growth boundaries include lands currently inhabited by Sonoma County California tiger salamander, and such growth continues to threaten the species. The current core range of Sonoma County California tiger salamander encompasses approximately 18,000-20,000 acres of fragmented habitat. This distribution has been curtailed primarily in two areas in recent times: the Santa Rosa Air Center area (southwest Santa Rosa) where observations have decreased since the early 1990s; and in the south Cotati area, where salamanders were once commonly observed in the late 1980s to early 1990s (D. Cook, in litt, 2009).

At the time of listing, we determined that the primary cause for the decline of the Sonoma County California tiger salamander was loss, degradation, and fragmentation of habitat as the result of urbanization (FWS 2003). It is estimated that, by 1990, 25 percent of the 28,000-acre range of this DPS within the Plain had been converted to subdivisions, ranchettes, golf courses, and commercial buildings, while an additional 17 percent of this area had been converted to agricultural uses (Waaland et al. 1990). Sonoma County California tiger salamander habitat is also degraded by certain activities, including measures to control burrowing rodents and alteration of hydrology due to wastewater irrigation (effluent disposal), as well as proliferation of dense invasive weeds that overtake vernal pool habitats in the absence of grazing or mowing. Climate change was not considered a threat to California tiger salamanders at the time of listing (FWS 2003). However, current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, IPCC 2013). Because California experiences highly variable annual rainfall events and droughts, California tiger salamanders adapted a life history strategy to deal with inconsistent environmental conditions. Predation by bullfrogs, western mosquito fish, and non-native tiger salamanders continue to threaten the species. At the time of listing, mortality from road crossings was deemed a threat to the Sonoma County California tiger salamander (FWS 2003). Mortality from road crossings has been well documented in Sonoma County (D. Cook, in litt, 2011; D. Cook, in litt, 2009). Contaminants were considered a threat to California tiger salamanders at the time of listing (FWS 2003). Mosquito control continues to threaten the Sonoma County California tiger salamander through the introduction of mosquito fish into the environment and the use of methoprene and Bacillus thuringiensis israeli (Bti). The listing of the California tiger salamander, following endangered designation of the three listed Santa Rosa Plain plants, caused a level of uncertainty for local jurisdictions, landowners, and developers regarding their activities in the presence of endangered species. Consequently, the Santa Rosa Plain Conservation Strategy (Strategy; USFWS, 2005) was developed by the FWS, CA Department of Fish and Game, the Army Corps of Engineers, U.S. Environmental Protection Agency, Regional Water Quality Control Board, and local jurisdictions, interest groups, and community representatives in order to coordinate development with the conservation needs of the species (USFWS 2005). In addition, since the Sonoma County California tiger salamander was listed, multiple conservation banks have been established and vernal pool and grassland habitat have been protected with conservation easements. However, current preserve sizes for remnant populations are insufficient to support stable metapopulation dynamics.

EB/CE Source: U.S. Fish and Wildlife Service. 2016. Recovery Plan for the Santa Rosa Plain: *Blennosperma bakeri* (Sonoma sunshine); *Lasthenia burkei* (Burke's goldfields); *Limnanthes vinculans* (Sebastopol meadowfoam); California Tiger Salamander Sonoma County Distinct Population Segment (*Ambystoma californiense*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. vi + 128 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:

Terrestrial Phase: The California tiger salamander (Sonoma DPS) is expected to experience mortality from malathion exposure at maximum rates on use sites. . Mortality is not expected from exposure to spray drift, but effects from loss of prey are anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	Mortality	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	Effects to growth, reproduction	G – M R – M B – L
Direct spray or contact with contaminated media	Mortality if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	Mortality of terrestrial invertebrates, reptiles, and amphibians	
Spray drift areas - Prey item mortality	Mortality of terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	M
Indirect	Mortality of terrestrial invertebrates, reptiles and amphibians	H

Risk modifiers:

The California tiger salamander (Sonoma DPS) is restricted to grasslands and low foothills with pools or ponds that are necessary for breeding, and spends most of its life on land. They are poor burrowers and require refuges provided by other animals. California tiger salamanders enter a dormant state called estivation during the dry months. They come out of their burrow around November.

Adults mostly eat insects. Larvae have a broader diet including algae, mosquito larvae, tadpoles and insects.

Allowable uses driving effects/other considerations: Prior to finalizing this Biological Opinion, we discovered that the overlap of malathion use sites with the species range was calculated based on an inaccurate range map for this species. As a result, we did not carry forward the overlap values from the draft Opinion into this final Opinion. Instead, we qualitatively estimated the types and extent of malathion use sites occurring within the range by visually examining mapped crop data layers in proximity to the species range and, where available, considering information regarding habitat preferences and likely locations of individuals and populations.

Malathion use sites within the range of the California tiger salamander (Sonoma DPS) include developed, open space developed, and orchards and vineyards.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Agricultural usage based on CalPUR data:

For estimation of usage, we considered county-level CalPUR data for agriculture, county level sales and usage data for mosquito adulticide, and developed and open space developed usage consistent with our overall estimates for listed species.

Information from CalPUR indicates that a small number of acres of cropland (0 – 171 acres) in Sonoma County were treated with malathion annually from 2012 – 2018. Overall, orchards and vineyards (primarily grapes, with some usage on walnuts) tended to account for most treated acres. In addition, we estimate that up to 5% of developed and open space developed use sites within the species range could undergo some level of treatment with malathion. For mosquito control, neither CalPUR data nor sales data indicate past usage of malathion for this use within Sonoma county for the 5 years of data available.

 # acres in species range: not available
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: not available

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. We anticipate that, in many cases, these buffers will significantly 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 California tiger Salamander (Sonoma DPS). As discussed below, even though the vulnerability is 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The California tiger Salamander (Sonoma DPS) has a high vulnerability ranking due to its endangered status, declining population, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss, degradation, and fragmentation of habitat as the result of urbanization). The species has a medium risk ranking from labeled uses across the range, primarily from mortality on use sites and effects to prey on and near use sites, and from mosquito adulticide use. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). We anticipate the species' susceptibility to adverse effects from pesticides and exposure given its remaining habitat's proximity to pressures from and the threat of additional urbanization.

However, estimated malathion usage within Sonoma County where the species resides is low; (based on CalPur data) we anticipate limited exposure of the California tiger salamander (Sonoma DPS) and therefore limited risk of mortality to individuals and effects to prey associated with malathion use.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low based on the CalPur usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Much of the land in Sonoma County is privately owned and any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the California tiger salamander (Sonoma DPS) based on standard practice and procedures.

We anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers will further reduce the likelihood of exposure of the species, their prey, and their habitat. The California tiger salamander breeds in ephemeral ponds and spends most of its life history in moist crevices, abandoned animal burrows, and rotted logs in or around ponds in grasslands and oak savanna habitats. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the California tiger salamander when the animals are most active (e.g., following a precipitation event, particularly the initial event seasonally). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations by limiting applications to spot treatments and reduces the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used and resulting amounts of runoff and drift in developed and open space developed areas. Combined, these conservation measures substantially reduce exposure to the California tiger salamander and its prey base.

Thus, although we anticipate small numbers of individual salamanders would be lost over the duration of the action, and small numbers of individuals will experience small reductions in their prey base resulting in decreased fitness related to survival and growth, we do not anticipate species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the California tiger Salamander (Sonoma DPS).

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the California tiger Salamander (Sonoma DPS).

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Anaxyrus californicus	Arroyo (=arroyo southwestern) toad	204

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:

Arroyo toads were once relatively abundant in coastal central and southern California. Arroyo toads historically were known to occur in coastal drainages in southern California from the upper Salinas River system in Monterey and San Luis Obispo Counties; south through the Santa Maria and Santa Ynez River basins in Santa Barbara County; the Santa Clara River basin in Ventura County; the Los Angeles River basin in Los Angeles County; the coastal drainages of Orange, Riverside, and San Diego Counties; and south to the Arroyo San Simeon system in Baja California, Mexico (Sweet 1992, p. 18; FWS 1999, p. 12). Currently, arroyo toads are limited to isolated populations found primarily in the headwaters of coastal streams along the central and southern coast of California and southward to Rio Santa Maria near San Quintin in northwestern Baja California, Mexico (Lovich 2009, p. 62). Arroyo toads are still extant within the range they occupied historically and at the time of listing, but new data indicate that the species has continued to decline in numbers and in area occupied within its current range (Hancock 2007–2014, entire; Hollingsworth in litt. 2014; USGS in litt. 2014; Sweet 2015, pers. comm.; USGS 2015, pers. comm.). Overall, we recognize 25 river basins in the United States and an additional 10 river basins in Baja California, Mexico, as containing at least one extant population of arroyo toads (FWS 2015). At the time of listing, the primary threats to arroyo toads were urban development, agricultural conversion, operations of dams and water flow, roads and road maintenance, recreational activities, introduced predator species, and drought (59 FR 64859; December 16, 1994). Other threats identified in 1994 included livestock grazing, mining and prospecting, and alteration of the natural fire regime (59 FR 64859). Current and potential future threats to arroyo toads include urban development, agriculture, operation of dams and water diversions, mining and prospecting, livestock grazing, roads and road maintenance, recreation, invasive, nonnative plants, disease, introduced predator species, drought, fire and fire suppression, and climate change.

EB/CE Source: U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants; Withdrawal of Proposed Rule to Reclassify the Arroyo Toad as Threatened. Federal Register, Vol. 80, No. 246, 79805-79816.; U.S. Fish and Wildlife Service. 2014. Arroyo Toad (*Anaxyrus californicus*), Species Report. Ventura Fish and Wildlife Office, Ventura, CA.; U.S.

Fish and Wildlife Service. 1999. Arroyo southwestern toad (*Bufo microscaphus californicus*) recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. vi + 119 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:

Terrestrial Phase: Individual Arroyo toads exposed to malathion at maximum rates on use sites with higher allowable use rates are expected to experience sublethal effects from foraging on contaminated arthropods or exposure to direct spray.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses. We anticipate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 2% mortality of individuals and 55% mortality of prey items from mosquito control efforts if exposed.

DIRECT (all uses except mosquito control)	Terrestrial	Aquatic
Use areas – mortality	Mortality	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	Effects to growth and reproduction	G – M R – M B – M
Direct spray or contact with contaminated media	Sublethal effects if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	Mortality of terrestrial invertebrates	
Spray drift areas - Prey item mortality	Mortality of terrestrial invertebrates	H

Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	M
Indirect	No effects expected	H

Risk modifiers:

Arroyo toads are breeding habitat specialists and need slow moving streams that are composed of sandy soils with sandy streamside terraces. Reproduction is dependent upon the availability of very shallow, still, or low-flow pools in which breeding, egg laying, and tadpole development occur.

Allowable uses driving effects/other considerations: Prior to finalizing this Biological Opinion, we discovered that the overlap of malathion use sites with the species range was calculated based on an inaccurate range map for this species. As a result, we did not carry forward the overlap values from the draft Opinion into this final Opinion. Instead, we qualitatively estimated the types and extent of malathion use sites occurring within the range by visually examining mapped crop data layers in proximity to the species range and, where possible, considering information regarding habitat preferences and likely locations of individuals and populations.

A visual inspection of cropland data layers indicates that developed and open space developed use sites have the most overlap with the range of this species. A smaller percentage of the frog's range overlaps with agricultural areas, particularly crops within the vegetables and ground fruit UDL.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

For estimation of usage, we considered county-level CalPUR data for agriculture, county level sales and usage data for mosquito adulticide, and developed and open space developed usage consistent with our overall estimates for listed species

Information from CalPUR indicates that malathion usage has occurred on crops within the range of the Arroyo toad within the vegetables and ground fruit categories in the non-federal portion of the species' range. We estimate that up to 5% of developed and open space developed use sites within the species range could undergo some level of treatment with malathion. For mosquito adulticide, neither CalPUR data nor sales data indicate past usage of malathion within the counties where the toad's range is located for the 5 years of data available.

Agricultural usage based on CalPUR data:

 # acres in species range: not available
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: not available

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied,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 ground fruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Arroyo toad. 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, 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Arroyo toad has a high vulnerability ranking due to its endangered status, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss, degradation, and fragmentation of habitat as the result of urbanization and agriculture). The species has a medium risk ranking from labeled uses across the range, primarily from effects to prey from use and spray drift areas. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). We anticipate the species' susceptibility to adverse effects from pesticides and exposure given its remaining habitat's proximity to pressures from and the threat of additional urbanization. However, estimated usage is limited within the species range (based on CalPur data) and we anticipate that the usage information represents the more reliable information regarding exposure of this species.

For aquatic life stages, any exposure from use sites would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. While the Arroyo toads utilize ephemeral floodplain pools adjacent lower gradient small to medium sized streams or rivers for reproduction, individuals are fully aquatic (i.e., egg or tadpole) for a few months of their life history which would limit exposure. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high and the risk is medium for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Arroyo toad based on standard practice and procedures. We anticipate limited exposure of the Arroyo toad resulting from agricultural usage and effects to prey items associated with malathion use.

We anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Arroyo toad breeds in its namesake seasonal ponds or off-channel pools adjacent to rivers or creeks. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Arroyo toad when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, changes to the residential use label are expected to reduce environmental concentrations by limiting applications to spot treatments and reducing the number of applications per year (2-4), significantly decreasing the overall amounts of malathion used and resulting amounts of runoff and drift in developed and open space developed areas.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Arroyo toad.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Rana draytonii	California red-legged frog	205

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

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

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

The historic range of the California red-legged frog extended from the vicinity of Elk Creek in Mendocino County, California, along the coast inland to the vicinity of Redding in Shasta County, California, and southward to northwestern Baja California, Mexico (Fellers 2005; Jennings and Hayes 1985; Hayes and Krempels 1986). The species was historically documented in 46 counties but the taxa now remains in 238 streams or drainages within 23 counties, representing a loss of 70 percent of its former range (FWS 2002). California red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the Central California Coast. Isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. The species is believed to be extirpated from the southern Transverse and Peninsular Ranges, but is still present in Baja California, Mexico (CDFW 2015). Habitat loss, non-native species introduction, and urban encroachment are the primary factors that have adversely affected the California red-legged frog throughout its range. Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs in systems supporting bullfrogs (Jennings and Hayes 1990, Twedt 1993), red swamp crayfish, signal crayfish, and several species of warm water fish including sunfish, goldfish, common carp, and mosquitofish (Moyle 1976, Barry 1992, Hunt 1993, Fisher and Schaffer 1996). This has been attributed to predation, competition, and reproduction interference. The urbanization of land within and adjacent to California red-legged frog habitat has also affected the threatened amphibian. These declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks dispersal, and the introduction of predatory fishes and bullfrogs. Diseases may also pose a significant threat, although the specific effects of disease on the California red-legged frog are not known.

EB/CE Source: U.S. Fish and Wildlife Service. 2002. Recovery Plan for the California Red-legged Frog (Rana aurora draytonii). U.S. Fish and Wildlife Service, Portland, Oregon. viii + 173 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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on use sites with higher allowable application rates are expected to experience mortality from foraging on contaminated arthropods. We expect sublethal effects to some individuals would occur if exposed to direct spray. Mortality is not expected from exposure to spray drift. Effects due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2, 3 5 and 6 would be at high risk of mortality with bin 7 having a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	12% mammals, 8% terrestrial invertebrates, 0% amphibians	
Spray drift areas – mortality	No effects anticipated	
Sublethal – growth (G), reproduction (R) and behavior (B)	13-21% (G, R - low effects; mammals and terrestrial invertebrates), 6-13% (G, R – high effects); no effects from consumption of amphibians	G – M R – L B – M
Direct spray or contact with contaminated media	Sublethal effects if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	20% terrestrial invertebrates, reptiles, amphibians, no effects to mammals	
Spray drift areas - Prey item mortality	Effects to terrestrial invertebrates, amphibians, reptiles	H

Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	L
Indirect	53% terrestrial invertebrates, 5% reptiles and amphibians, no effects to mammals	H

Risk modifiers: The California red-legged frog breeds in standing bodies of fresh water (salinity less than 4.5 parts per thousand) including natural and manmade (e.g., stock) ponds, slow-moving streams or ponds within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest of years. Breeding occurs during or after large rain events in late winter and early spring between November and April. Egg masses are attached to a brace such as emergent vegetation or roots and twigs. Eggs develop into tadpole in 20 to 22 days.

Tadpoles are both active both diurnally and nocturnally feeding on algae, organic debris, plant tissue, and minute organisms. Larvae undergo metamorphosis 3.5 to 7 months after hatching, however certain individuals have been shown to overwinter as metamorphs. Juveniles and adults start moving to upland habitats based on environmental conditions and existence of suitable corridors facilitating their movement. Dispersal habitat requires accessible upland and riparian habitat that includes various natural habitat and altered habitats, such as agricultural fields, that do not contain barriers such as heavily traveled roadways without bridges or culverts.

The California red-legged frog is the largest native frog of the western United States. Their diet is opportunistic and generalist insectivore and carnivore. Food items include invertebrates and vertebrates including Pacific tree frogs (*Hyla regilla*) and California mice (*Peromyscus californicus*). Feeding activity likely occurs along the shoreline and on the surface of the water.

Adults occupy aquatic habitats, such as ephemeral freshwater ponds and stream habitats, that provide shelter, foraging, predator avoidance, and aquatic dispersal of juvenile and adult frogs. Other types of aquatic habitat include plunge pools within intermittent creeks, seeps, quiet water refugia within streams during high water flow, and springs of sufficient flow to withstand short-term dry periods. Upland areas adjacent to, or surrounding breeding and up to a distance of 1 mile in most cases including various vegetational types, such as grassland, woodland, forest, wetland, and riparian areas that provide shelter, forage, and predator avoidance for the California red-legged frog. Upland habitat should include structural features such as boulders, rocks, and organic debris (e.g., downed trees, logs), small mammal burrows, and moist leaf litter.

Allowable uses driving effects/other considerations: The range of the California red-legged frog overlaps with numerous use sites. Of those, orchards and vineyards, developed, and developed open space contribute most to anticipated mortality and sublethal effects. However, the maximum application rate used to calculate effects for orchards and vineyards is not completely representative of usage for this category within the range of the California red-legged frog and therefore likely over-estimates effects.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

As described 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, and that 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)

Agricultural usage based on CalPUR data:

Use type	Risk to species on terrestrial use sites [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	I	27,611,025	52.51	261,900	0.50	2,3,5,6,7	H,H,H,M,M
Orchards and Vineyards	D, I	3,420,203	6.51	32,262	0.06	2,3,5,6,7	H,H,H,H,H
Developed	D, I	1,747,862	3.32	87,393	0.17	2,3,5,6,7	M,M,M,L,L
Other Crops	D, I	1,652,762	3.14	41	<0.001	2,3,5,6,7	H,H,HH,M
Open Space Developed	D, I	1,634,260	3.11	81,713	0.16	2,3,5,6,7	*,*,*,*,*
Pasture	D, I	693,760	1.32	48,338	0.092	2,3,5,6,7	H,H,H,H,M
Wheat	D, I	606,468	1.15	7,100	0.014	2,3,5,6,7	H,H,H,H,M
Rice	*	503,667	0.96	904	0.002	2,3,5,6,7	*,*,*,*,*
Vegetables and Ground Fruit	D, I	479,715	0.91	101,252	0.193	2,3,5,6,7	H,H,H,H,M
Other Grains	D, I	366,525	0.70	2,597	0.005	2,3,5,6,7	H,H,H,H,M
Cotton	D, I	246,551	0.47	14,905	0.028	2,3,5,6,7	H,H,H,H,M

[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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Corn	D, I	201,711	0.38	1,466	0.014	2,3,5,6,7	H,H,H,H,M
Sub-TOTAL (D): *Other uses with direct effects*[3]		11,049,816	21.02	377,067	0.736		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		11,049,816	21.02	377,067	0.736		
TOTAL[4]:		38,660,841	73.53	638,967	1.236		

See above for updated bin 3 and 4 considerations.

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 52,578,029 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 18,044,394 acres, 34%

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. We anticipate that, in many cases,

[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.

these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 California red-legged frog. As discussed below, even though the vulnerability is medium and risk is 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The California red-legged frog has a medium vulnerability ranking due to its threatened status, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss, degradation, and fragmentation of habitat as the result of urbanization and agriculture). The species has a high risk ranking from labeled uses across the range, primarily from orchards and vineyards, developed, and developed open space use overlap that contribute most to anticipated mortality and sublethal effects. California red-legged frogs exposed to malathion at maximum rates on use sites will experience <1 to 79% mortality. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). We anticipate the species' susceptibility to adverse effects from pesticides, likely continued exposure to malathion use sites specifically, and its exposure given its remaining habitat's proximity to pressures from and the threat of additional urbanization. However, estimated usage is limited to 1.2% of the species range (based on CalPur data). Estimated overlap of use with the species range is high, in excess of 73% (primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low. We don't anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the California red-legged frog based on standard practice and procedures. We anticipate limited exposure of the California red-legged frog resulting from agricultural usage and effects to prey items associated with malathion use.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The California red-legged frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, marshes). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the California red-legged frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the California red-legged frog.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Lithobates chiricahuensis	Chiricahua leopard frog	206

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:

In Arizona, recent survey data indicate that populations are increasing. Results of surveys indicate that there were 83 extant sites in 2002, 85 in 2008 and 92 in 2009. In conclusion, there is no evidence of decline in Arizona, rather, the data suggest a least modest increases. In New Mexico, monitoring of Chiricahua leopard frog populations from 1994 to 2010, found a total of 71 occupied sites. Since 1994, at least 42 of these sites have been extirpated, accounting for 59 percent of the known sites in a 16-year period. At present, the FWS is aware of 11 extant reproductive sites (1 of which is a robust metapopulation, and 2 of which are on private land and have not been monitored in recent years but thought to be extant); 10 sites with low population numbers or possible extirpation; 6 dispersal areas; and 2 sites where the status is unknown. These numbers include dispersal sites, most often comprised of a single juvenile frog, with no observed reproduction. The status of the Chiricahua leopard frog in New Mexico is thought to be declining. However, recovery actions in New Mexico have focused on creating off-site refugia populations. As of 2010, the FWS has attempted to establish eight refugia populations. Two of the source populations for the eight refugia sites have since experienced die-off and are extirpated. Other conservation measures include captive breeding and release, a Safe Harbor Agreement implemented by Arizona Game and Fish Department, habitat improvements and control of non-native predators. Habitat threats that remain important today are degradation and loss of habitat as a result of drought, water diversions and groundwater pumping; livestock management that degrades frog habitat; a history of fire suppression and grazing that has increased the likelihood of crown fires; mining; development; environmental contamination; disruption of metapopulation dynamics via physical blockage of dispersal corridors; and the dynamic nature of frog habitats. Although these threats are widespread and varied, a threats assessment that was accomplished as part of the recovery plan showed predation by non-native species (American bullfrogs, crayfish, salamanders, and fish species) and chytridiomycosis as consistently more important threats than these habitat-based factors (USFWS 2007). Other natural or manmade factors affecting the species continued existence include small population size and climate change.

EB/CE Source: U.S. Fish and Wildlife Service. 2011. Chiricahua Leopard Frog (Lithobates chiricahuensis) 5-Year Review : Summary and Evaluation. U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Pheonix, Arizona. U.S. Fish and Wildlife Service. 2007. Chiricahua Leopard Frog (Rana chiricahuensis) Recovery Plan. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM. 149 pp. + Appendices A-M.

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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on use sites are expected to experience low levels of mortality and sublethal effects to growth and reproduction. Mortality is not expected from exposure to spray drift. Effects due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2, 3, 4, 5 and 6 would be at high risk of mortality while those exposed in bin 7 are anticipated to have a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	<1% birds, no effects expected from other dietary items (terrestrial invertebrates, fish, amphibians)	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	<1% (G, R – low effects, terrestrial invertebrates; high effects - birds)	G – M R – L B – M
Direct spray or contact with contaminated media	Sublethal effects if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		

Use areas - Prey item mortality	<1% invertebrates, birds, fish, and amphibians	
Spray drift areas - Prey item mortality	Up to 4% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	10% (R – low effects, birds only; no effects from other dietary items)	
Indirect	10% invertebrates, fish, and amphibians; no effects to birds	H

Risk modifiers: Chiricahua leopard frogs are not expected to enter agricultural use sites.

Allowable uses driving effects/other considerations: Overlap with developed and open space developed accounts for effects to Chiricahua leopard frogs on use sites.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.As described 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, and that 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 on terrestrial use sites [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	3,898,218	10.49	0	0	2,3,4,5,6,7	H,H,H,H,M,L
Other Crops	*	337,788	0.91	0	0	2,3,4,5,6,7	H,H,H,H,H,M
Open Space Developed	D, I	162,591	0.44	8,130	0.02	2,3,4,5,6,7	*,*,*,*,*
Developed	D, I	84,231	0.23	4,212	0.01	2,3,4,5,6,7	M,M,M,M,L,L
Pasture	*	54,719	0.15	31,504	0.08	2,3,4,5,6,7	H,H,H,H,H,M
Cotton	*	32,176	0.09	9,988	0.03	2,3,4,5,6,7	H,H,H,H,H,H
Corn	*	28,764	0.08	279	<0.01	2,3,4,5,6,7	H,H,H,H,H,M
Other Grains	*	24,050	0.06	5,998	0.02	2,3,4,5,6,7	H,H,H,H,H,M
Orchards and Vineyards	D, I	16,012	0.04	2,111	0.01	2,3,4,5,6,7	H,H,H,H,H,M
Vegetables and Ground Fruit	*	11,858	0.03	2,711	0.01	2,3,4,5,6,7	H,H,H,H,H,M
Wheat	*	9,283	0.02	9,083	0.02	2,3,4,5,6,7	H,H,H,H,M,M
Nurseries	D, I	127	0.00	127	<0.01	2,3,4,5,6,7	H,H,H,H,H,M
Sub-TOTAL (D): *Other uses with direct effects*[3]		262,961	0.71	14,579	0.04		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		262,961	0.71	14,579	0.04		
TOTAL[4]:		4,161,179	11.20	14,579	0.04		

See above for updated bin 3 and 4 considerations.

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the terrestrial invertebrate prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 37,147,353 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 17,528,205 acres, 47%

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. We anticipate that, in many cases, these buffers will significantly 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Chiricahua leopard frog. As discussed below, even though the vulnerability is medium and risk is 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 Chiricahua leopard frog has a medium vulnerability ranking due to its threatened status, susceptibility to stochastic events, declining populations (in New Mexico), and anthropogenic threats to the species (e.g., loss, degradation, and fragmentation of habitat as the result of urbanization and agriculture). The species has a low risk ranking from labeled uses across the range and is anticipated be minimally affected by prey item contamination (<1% of frogs consuming birds). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is limited to <1% of the species range. Estimated overlap of use with the species range is 11% (primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species. Chiricahua leopard frogs are not expected to enter agricultural use sites.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Chiricahua leopard frog based on standard practice and procedures. We anticipate limited exposure of the Chiricahua leopard frog resulting from agricultural usage and effects to prey items associated with malathion use. Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Chiricahua leopard frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, marshes). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Chiricahua leopard frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Chiricahua leopard frog.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Rana muscosa	Mountain yellow-legged frog (Southern CA DPS)	207

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); Declining population(s) – one or more populations declining
Species Trends: Unknown population trends
Pesticides noted ☐

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

Historically, the northern DPS of the mountain yellow-legged frog ranged from the Monarch Divide in Fresno County as far southward as Breckenridge Mountain, in Kern County (Vredenburg et al. 2007, p. 371). The historical ranges of the two frog species within the mountain yellow-legged complex meet each other roughly along the Monarch Divide to the north, and along the crest of the Sierra Nevada to the east. Because we have determined that the historic range of *R. muscosa* is entirely within the State of California, in this final rule we correct the listing for the southern DPS of the mountain yellow-legged frog to remove Nevada from its historic range. Since the time of the mountain yellow-legged frog observations of Grinnell and Storer (1924, pp. 664–665), a number of researchers have reported disappearances of these species from a large fraction of their historical ranges in the Sierra Nevada (Hayes and Jennings 1986, p. 490; Bradford 1989, p. 775; Bradford et al. 1994, pp. 323–327; Jennings and Hayes 1994, p. 78; Jennings 1995, p. 133; Stebbins and Cohen 1995, pp. 225–226; Drost and Fellers 1996, p. 414; Jennings 1996, pp. 934–935; Knapp and Matthews 2000, p. 428; Vredenburg et al. 2005, p. 564). The most pronounced declines within the mountain yellow-legged frog complex have occurred north of Lake Tahoe in the northernmost 125-km (78-mi) portion of the range (Sierra Nevada yellow-legged frog) and south of Kings Canyon National Park in Tulare County (the northern DPS of the mountain yellow-legged frog). CDFW (CDFG (CDFW) 2011, pp. 17–20) used historical localities from museum records covering the same time interval (1899–1994), but updated recent locality information with additional survey data (1995–2010) to significantly increase proportional coverage from the Vredenburg et al. (2007) study. These more recent surveys failed to detect any extant frog populations (within 1 km (0.63 mi), a metric used to capture interbreeding individuals within metapopulations) at 220 of 318 historical Sierra Nevada yellow-legged frog localities and 94 of 109 historical northern DPS of the mountain yellow-legged frog localities (in the Sierran portion of their range). This calculates to an estimated loss of 69 percent of Sierra Nevada yellowlegged frog metapopulations and 86 percent of northern DPS of the mountain yellow-legged frog metapopulations from historical occurrences. To summarize population trends over the available historical record, estimates range from losses between 69 to 93 percent of Sierra Nevada yellow-legged frog populations and 86 to 92 percent of the northern DPS of the mountain yellow-legged frog. Fish introductions, dams and water diversions, livestock grazing, timber management, road construction and maintenance, packstock use, recreational activities, and fire management activities may have degraded habitat in ways that have reduced its capacity to sustain viable populations and may have fragmented and isolated mountain yellow-legged frog populations from each other. Other threats include predation by bullfrogs, amphibian pathogens (most specifically, the chytrid fungus), climate change, direct and indirect mortality (e.g.,, trampling by livestock, recreational activities), and small population size.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Sierra Nevada Yellow-Legged Frog and Northern Distinct Population Segment of the Mountain Yellow-Legged Frog, and Threatened Species Status for Yosemite Toad; Final Rule. Federal Register, Vol. 79, No. 82, 24256-24310.

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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on use sites with higher allowable application rates are expected to experience low risk of mortality and sublethal effects to growth and reproduction.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	<1%	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	16% (G, R – low effects)	G – M R – L B – M

Direct spray or contact with contaminated media	Sublethal effects if exposed on use sites	
Volatilization	Additional exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	16% invertebrates	
Spray drift areas - Prey item mortality	Up to 10% invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	37% invertebrates	H

Risk modifiers:

Allowable uses driving effects/other considerations: Overlap with developed and open space developed use sites accounts for most direct effects to the mountain yellow-legged frog.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.As described 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, and that 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)

Agricultural usage based on CalPUR data:

Use type	Risk to species on terrestrial use sites [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	I	1,447,583	36.90	197,359	5.03	2,3	H,H
Developed	D, I	454,561	11.59	22,728	0.58	2,3	M,M
Open Space Developed	D, I	177,858	4.53	8,893	0.23	2,3	*,*
Other Crops	I	6,446	0.16	0	0	2,3	H,H
Orchards and Vineyards	D, I	5,447	0.14	255	0.007	2,3	H,H
Nurseries	D, I	1,374	0.04	240	0.006	2,3	H,H
Pasture	I	859	0.02	0	0	2,3	H,H
Other Grains	I	677	0.02	0	0	2,3	H,H
Wheat	I	446	0.01	0	0	2,3	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		639,239	16.29	32116	0.823		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		647,668	16.51	32116	0.823		
TOTAL[4]:		2,095,250	53.41	229475	5.853		

See above for updated bin 3 and 4 considerations.This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 3,923,306 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 2,406,507 acres, 61%

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

[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.

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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 Mountain yellow-legged frog (Southern CA DPS). As discussed below, even though the vulnerability is high and risk and usage are medium 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Mountain yellow-legged frog (Southern CA DPS) has a high vulnerability ranking due to its endangered status, limited distribution, small population size, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., fish introductions, dams and water diversions, livestock grazing, timber management, road construction and maintenance, packstock use, recreational activities, and fire management activities). The species has a medium risk ranking from labeled uses across the range, primarily from sublethal growth and reproduction effects (16%) from use sites and effects to prey from use and spray drift areas in addition to mosquito adulticide use, (16%, up to 10%, and 37%, respectively). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is limited to 5.8% of the species range (based on CalPur data) and approximately 5% of that is from mosquito adulticide usage. Estimated overlap of use with the species range is high, in excess of 53% (also primarily from mosquito adulticide), but we anticipate the usage information represents the more reliable information regarding exposure of this species. Given the generally higher altitudes and remote mountain ranges inhabited by the Mountain yellow-legged frog (Southern CA DPS), we anticipate the effects to the species are likely overestimated, even utilizing the CalPur dataset.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low based on the CalPur data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Mountain yellow-legged frog (Southern CA DPS) based on standard practice and procedures. We anticipate limited exposure of the Mountain yellow-legged frog (Southern CA DPS) resulting from malathion usage.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Mountain yellow-legged frog (Southern CA DPS) breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., high or low-gradient streams, marshy edges). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Mountain yellow-legged frog (Southern CA DPS) when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications, though these are expected to be of limited consequence given the species' mountainous riparian habitat preference. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth and reproduction, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Mountain yellow-legged frog (Southern CA DPS).

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Rana sevosa	Dusky gopher frog	208

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, the dusky gopher frog was known from Alabama, Louisiana, and Mississppi. Its current distribution is restricted to the state of Mississippi. At the time of listing, only one population of the species was known. Subsequently, two other naturally-occurring populations were discovered. One additional dusky gopher frog population has been established in Mississippi as a result of translocation experiments. Presently, it is estimated that a minimum of 135 individual adult frogs survive in the wild, the vast majority of which occur in the original population known at the time of listing. The dusky gopher frog is an endemic of the longleaf pine ecosystem. Habitat loss and degradation is the primary factor in the loss of historical dusky gopher frog populations in Alabama, Louisiana, and Mississippi. Outside of occupied habitat and those areas managed as potential translocation sites, the remaining parts of the longleaf pine ecosystem within the historical range of the frog continue to decline through fragmentation and destruction, primarily as a result of urbanization from residential and commercial development. In addition, management of remaining natural areas of the longleaf pine ecosystem is inadequate (e.g., limited use of prescribed fire as a management tool). Plant community changes as a result of invasive species such as cogongrass (Imperata cylindrica) and tallow tree (Triadica sebifera) represent an additional threat to the frog's habitat. Optimal terrestrial microhabitat, within burrows of the threatened gopher tortoise, continues to decline as gopher tortoise populations are diminished (Hinderliter 2015). Loss of connectivity between breeding and nonbreeding habitat, loss of wetland habitat, and loss of metapoulations and connectivity between metapopulations is a serious concern. Fire supression and hydrological alterations represent serious threats to dusky gopher breeding sites. Diseases are a threat to the dusky gopher frog. Mortality has been documented from an unnamed protist (Dermomycoides sp., also known as "Perkinsus-like" disease (Green et al. 2003, Jones et al. 2012)). Other disease threats potentially include chytrid fungus and ranaviruses. Non-native predators, such as introduced fish and red imported fire ants (Solenopsis invicta), are currently a threat to the frog. Pesticides and herbicides commonly used in habitat management pose a threat to amphibians such as the dusky gopher frog, because their permeable eggs and skin readily absorb substances from the surrounding aquatic or terrestrial environment (Duellman and Trueb 1986). Negative effects of commonly used pesticides and herbicides on amphibian larvae include delayed metamorphosis, paralysis, reduced growth rates, and mortality (Bishop 1992, Berrill et al. 1997, Bridges 1999). Sublethal levels of chemical contamination can alter juvenile recruitment in amphibian populations (Bridges and Semlitsch 2000, Rohr et al. 2013). Herbicides may alter the density and species composition of vegetation surrounding a breeding site and reduce the number of potential sites for egg deposition, larval development, or shelter for migrating frogs. For the reasons described above, the USFWS and our private and Federal partners who own property occupied by the dusky gopher frog are vigilant in the approval and use of any pesticides and/or herbicides on these sites. Additional threats described in the recovery plan include habitat fragmentation, low reproductive potential, and changes induced from climate change (e.g., drought). The Desoto National Forest has implemented conservation actions to create, enhance and restore both aquatic and upland habitat for the dusky gopher frog for future translocations. In addition, the Nature Conservancy has implemented restoration activities on their property, through funding from the Natural Resources Conservation Service, to improve frog habitat that support's Mike's Pond.

EB/CE Source: U.S. Fish and Wildlife Service. 2015. Dusky Gopher Frog (*Rana sevosa*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Mississippi Ecological Services Field Office, Jackson, Mississippi. U.S. Fish and Wildlife Service. 2015. Dusky Gopher Frog (Rana sevosa) Recovery Plan. Atlanta, Georgia. 86 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:

Terrestrial Phase: We anticipate some individuals exposed from foraging on arthropods on malathion use sites with higher allowable application rates would experience sublethal effects to growth and reproduction. Mortality is not expected from exposure to direct spray on use sites or from spray drift. Effects to due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that individuals exposed to malathion in bin 6 are at high risk of mortality for all uses except for Developed, which has a low risk of mortality. We anticipate that individuals in bin 7 are at a medium risk of mortality for all uses except Developed, which has a low risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic

Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	<0.1% (G, R terrestrial invertebrates)	G – L R – L B – L
Direct spray or contact with contaminated media	No effects expected	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	<0.1% terrestrial invertebrates, amphibians	
Spray drift areas - Prey item mortality	Up to 18% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	44% terrestrial invertebrates, 4% amphibians	H

Risk modifiers: Adult dusky gopher frog occupy underground sump holes, small mammal burrows, and active and abandoned gopher tortoise burrows in upland sandy and sandy loam habitat in open canopy woodlands dominated by longleaf pine with an understory of grasses such as little bluestem. Adults are carnivorous feeding on terrestrial invertebrates and vertebrates and fossorial invertebrates.

Adults migrate to ephemeral ponds not connected to other water bodies during rains associated with passing cold fronts. Breeding typically occurs in December through March, it has been documented in all months except May, June, and July. Males migrate to breeding ponds prior to females and began calling. Females arrive, breed, and deposit one egg mass on emergent herbaceous vegetation and leave the pond. Males generally remain longer. After breeding adult dusky gopher frogs leave the pond sites during rainfall events and move to terrestrial belowground refuge.

Egg masses complete hatching between 9 and 21 days, and metamorphose as early as 94 days. Dusky gopher frog larvae are likely filter feeders and also graze on periphyton and epiphytic algae.

Dusky gopher frogs are expected to be sensitive to pesticide exposure due to their permeable eggs and skin that readily absorb substances from the surrounding aquatic and terrestrial environment. Migratory connectivity between breeding and non-breeding habitats are essential for species survival. Current population estimates are 135 individuals. Populations are probably grouped around existing breeding locations.

Dusky gopher frogs are unlikely to enter most malathion use sites. Only use of orchards and vineyards were not ruled out.

Allowable uses driving effects/other considerations: Effects from spray drift are likely to be lower than predicted due to the forested habitat preferred by the gopher frog which is likely to impede spray drift from entering occupied areas.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☐ High ☒ Medium ☐ Low

USAGE

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

Use type	Risk to species on terrestrial use sites [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	I	628,781	43.57	0	0	6,7	M,L
Open Space Developed	*	59,860	4.15	2,993	0.21	6,7	*,*
Developed	*	37,331	2.59	1,867	0.13	6,7	L,L
Other Crops	*	7,036	0.49	0	0	6,7	H,M
Cotton	*	6,592	0.46	5,865	0.41	6,7	H,M
Other Row Crops	*	5,948	0.41	4,992	0.35	6,7	H,M
Corn	*	1,464	0.10	1,045	0.07	6,7	H,M
Orchards and Vineyards	D, I	957	0.07	346	0.02	6,7	H,M
Vegetables and Ground Fruit	*	185	0.01	183	0.01	6,7	H,M
Wheat	*	102	0.01	102	0.01	6,7	H,M
Sub-TOTAL (D): *Other uses with direct effects*[3]		957	0.07	317	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 on terrestrial use sites [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]		957	0.07	317	0.02		
TOTAL[4]:		629,737	43.63	317	0.02		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 1,443,215 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 594,313 acres, 41%

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. We anticipate that, in many cases, these buffers will 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

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

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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 dusky gopher frog. As discussed below, even though the vulnerability is high and risk medium 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The dusky gopher frog has a high vulnerability ranking due to its endangered status, extremely limited distribution, small population size, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., fragmentation and destruction, primarily as a result of urbanization from residential and commercial development). The species has a medium risk ranking from labeled uses across the range, primarily from the effects to invertebrate prey from spray drift areas in addition to mosquito adulticide use (up to 18% and 44%, respectively). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is limited to less than 1% of the species range. 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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the dusky gopher frog based on standard practice and procedures. Overlap with the species range of approximately 44% from mosquito adulticide is likely an overestimate of actual exposure as the sites managed for the species take great care to limit pesticide use. We anticipate limited exposure of the dusky gopher frog resulting from malathion usage.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The dusky gopher frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, marshes). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the dusky gopher frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience low levels of effects to growth and reproduction from small reductions in the forage base over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the forage base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the dusky gopher frog.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Anaxyrus canorus	Yosemite toad	1707

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:

The current range of the Yosemite toad, at least in terms of overall geographic extent, remains largely similar to the historical range; however, within that range, toad habitats have been degraded and may be decreasing in area as a result of conifer encroachment and historical livestock grazing. The vast majority of the Yosemite toad's range is within federally managed land. Baseline data on the number and size of historical Yosemite toad populations are limited, and historic records are largely based on accounts from field notes, or pieced together through museum collections, thereby providing limited information on historical populations. Systematic survey information across the range of the species on National Forest System Lands largely follows the designation of the Yosemite toad as a candidate species under the Act. In addition, surveys for the Yosemite toad have been conducted within Yosemite, Kings Canyon, and Sequoia National Parks (Knapp 2013, unpaginated). From these recent inventories, Yosemite toads have been found at 469 localities collectively on six National Forests (USFS et al. 2009, p. 40; see also Brown and Olsen 2013, pp. 675–691), at 179 breeding sites that were surveyed between 1992 and 2010 in Yosemite National Park (Berlow et al. 2013, p. 3), and detected at 18 localities in Kings Canyon National Park (NPS 2011, geospatial data). The number of localities identified in these surveys reflects more occupied sites than were known before such extensive surveys were conducted, and indicates that the species is still widespread throughout its range. These inventories were typically conducted to determine toad presence or absence (they were not censuses), and do not explicitly compare historic sites to recent surveys. Moreover, single-visit surveys of toads are unreliable as indices of abundance because timing is so critical to the presence of detectable life stages and not all potential breeding habitats within the range of the species were surveyed (USFS et al. 2009, p. 41; Liang 2010, p. 10; Brown and Olsen 2013, p. 685). Given these considerations, conclusions about population trends, abundance, or extirpation rates are not possible from these datasets overall. However, there have been several studies, as described in the final listing rule (79 FR 24256-24310), that compared historical survey data to current surveys and one long-term, site-specific population study that demonstrated drastic population declines and even sites where toads have been extirpated. Past and current factors threatening Yosemite toads include climate change and meadow habitat loss and degradation from overgrazing, fire suppression (i.e., tree encroachment), road building, dams and diversions, and recreational uses. Disease continues to threaten Yosemite toads, especially the amphibian pathogen, Bd.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Sierra Nevada Yellow-Legged Frog and Northern Distinct Population Segment of the Mountain Yellow-Legged Frog, and Threatened Species Status for Yosemite Toad; Final Rule. Federal Register, Vol. 79, No. 82, 24256-24310.

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:

Terrestrial Phase: We anticipate individuals exposed to malathion at maximum rates on use sites from foraging on arthropods or from direct exposure to spray would die. Mortality is not expected from exposure to spray drift. Effects due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2, 3, 5 and 6 would be at high risk of mortality except for Developed, which has a medium (bins 2, 3, and 5) to low (bins 6 and 7) risk of mortality. Individuals exposed in bin 7, for most uses, would be anticipated to have a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	Low likelihood across range	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	Low likelihood across range	G – M R – M B – L
Direct spray or contact with contaminated media	Mortality if exposed	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		

Use areas - Prey item mortality	Mortality of terrestrial invertebrates	
Spray drift areas - Prey item mortality	Mortality of terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	No effects expected	H

Risk modifiers: Yosemite toads are found in a 150 mile span of the Sierra Nevada Mountains from Ebbetts Pass in Alpine County in the north to Fresno and northern Inyo Counties in the south. This species is found primarily on publicly managed lands at high elevations, including streams, lakes, ponds, and meadow habitats located within national forests and national parks.

Yosemite toads are found in wet meadows and forests at high elevations (about 4,800 to 12,000 feet). Yosemite toads are usually in sunny areas, where basking in sunlight is needed to maintain an optimal body temperature. In hotter, drier months they can often be found in moister areas within or near the meadow, including within natural cover or even cattle hoofprints. They use spaces under surface objects, including logs and rocks, for temporary refuge. Yosemite toads are usually not more than about 300 feet from permanent water, with females tending to move farther from breeding ponds than males. The majority of their life is spent in the upland habitats close to their breeding meadows. Yosemite toads are not expected to enter agricultural use sites.

The active period of the Yosemite toad is from April through July to late September or early October. During winter, Yosemite toads shelter in the burrows of small mammals, willow thickets, forest edges adjoining meadows, and in clumps of vegetation near water.

The Yosemite toad's diet consists of a wide variety of invertebrates: beetles, ants, spiders, bees, wasps, flies, and millipedes.

Allowable uses driving effects/other considerations: Prior to finalizing this Biological Opinion, we discovered that the overlap of malathion use sites with the species range was calculated based on an inaccurate range map for this species. As a result, we did not carry forward the overlap values from the draft Opinion into this final Opinion. Instead, we qualitatively estimated the types and extent of malathion use sites occurring within the range by visually examining mapped crop data layers in proximity to the species range and, where possible, considering information regarding habitat preferences and likely locations of individuals and populations.

The primary use site overlapping with the range of the Yosemite toad is open space developed, primarily on federally managed lands. We do not anticipate that the Yosemite toad will be found near agriculture, developed areas, or locations where mosquito control is likely to occur.

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE

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

For estimation of usage, we considered county level sales and usage data for mosquito adulticide, and developed and open space developed usage consistent with our overall estimates for listed species.

We estimate that up to 5% of open space developed use sites on the non-federal portion of the species' range could undergo some level of treatment with malathion. For mosquito adulticide, data indicated past usage of malathion within the range of the species in Fresno County only. However, the range of the Yosemite toad occurs in the mountains of this county where we consider usage unlikely because it is forested.

 # acres in species range: not available
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: quantitative estimate not available, though the vast majority of the range is known to occur on federally managed lands.

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

CONSERVATION MEASURES

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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 Yosemite toad. As discussed below, the vulnerability ranking is medium, we anticipate the risk and 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.

The Yosemite toad has a medium vulnerability ranking due to its theatened status, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., climate change and meadow habitat loss and degradation from overgrazing, fire suppression (i.e., tree encroachment), road building, dams and diversions, and recreational uses). The species has a low risk ranking from labeled uses across the range, primarily because it is not expected to be found near malathion agricultural, developed, and mosquito control use sites. Overlap with open space developed use sites may result in some risk of mortality as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). However, the Yosemite toad resides primarily in conserved areas of Federal lands (e.g., National Parks and National Forests).

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, the risk and likelihood of exposure to malathion via this exposure pathway is very low based on occurrence on or near malathion use sites. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Yosemite toad based on standard practice and procedures. We anticipate limited exposure of the Yosemite toad resulting from malathion usage and as pesticides are not known to be a stressor to this species as it occurs primarily on conserved federal lands.

We anticipate the additional conservation measures above, including residential use label changes that apply to open space developed areas will further reduce the likelihood of exposure of the species, their prey, and their habitat to malathion. The Yosemite toad breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, marshes). As with most amphibians, the rain restriction associated with the residential conservation measure for developed and open space developed areas is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Yosemite toad when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffer associated with this measure is anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, other residential use label changes are expected to reduce environmental concentrations by limiting applications to spot treatments only.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of of the Yosemite toad.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Rana muscosa	Mountain yellow-legged frog (Northern CA DPS)	1740

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); Declining population(s) – one or more populations declining
Species Trends: Unknown population trends
Pesticides noted ☐

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

Southern *Rana muscosa* was known from an estimated 166 historical localities from creeks and drainages in the San Gabriel, San Bernardino, San Jacinto, and Palomar Mountains of Los Angeles, San Bernardino, Riverside, and San Diego counties. In the 1994 assessment Amphibian and Reptile Species of Special Concern in California, Jennings and Hayes (1994b, p. 77) estimated that southern R. muscosa had been extirpated from more than 99 percent of its previously documented range. Between 1970 and 1993, southern R. muscosa was thought to be extirpated from the San Bernardino Mountains (Jennings and Hayes, 1994b, p. 77) until a single small population was rediscovered at East Fork City Creek (a tributary of the Santa Ana River) in 1998 (USGS 1999, p. 6). At the time southern Rana muscosa was listed as endangered in 2002, it was known from only 7 of the 166 historical localities in southern California including 5 small streams in the San Gabriel Mountains (Bear Gulch, Vincent Gulch, South Fork Big Rock Creek, Little Rock Creek, and Devil's Canyon), 1 stream in the San Bernardino Mountains (East Fork City Creek), and 1 stream in the upper reaches of the San Jacinto River system in the San Jacinto Mountains (Fuller Mill Creek) (USGS 2002a, p. 1). Since listing, USGS has identified two additional waterways occupied by southern Rana muscosa, both in the San Jacinto Mountains. Therefore, the southern Rana muscosa, is currently limited to nine populations in the San Gabriel, San Bernardino, and San Jacinto Mountains in southern California. Determining accurate population estimates has been a challenge due to exceedingly low numbers at almost all nine currently extant localities (Backlin 2012, pers. comm.). Regardless, it is clear that every population remains precariously small today. Two of the larger populations at listing now may have less than five adults remaining (Bear Gulch and East Fork City Creek). Tahquitz-Willow Creek also appears to have less than five adults remaining. Three additional populations may have 15 or fewer adults (Vincent Gulch, Fuller Mill Creek, and Dark Canyon). However, threat abatement including increased restrictions on recreation and trout removal at Dark Canyon may have reversed the decline of this population as evidenced by a recent increase in abundance (Backlin 2012, pers. comm.). South Fork Big Rock Creek appears to be stable at a low abundance of less than 30 adults and may be on an upward trajectory. Only Little Rock Creek has experienced a substantial increase since 2001; this increase is a result of trout removal efforts performed by CDFG and the creek closure enforced by the USFS at this location (USGS 2012, p. 18). The status of the Devil's Canyon is unclear although it also persists at a very low abundance. Each southern Rana muscosa population is highly susceptible to stochastic events, especially wildfire, which probably initiated the decline of the East Fork City Creek population. Measures have been taken to reduce the impact of certain threats since listing, including recreation. However, threats to the habitat remain, including marijuana cultivation, suction dredge mining, recreational and fire management activities, and roadwork construction. The most significant stressors to southern *R. muscosa* are related to the constraints on recruitment by predation and disease. Where adults reproduce in trout-occupied waters, or where tadpoles disperse downstream into trout-occupied waters, those tadpoles are likely to be preyed upon by trout. Additionally, all populations are positive for Bd, and although infection rates are low, the juvenile lifestage, which experiences the highest mortality from Bd, is usually undetected during annual population surveys. Small population sizes and a fragmented metapopulation structure are a great impetus for threat abatement, including trout removal and recreational closures adjacent to extant populations. Other threats to southern *Rana muscosa* include potential impacts from climate change, exposure to UV-B radiation, acid precipitation, and contaminates (e.g., pesticides, heavy metals, and nitrogen based fertilizers).

EB/CE Source: U.S. Fish and Wildlife Service. 2012. Mountain Yellow-legged Frog (Rana muscosa), Southern California Distinct Population Segment 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

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:

Terrestrial Phase: We anticipate some individuals exposed to malathion from foraging on contaminated arthropods on use sites with higher allowable application rates would experience sublethal effects to growth and reproduction. Effects from loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	<1% (G, R – low effects)	G – M R – M B – M
Direct spray or contact with contaminated media	Sublethal effects if exposed on use sites	
Volatilization	Contribution to exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	<1% invertebrates	
Spray drift areas - Prey item mortality	Up to 1% invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	9% invertebrates	H

Risk modifiers: Mountain yellow-legged frogs are not expected to enter agricultural use sites.

Allowable uses driving effects/other considerations: Overlap with developed and open space developed use sites accounts for most direct effects to the mountain yellow-legged frog.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.As described 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, and that 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)

Agricultural usage based on CalPUR data:

Use type	Risk to species on terrestrial use sites [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	I	306,884	8.92	0	0.00	2,3	H,H
Open Space Developed	D, I	9,212	0.27	461	0.01	2,3	*,*
Developed	D, I	4,182	0.12	209	0.01	2,3	M,M
Pasture	I	848	0.02	0	0	2,3	H,H
Other Crops	*	123	<0.01	0	0	2,3	H,H
Orchards and Vineyards	D, I	109	<0.01	0	0	2,3	H,H
Wheat	*	27	<0.01	0	0	2,3	H,H
Other Grains	*	24	<0.01	0	0	2,3	H,H
Corn	*	15	<0.01	0	0	2,3	H,H
Vegetables and Ground Fruit	*	10	<0.01	0	0	2,3	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		13,504	0.39	670	0.02		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		14,351	0.42	670	0.02		
TOTAL[4]:		321,236	9.33	670	0.02		

See above for updated bin 3 and 4 considerations.

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 3,441,243 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 2,723,921 acres, 79%

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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 Mountain yellow-legged frog (Northern CA DPS). As discussed below, even though the vulnerability is high for this species, risk and usage are low and 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Mountain yellow-legged frog (Northern CA DPS) has a high vulnerability ranking due to its endangered status, limited distribution, small population size, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., fish introductions, dams and water diversions, livestock grazing, timber management, road construction and maintenance, packstock use, recreational activities, and fire management activities). The species has a low risk ranking from labeled uses across the range, primarily from effects to prey from mosquito adulticide use (9%). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is limited to less than 1% of the species range (based on CalPur data). Estimated overlap of use with the species range is less than 10% (also primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low based on the CalPur usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Mountain yellow-legged frog (Northern CA DPS) based on standard practice and procedures. Given the generally higher altitudes and remote mountain ranges inhabited by the species, we anticipate limited exposure of the Mountain yellow-legged frog (Northern CA DPS) resulting from malathion usage.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Mountain yellow-legged frog (Northern CA DPS) breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., lakes, ponds, high or low-gradient streams, marshy edges). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Mountain yellow-legged frog (Northern CA

DPS) when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Thus, we anticipate only small numbers of individuals of this species will experience low level, effects to growth and reproduction, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Mountain yellow-legged frog (Northern CA DPS).

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Plethodon neomexicanus	Jemez Mountains salamander	3849

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:

The Jemez Mountains salamander is restricted to the Jemez Mountains in northern New Mexico, in Los Alamos, Rio Arriba, and Sandoval Counties, around the rim of the collapsed caldera (large volcanic crater), with some occurrences on topographic features (e.g., resurgent domes) on the interior of the caldera. The species predominantly occurs at an elevation between 7,200 and 9,500 feet (ft) (2,200 and 2,900 meters (m)) (Degenhardt et al. 1996, p. 28), but has been found as low as 6,998 ft (2,133 m) (Ramotnik 1988, p. 78) and as high as 10,990 ft (3,350 m) (Ramotnik 1988, p. 84). According to the final listing rule, the FWS has approximately 20 years of salamander survey data that provide detection information at specific survey sites for given points in time. The overall rangewide population size of the Jemez Mountains salamander is unknown because surveys tend to be localized (approximately 256-ft-by-256- ft areas, 200-m-by-200-m). Additionally, like most plethodontid salamanders, monitoring population size or trends of the Jemez Mountains salamander is inherently difficult because of the natural variation associated with the species' behavior (Hyde and Simons 2001, p. 624). Despite the FWS' inability to quantify population size or trends for the salamander, qualitative data (data that are observable, but not measurable) provide information for potential inferences. Based on these inferences, the persistence of the salamander may vary across the range of the species. For example, in some localities where the salamander was once considered abundant or common, the salamander is now rarely detected or has not been recently detected at all (New Mexico Heritage Program 2010a and b, spreadsheets). The number of areas where salamanders were once present, but have not been observed during more recent surveys, also appears to have increased (New Mexico Heritage Program 2010a and b, spreadsheets). Alternatively, there are two localities on the Valles Caldera National Preserve where the salamander continues to be relatively abundant (Redondo Border located in the central portion of the Valles Caldera National Preserve, and on a slope in the northeast portion of the Valles Caldera National Preserve), compared to most other recent detections at other sites. The number of salamanders observed during recent surveys is far less than observed in historical surveys. Currently, there is no known location where the number of salamanders observed is similar to that observed in 1970. The Jemez Mountains salamander and its habitat experience threats from historical and current fire management practices; severe wildland fire; forest composition and structure conversions; post-fire rehabilitation; forest management (including silvicultural practices); roads, trails, and habitat fragmentation; and recreation. The best available information does not indicate that disease is a threat to the salamander's continued existence now, but it could be a threat in the future. The salamander has the potential to be impacted by chemical use. Chemicals are used to suppress wildfire and for noxious weed control. Chemicals may impact individual salamanders and their habitat, but based the best available scientific and commercial data does not indicate that it is a threat to the species as a whole. Many of these chemicals have not been assessed for effects to amphibians, and none have been assessed for effects to terrestrial amphibians. We do not currently have information that chemical use is a threat to the salamander. Current and future effects from warmer climate conditions in the Jemez Mountains could reduce the amount of suitable salamander habitat, reduce the time period when the species can be active above ground, and increase the moisture demands and subsequent physiological stress on salamanders. Warming and drying trends in the Jemez Mountains currently are threats to the species, and these threats are projected to continue into the future.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Jemez Mountains Salamander (*Plethodon neomexicanus*) Throughout Its Range; Final Rule. Federal Register, Vol. 78, No. 175, 55600-55627.

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 that some individual Jemez Mountains salamanders exposed to malathion on use sites with higher allowable application rates would experience mortality from foraging on contaminated prey items or from exposure to direct spray. Effects associated with loss of invertebrate prey are also anticipated.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	1%
Spray drift areas – mortality	No effects expected
Sublethal – growth (G), reproduction (R) and behavior (B)	3% (G, R - low effects)
Direct spray or contact with contaminated media	Mortality if exposed
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	

Use areas - Prey item mortality	3% terrestrial invertebrates
Spray drift areas - Prey item mortality	Up to 3% terrestrial invertebrates
Plants affected (decline in growth)	N/A
MOSQUITO CONTROL	
Direct (mortality)	No effects expected
Sublethal	No effects expected
Indirect	9% terrestrial invertebrates

Risk modifiers:

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	Acres	%
Mosquito Control	I	50,626	8.85	0	0.00
Open Space Developed	D, I	9,219	1.61	461	0.08
Developed	D, I	4,365	0.76	229	0.04
Corn	D, I	3,978	0.70	1	0.00
Cotton	D, I	1,519	0.27	0	0.00
Other Crops	I	366	0.06	0	0.00
Other Grains	D, I	62	0.01	0	0.00
Nurseries	I	31	0.01	0	0.00
Vegetables and Ground Fruit	D, I	4	0.00	0	0.00
Orchards and Vineyards	D, I	2	0.00	0	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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	Acres	%
Pasture	I	1	0.00	1	0.00
Wheat	D, I	0	0.00	0	0.00
Sub-TOTAL (D): *Other uses with direct effects*[3]		19,149	3.35	691	0.12
Sub-TOTAL (I): *Other uses with indirect effects*[3]		19,547	3.42	692	0.12
TOTAL[4]:		70,173	12.27	692	0.12

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself).

 # acres in species range: 6,221,273 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 3,010,776 acres, 48%

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. We anticipate that, in many cases, these buffers will significantly 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 Jemez Mountains salamander. 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, 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Jemez Mountains salamander has a high vulnerability ranking due to its endangered status, limited distribution, small population size, declining populations, susceptibility to stochastic events (e.g., severe wildfire), and anthropogenic threats to the species (e.g., historical and current fire management practices; forest composition and structure conversions; post-fire rehabilitation; forest management (including silvicultural practices); roads, trails, and habitat fragmentation; and recreation). The species has a medium risk ranking from labeled uses across the range, primarily from effects to invertebrate prey from spray drift and mosquito adulticide use (3% and 24%, respectively). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is limited to less than 1% of the species range. Estimated overlap of use with the species range is approximately 25% (also primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Jemez Mountains salamander based on standard practice and procedures. Given the generally higher altitudes and remote mountain ranges inhabited by the Jemez Mountains salamander, we anticipate limited exposure of the species resulting from malathion usage.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Jemez Mountains salamander breeds and spends most of its life history in moist sheltered environments where its young develop directly from egg to juvenile without a free-swimming larval stage. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Jemez Mountains salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Thus, we anticipate only small numbers of individuals of this species will experience low level, effects to growth and reproduction, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Jemez Mountains salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Rana pretiosa	Oregon spotted frog	4090

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:

Historically, the Oregon spotted frog ranged from British Columbia to the Pit River basin in northeastern California (Hayes 1997, p. 40; McAllister and Leonard 1997, p. 7). Oregon spotted frogs have been documented at 61 historical localities in 48 watersheds (3 in British Columbia, 13 in Washington, 29 in Oregon, and 3 in California) in 31 sub-basins (McAllister et al. 1993, pp. 11–12; Hayes 1997, p. 41; McAllister and Leonard 1997, pp. 18–20; COSEWIC 2011, pp. 12–13). Currently, the Oregon spotted frog is found from extreme southwestern British Columbia south through the Puget Trough and in the Cascades Range from south-central Washington at least to the Klamath Basin in southern Oregon. Oregon spotted frogs occur in lower elevations in British Columbia and Washington and are restricted to high elevations in Oregon (Pearl et al. 2010, p. 7). In addition, Oregon spotted frogs currently have a very limited distribution west of the Cascade crest in Oregon, are considered to be extirpated from the Willamette Valley in Oregon (Cushman et al. 2007, p. 14), and may be extirpated in the Klamath and Pit River basins of California (Hayes 1997, p. 1). In Washington, the Oregon spotted frog is currently known from four watersheds in the Pugent Trough and two watersheds in the southeast Cascades. Current population estimates for Washington are based on the 2012 census of egg masses at all known extant breeding areas. Based on these estimates, the minimum population in Washington was at least 7,368 breeding adults in 2012. Population estimates of Oregon spotted frogs in Oregon are primarily based on egg mass surveys conducted in 2011 and 2012 at known extant sites (eight sub-basins), and newly discovered occupied areas that had been unsurveyed prior to 2012. Population estimates for the Middle Fork Willamette River sub-basin are based on mark-recapture studies conducted by U.S. Geological Survey (USGS) in 2011, rather than egg mass surveys. Based on these survey data, the minimum population estimate in Oregon consists of approximately 12,847 breeding adults. The best scientific and commercial information available indicates the trend is undetermined for Oregon spotted frog populations in 13 of the sub-basins and is declining in the Lower Fraser River and Middle Klickitat sub-basins. Oregon spotted frogs are currently impacted by one or more of the following factors: 1) Habitat necessary to support all life stages continues to be impacted or destroyed by human activities that result in the loss of wetlands to land conversions; hydrologic changes resulting from operation of existing water diversions/manipulation structures, new and existing residential and road developments, drought, and removal of beavers; changes in water temperature and vegetation structure resulting from reed canarygrass invasions, plant succession, and restoration plantings; and increased sedimentation, increased water temperatures, reduced water quality, and vegetation changes resulting from the timing and intensity of livestock grazing (or in some instances, removal of livestock grazing at locations where it maintains early seral stage habitat essential for breeding); 2) predation by nonnative species, including nonnative trout and bullfrogs; 3) other natural or manmade factors including small and isolated breeding locations, low connectivity, low genetic diversity within occupied sub-basins, and genetic differentiation between subbasins. Additionally, water quality and contamination is a concern. Although pesticides are known to affect various life stages of the Oregon spotted frog, the impact of this potential threat is undetermined at this time.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Threatened Status for Oregon Spotted Frog; Final Rule. Federal Register, Vol. 79, No. 168, 51658-51710.

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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on some use sites (e.g., developed, open space developed, vegetables and ground fruit, orchards and vineyards) are expected to experience high mortality. Some individuals on all use sites are anticipated to experience effects to growth and reproduction.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic (L=Low, M=Medium, H=High)
Use areas – mortality	Mortality	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	Effects to growth and reproduction	G – M R – M B – M

Direct spray or contact with contaminated media	Sublethal effects and low for mortality if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	Mortality to terrestrial invertebrates	
Spray drift areas - Prey item mortality	Mortality to terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	Mortality to terrestrial invertebrates	H

Risk modifiers: The Oregon spotted frog is the most aquatic native frog in the Pacific Northwest, and its habitats include lakes, ponds, wetlands and riverine sloughs. It is almost always found in or near a perennial body of water that includes zones of shallow water and abundant emergent or floating aquatic plants, which the frogs use for basking and escape cover. Large wetland complexes with the following characteristics are likely to host a larger number of frogs than small sites: (1) breeding and overwintering sites are connected by year-round water; (2) water levels of sufficient depth are maintained throughout the period between oviposition and metamorphosis; and (3) absence of introduced predators, especially warm-water game fish and bullfrogs. Larger wetland habitats with perennial water are more likely to provide an abundance of seasonal microhabitats, hiding cover from predators and food for frogs.

Oregon spotted frogs feed on live animals, primarily insects. Tadpoles are grazers, having rough tooth rows for scraping plant surfaces and ingesting plant tissue and bacteria. They also consume algae, detritus, and probably carrion.

Allowable uses driving effects/other considerations: Prior to finalizing this Biological Opinion, we discovered that the overlap of malathion use sites with the species range was calculated based on an inaccurate range map for this species. As a result, we did not carry forward the overlap values from the draft Opinion into this final Opinion. Instead, we qualitatively estimated the types and extent of malathion use sites occurring within the range by visually examining mapped crop data layers in proximity to the species range and, where possible, considering information regarding habitat preferences and likely locations of individuals and populations.

A visual inspection of cropland data layers indicates that developed and open space developed use sites have the most overlap with the range of this species. A smaller percentage of the frog's range overlaps with agricultural areas, including crops within the corn, other crops, vegetables and groundfruit, wheat, other grains, and pasture UDLs.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

For estimation of usage, we considered state-level agricultural information described in EPA's SUUM (Appendix G), county level sales and usage data for mosquito adulticide, and developed and open space developed usage consistent with our overall estimates for listed species.

Information regarding past usage of malathion for corn, wheat, other grains, and pasture indicates that a low percentage (less than or equal to 3.3%) of these crops were treated with malathion in Oregon and Washington, which contain the majority of the Oregon spotted frog's range. It is unknown how much of this usage occurs within or near the range of the Oregon spotted frog, and usage values within the species range could be higher or lower than these statewide averages. We estimate that up to 5% of developed and open space developed within the species range could undergo some level of treatment with malathion.

For mosquito adulticide, data indicated past usage of malathion in 2 of the 21 counties in California, Oregon, and Washington that contain areas of the Oregon spotted frog's range for the five years of data available. Of those counties, only a small fraction of the species range occurs in one, generally in forested areas and open range, and for the other county, sales or usage occurred only once within that timespan.

 # acres in species range: not available
% of range in California (i.e., where CalPUR data is available): not available
Range overlap with Federal lands: not available

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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Oregon spotted frog. As discussed below, while the vulnerability and risk are medium 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Oregon spotted frog has a medium vulnerability ranking due to its theatened status, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss of wetlands to land conversions; hydrologic changes resulting from operation of existing water diversions/manipulation structures, new and existing residential and road development). The species has a medium risk ranking from labeled uses across the range, primarily from use area mortality and sublethal effects and the effects to invertebrate prey from use and spray drift areas in addition to mosquito adulticide use. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). However, estimated usage is anticipated to be low based on available statewide data for agriculture and habitat preferences, and on mosquito adulticide data indicating minimal usage in the counties that contain areas of the frog's range..

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Oregon spotted frog based on standard practice and procedures. We anticipate limited exposure of the Oregon spotted frog resulting from malathion usage. Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduction in the number of applications and reduction in application rate will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Oregon spotted frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, wetlands). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Oregon spotted frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrict applications during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Combined, all of these measures are expected to substantially reduce the amount of malathion that reaches the aquatic habitats occupied by the frog and its forage base and decrease the likelihood of exposure of the species to this pesticide.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Oregon spotted frog.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Ambystoma californiense	California tiger salamander (Central CA DPS)	4773

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:

Multiple factors have contributed to population declines of this species, including habitat loss and fragmentation; predation from, and competition with, invasive species; hybridization with nonnative barred tiger salamanders (Ambystoma tigrinum) (sometimes referred to as Ambystoma tigrinum mavortium); mortality from road crossings; contaminants; and small mammal burrow control efforts (FWS 2004, 2014). Potential threats include introduction of diseases such as ranaviruses and also climate change (FWS 2004, 2014). The loss, degradation, and fragmentation of habitat as the result of human activities are the primary threats to the Central California tiger salamander (FWS 2004, 2014). Aquatic and upland habitat available to Central California tiger salamanders has been degraded and reduced in area through agricultural conversion, urbanization, road construction, and other projects (FWS 2014). Central California tiger salamander populations occur in scattered and increasingly isolated breeding sites, reducing opportunities for inter-pond dispersal. Urban development and agricultural conversion continue to threaten the species. Grazing is a compatible land use with Central California tiger salamander survival; however, ranches with grazing as their primary land use are declining within the range of the Central California tiger salamander and are being replaced by vineyards, orchards, row crops, and development, which are not compatible with California tiger salamander conservation. The FWS utilized GIS to analyze the amount of habitat lost from 2001 to 2006 and found that habitat loss has occurred within each of the four regions of the Central California tiger salamander, with the Central Coast Range and the Central Valley undergoing the largest amounts of habitat loss. From 2001 to 2006, the Central California tiger salamander lost approximately 8,000 acres (3,237 hectares) of potential habitat that was converted to urban and agricultural uses. Since the time of listing, approximately 8,656 acres (3,503 hectares) of permanent habitat loss has been exempted through section 7 of the Act. Incidental take permits associated with HCPs have permitted the loss of over 25,000 acres (10,117 hectares) of potential habitat. Since the time of listing in 2004, 7,993 acres (3,234.6 hectares) of habitat have been permanently protected as conservation banks. In addition, there are multiple public and private lands that protect known occurrences of California tiger salamander. These properties protect large, intact, areas of suitable habitat for the species; although it is unknown at this time how much occupied habitat occurs on many of these properties as thorough surveys have not been conducted on many of these lands. In addition, many of these lands are not managed solely for California tiger salamanders and have other priority land uses.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. California Tiger Salamander (Ambystoma californiense) Central California Distinct Population Segment, 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, CA. U.S. Fish and Wildlife Service. 2015. Draft Recovery Plan for the Central California Distinct Population Segment of the California Tiger Salamander (Ambystoma californiense). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. v + 53pp.

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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on use sites are expected to experience low risk of mortality on most use sites, with sublethal effects to growth and reproduction anticipated for use sites with higher application rates (e.g., developed, open space developed, orchards and vineyards, cotton, vegetables and ground fruit). We anticipate individuals exposed from direct exposure to spray would die or experience sublethal effects.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality for bin 5 and a low risk for bin 6. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	24% (G, R – low effects; terrestrial invertebrates only), 12% (R – high effects; terrestrial invertebrates), no	G – M R – M B – M

	effects from other dietary items	
Direct spray or contact with contaminated media	Mortality or sublethal effects if exposed	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	37% terrestrial invertebrates, amphibians	
Spray drift areas - Prey item mortality	Up to 71% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	79% terrestrial invertebrates, 7% amphibians	H

Risk modifiers:

Allowable uses driving effects/other considerations: Overlap with developed, open space developed, orchards and vineyards, and vegetables and ground fruit use sites accounts for most direct effects to the California tiger salamander. Effects resulting from exposure in orchards and vineyards is likely over-estimated, as the maximum application rate used in calculations is not completely representative of usage for this category within the range of the California tiger salamander.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Agricultural usage based on CalPUR data:

Use type	Risk to species on terrestrial use sites [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	I	15,252,167	78.94	237,867	1.23	5,6	H,M
Orchards and Vineyards	D, I	2,371,313	12.27	22,570	0.117	5,6	H,H
Developed	D, I	1,202,617	6.22	60,131	0.31	5,6	L,L
Other Crops	I	1,051,423	5.44	41	<0.001	5,6	H,H
Open Space Developed	D, I	862,239	4.46	43,112	0.22	5,6	H,H
Pasture	I	533,317	2.76	43,424	0.225	5,6	H,H
Wheat	I	459,906	2.38	4,313	0.022	5,6	H,H
Vegetables and Ground Fruit	D, I	386,654	2.00	72,290	0.374	5,6	H,H
Rice	*	359,574	1.86	480	0.002	5,6	H,H
Other Grains	I	266,234	1.38	1,729	0.009	5,6	H,H
Corn	I	178,266	0.92	1,057	0.005	5,6	H,H
Cotton	D, I	142,058	0.74	6,055	0.031	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		4,964,880	25.70	204,158	1.05		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		7,454,025	38.58	254,722	1.31		
TOTAL[4]:		22,706,192	117.52	492,589	2.54		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 19,321,621 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 1,815,299 acres, 9%

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

CONSERVATION MEASURES

[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.

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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 California tiger salamander (Central CA DPS). As discussed below, even though the vulnerability is medium and risk is 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The California tiger salamander (Central CA DPS) has a medium vulnerability ranking due to its threatened status, declining population, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss, degradation, and fragmentation of habitat as the result of agricultural conversions, urbanization, and road construction). The species has a high risk ranking from labeled uses across the range, primarily from sublethal effects to growth and reproduction if exposed. Similarly, risk to the species includes use site, spray drift, and mosquito adulticide effects to prey, estimated at 37% terrestrial invertebrate and amphibian prey, 71% terrestrial invertebrates, and 79% terrestrial invertebrate and 7% amphibian prey, respectively. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). We anticipate the species' susceptibility to adverse effects from malathion and its exposure given its remaining habitat's proximity to pressures from and the threat of additional urbanization. However, estimated usage is 2.5% of the species range (based on CalPur data), including 1.2% from mosquito adulticide. Estimated overlap of use with the species range is high, in excess of 100% (primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the CalPur usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the California tiger salamander (Central CA DPS) based on standard practice and procedures. We anticipate limited exposure of the California tiger salamander (Central CA DPS) resulting from effects to prey items associated with malathion use.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The California red-legged frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, marshes). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the California red-legged frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience low level, effects to growth and reproduction, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the California tiger salamander (Central CA DPS).

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Ambystoma californiense	California tiger Salamander (Santa Barbara DPS)	8395

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:

There are six recognized metapopulations of California tiger salamanders within the range of the Santa Barbara County Distinct Population Segment (DPS). The DPS is endemic to the northern portion of Santa Barbara County, California. These metapopulations each utilize an array of vernal pools and swales, created ponds, and uplands, separated from one another by distance, topography, or anthropogenic barriers. At the time of listing, we determined that loss, destruction, degradation, and fragmentation of habitat was the primary threat to the Santa Barbara County DPS of the California tiger salamander, and it remains the current primary threat (USFWS 2000a, b; 2009). The ponds available to Santa Barbara County California tiger salamanders for breeding, and the associated upland habitats inhabited by salamanders for most of their life cycle, have been degraded and reduced in area through agricultural conversion, urbanization, and the building of roads and highways. Maintaining inter-pond dispersal potential (connectivity between ponds) is important for the long-term viability of California tiger salamanders; however, the inter-pond linkages between populations of California tiger salamanders in Santa Barbara County are considerably degraded (Pyke 2005). Santa Barbara County California tiger salamanders are also negatively affected by factors that alter the quality of their habitat, including: measures to control burrowing rodents; dense vegetation, often non-native invasive species, that overtakes vernal pool habitats in the absence of grazing; alteration of hydrology; and pond water quality due to agricultural runoff. Disease is an important causative factor in the global amphibian decline crisis (Daszak et al. 2003). Because the Santa Barbara County DPS of the California tiger salamander has limited genetic variation, it is likely to be more vulnerable to unpredictable factors, including disease (Shaffer et al. 2013). Although the exact cause of death is unknown, a possible disease outbreak was reported by a landowner in the Los Alamos Valley who saw large numbers of dead and dying California tiger salamanders in a pond (Sweet, pers. comm. 1998). Chytrid fungus (*Batrachochytrium dedrobatidis*) (Bd) was first documented in California tiger salamanders in Santa Clara County, California (Central DPS) (Padgett-Flohr and Longcore 2005). In a short-term laboratory study of the effects of Bd on California tiger salamanders, the species was found to be susceptible to Bd, but did not die from chytridiomycosis infection (Padgett-Flohr 2008). Longer-term studies are needed to determine the negative effects of Bd infection in California tiger salamanders in the wild. California tiger salamanders in Santa Barbara County are susceptible to predation by several non-native species (Morey and Guinn 1992) such as non-native tiger salamanders (Ambystoma tigrinum mavortium), bullfrogs, mosquitofish, other introduced fish, non-native crustaceans and native species including birds, turtles, snakes and other amphibians. Non-native tiger salamanders can have negative effects on California tiger salamander populations through hybridization, resulting in loss of genetically pure native salamanders (Shaffer et al. 1993, Riley et al. 2003). Introduced species also can have negative effects on California tiger salamander populations through competition (Shaffer et al. 1993) for food and other resources. Vehicles on roads contribute to direct mortality of Santa Barbara County California tiger salamanders. Amphibians are extremely sensitive to pollutants, such as pesticides and other chemicals, due to their highly permeable skin, which can rapidly absorb pollutant substances (Blaustein and Wake 1990). Toxins at lower than lethal levels may cause abnormalities in larvae and behavioral anomalies in adults, both of which could eventually lead to mortality (Hall and Henry 1992, Blaustein and Johnson 2003). Pesticides may reduce or eliminate the prey base, increasing the rate of starvation in California tiger salamanders. Sources of chemical pollution that may threaten California tiger salamanders include hydrocarbon and other contaminants from the application of chemicals for agricultural production, burrowing animal control, oil production, and road runoff (FWS 2009). Although there is some evidence that some amphibians may be affected when they come into secondary contact with chemicals (such as pesticides on crops applied to the habitat during the migration and dispersal seasons) (Sparling et al. 2001), Davidson et al. (2001, 2002) found no significant overall relationship between upwind agriculture and the California tiger salamander's decline. While this indicates that long-distance spread of agricultural pesticides may not be a significant threat to California tiger salamanders, there is evidence that commonly used pesticides do have negative, measurable effects on amphibians in direct contact with them (FWS 2009). Since listing, several conservation efforts have been completed to date. These include habitat improvement projects, purchase of a conservation easement (539 acres) in the Purisima Hills metapopulation, funding of research projects (habitat use, non-native tiger salamander eradication), FWS approval of the La Purisima Conservation Bank (Purisima Hills metapopulation), and other cooperative conservation efforts with NRCS (biological opinion on agricultural improvement projects) and other stakeholders (publication - Managing Rangelands to Benefit the California Red-legged Frog and California Tiger Salamander (Ford et al. 2013)).

EB/CE Source: U.S. Fish and Wildlife Service. 2009. California Tiger Salamander (*Ambystoma californiense*) Santa Barbara County Distinct Population Segment, 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, CA. U.S. Fish and Wildlife Service. 2015. Draft recovery plan for the Santa Barbara County Distinct Population Segment of the California tiger salamander (*Ambystoma californiense*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Ventura, California. vi + 76 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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on use sites are anticipated to experience low risk of mortality on most use sites, with sublethal effects to growth and reproduction anticipated for use sites with higher application rates (e.g., developed, open space developed, orchards and vineyards, cotton, vegetables and ground fruit). We anticipate individuals exposed from direct exposure to spray would die or experience sublethal effects.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality for bin 5 and a low risk for bin 6. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	11% (G, R – low effects; terrestrial invertebrates), 3% (R – high effects; terrestrial invertebrates)	G – M R – M B – M
Direct spray or contact with contaminated media	Mortality or sublethal effects if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	16% terrestrial invertebrates, amphibians	
Spray drift areas - Prey item mortality	Up to 40% terrestrial invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	55% terrestrial invertebrates, 5% amphibians	H

Risk modifiers:

Allowable uses driving effects/other considerations: Overlap with developed, open space developed, orchards and vineyards, and vegetables and ground fruit use sites accounts for most direct effects to the California tiger salamander. Effects resulting from exposure in orchards and vineyards is likely over-estimated, as the maximum application rate used in calculations is not completely representative of usage for this category within the range of the California tiger salamander.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

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

Agricultural usage in California only based on CalPUR data:

Use type	Risk to species on terrestrial use sites [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	I	2,619,579	54.83	9,100	0.19	5,6	H,M
Pasture	I	18,521	0.39	17,229	0.36	5,6	H,H
Orchards and Vineyards	D, I	149,773	3.14	902	0.095	5,6	H,H
Vegetables and Ground Fruit	D, I	60,762	1.27	60,762	1.27	5,6	H,H
Open Space Developed	D, I	217,608	4.56	10,880	0.23	5,6	*,*
Developed	D, I	125,966	2.64	6,298	0.13	5,6	M,L
Other Grains	I	25,522	0.53	106	0.002	5,6	H,H
Other Crops	I	133,063	2.79	0	0	5,6	H,H
Wheat	I	23,897	0.50	418	0.009	5,6	H,H
Cotton	D, I	15,193	0.32	242	0.005	5,6	H,H
Corn	I	3,083	0.06	569	0.012	5,6	H,H

[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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Nurseries	I	1,240	0.03	1,203	0.025	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		569,303	11.92	79,084	1.73		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		774628	16.21	98609	2.14		
TOTAL[4]:		3394207	71.05	107709	2.33		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 4777290 acres
% of range in California (i.e., where CalPUR data is available): 100%
Range overlap with Federal lands: 1108890 acres, 23%

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. We anticipate that, in many cases,

[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.

these buffers will 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 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 California tiger Salamander (Santa Barbara DPS). 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The California tiger Salamander (Santa Barbara DPS) has a high vulnerability ranking due to its endangered status, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss, destruction, degradation, and fragmentation of habitat). The species has a high risk ranking from labeled uses across the range, primarily from sublethal effects to growth and reproduction if exposed. Similarly, risk to the species includes use, spray drift, and mosquito adulticide effects to prey, estimated at 16% (terrestrial invertebrate and amphibian prey), 40% (terrestrial invertebrates) and 55% (55% terrestrial invertebrate and 5% amphibian prey), respectively. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). We anticipate the species' susceptibility to adverse effects from pesticides and its exposure given its remaining habitat's proximity to pressures from and the threat of additional development. However, estimated usage is 2.3% of the species range (based on CalPur data), including less than 1% from mosquito adulticide. Estimated overlap of use with the species range is high at 71% (primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the CalPur usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the California tiger salamander (Santa Barbara DPS) based on standard practice and procedures. We anticipate limited exposure of the California tiger salamander (Santa Barbara DPS) resulting from effects to prey items associated with malathion use. While we do anticipate small numbers of individuals of the species or their prey would be exposed over the duration of the Action, we do not anticipate species-level effects.Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The California red-legged frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., ponds, springs, streams, marshes). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the California red-legged frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience low level, effects to growth and reproduction, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the California tiger Salamander (Santa Barbara DPS).

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Ambystoma bishopi	Reticulated flatwoods salamander	9943

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 main threat to the flatwoods salamander is loss of both its longleaf pine/slash pine flatwoods terrestrial habitat and its isolated, seasonally inundated breeding habitat. The combined pine flatwoods (longleaf pine-wiregrass flatwoods and slash pine flatwoods) historical acreage was approximately 32 million ac (12.8 million ha) (Wolfe et al., 1988; Outcalt, 1997). The combined flatwoods acreage has been reduced to 5.6 million ac (2.27 million ha) or approximately 18% of its original extent (Outcalt, 1997). These remaining pine flatwoods (non-plantation forests) areas are typically fragmented and degraded, with second-growth forests. Large tracts of intact longleaf pine flatwoods habitat are fragmented by roads and pine plantations. Most flatwoods salamander populations are widely separated from each other by unsuitable habitat. Land use conversions to urban development and agriculture eliminated large acreages of pine flatwoods in the past (Schultz, 1983; Stout and Marion, 1993; Outcalt and Sheffield, 1996; Outcalt, 1997). Wear and Greis (2002) identified conversion of forests to urban land uses as the most significant threat to southern forests. These authors predicted that the South could lose about 12 million forest acres (about 8% of its current forest land) to urbanization between 1992 and 2020. Flatwoods salamander breeding sites have also been degraded or altered. The number and diversity of these small wetlands have been reduced by alterations in hydrology, agricultural and urban development, incompatible silvicultural practices, shrub encroachment, dumping in or filling of ponds, conversion of wetlands to fish ponds, domestic animal grazing, and soil disturbance (Vickers et al., 1985; Ashton, 1992). Off-road vehicle (ORV) use within flatwoods salamander breeding ponds and their margins severely degrades wetland habitat. Habitat loss from agricultural conversion or commercial development, pond alteration and additional introduction of predatory fish, fire suppression leading to altered forest habitat and crayfish harvesting comprise the most serious threats to A. bishopi populations (Palis and Hammerson 2008). Disease is currently unknown in natural populations of reticulated flatwoods salamanders. Exposure to increased predation by fish is a potential threat to the reticulated flatwoods salamanders when isolated, seasonally ponded wetland breeding sites are changed to, or connected to, more permanent wetlands inhabited by fishes that are not typically found in temporary wetlands. Red imported fire ants (*Solenopsis invicta*) are potential predators of reticulated flatwoods salamanders, especially in disturbed areas. Nonindigenous feral swine can significantly impact reticulated flatwoods salamander breeding sites through rooting. Invasive plant species such as cogongrass (*Imperata cylindrica*) threaten to further degrade existing habitat. Climate change, especially in combination with other stressors, is a daunting challenge for the persistence of amphibians (Walls et al. 2013). Sea level rise is becoming and will likely continue to increase as a threat to the extant populations of the flatwoods salamanders (both species). Most of the remaining relatively resilient populations occur in very low lying areas within a short distance of the coast. Small population sizes, especially concentrated in small areas, are more susceptible to stochastic events that could negatively impact the entire population. Pesticides and herbicides are expected to pose a threat to amphibians such as the reticulated flatwoods salamander, because their permeable eggs and skin readily absorb substances from the surrounding aquatic or terrestrial environment (Duellman and Trueb, 1986).

EB/CE Source: U.S. Fish and Wildlife Service. 2015. Reticulated flatwoods salamander (*Ambystoma bishopi*), 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Panama City Field Office, Panama City, Florida.

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:

Terrestrial Phase: Individuals exposed to malathion at maximum rates on use sites are not expected to experience mortality from foraging on contaminated arthropods prey items, but some individuals are anticipated to die if exposed to direct spray. Mortality is not expected from exposure to spray drift. Effects due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	No effects expected	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	No effects expected	G – M R – M B – M

Direct spray or contact with contaminated media	Mortality if exposed on use sites	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	19 – 26% fish, amphibians, invertebrates	
Spray drift areas - Prey item mortality	Fish, amphibians, invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	
Indirect	50% fish and amphibians, 71% invertebrates	H

Risk modifiers:

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	I	4,974,300	71.24	236,282	3.38	5,6	H,M

[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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Pine Seed Orchards	I	488,143	6.99	14,330	0.21	5,6	*,*
Open Space Developed	I	334,685	4.79	16,734	0.24	5,6	*,*
Cotton	I	233,644	3.35	39,444	0.56	5,6	H,H
Other Crops	I	217,530	3.12	0	0	5,6	H,H
Other Row Crops	I	216,988	3.11	21,113	0.30	5,6	H,H
Developed	I	179,877	2.58	8,994	0.13	5,6	L,L
Corn	I	71,722	1.03	1,173	0.02	5,6	H,H
Orchards and Vineyards	I	52,453	0.75	7,452	0.11	5,6	H,H
Other Grains	I	29,564	0.42	12,377	0.18	5,6	H,H
Wheat	I	11,969	0.17	1,957	0.03	5,6	H,H
Pasture	I	197	<0.01	60	<0.01	5,6	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		0	0.00	0	0.00		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		1,836,772	26.31	123,633	1.77		
TOTAL[4]:		6,811,072	97.55	359,915	5.15		

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 6,982,344 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 573,151 acres, 8%

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

[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.

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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 reticulated flatwoods salamander. As discussed below, the vulnerability is high and risk and usage are medium 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The reticulated flatwoods salamander has a high vulnerability ranking due to its endangered status, limited distribution, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., habitat loss from agricultural conversion or commercial development, pond alteration and additional introduction of predatory fish, fire suppression leading to altered forest habitat and crayfish harvesting). The species has a medium risk ranking due to labeled uses across the range, primarily from effects to prey (19-26% for fish, amphibian, invertebrates). The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is 5.2% of the species range, including about 3.4% from mosquito adulticide so that we anticipate limited exposure of the reticulated flatwoods salamander, resulting in effects to prey items. As about half of the known occurrences of the reticulated flatwoods salamander exist on Federal or conserved state lands where the use of pesticides is generally rare or infrequent, we anticipate that the high overlap from mosquito adulticide is an overestimate. Similarly, the anticipated effects from such exposure would be much less than the approximate 71% overlap of the species range estimated from the use data (i.e., nearer the 3.4% estimated from the usage data).

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk of mortality is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is low based on the usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the reticulated flatwoods salamander based on standard practice and procedures.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The reticulated flatwoods salamander breeds in ephemeral ponds and spends most of its life history in seasonally wet pine flatwoods and wetlands. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the reticulated flatwoods salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, and effects to growth and reproduction from small reductions in the forage base over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the forage base would result in species-level effects. After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the reticulated flatwoods salamander.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians

Scientific Name:	Common Name:	Entity ID:
Rana sierrae	Sierra Nevada Yellow-legged frog	10517

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, the range of the Sierra Nevada yellow-legged frog extended in California from north of the Feather River, in Butte and Plumas Counties, south to the Monarch Divide on the west side of the Sierra Nevada crest in Fresno County. East of the Sierra Nevada crest in California, the historical range of the Sierra Nevada yellow-legged frog extends from areas north of Lake Tahoe, through Mono County (including the Glass Mountains) to Inyo County. Historical records indicate that the Sierra Nevada yellow-legged frog also occurred at locations within the Carson Range of Nevada, including Mount Rose in Washoe County, and also occurred in the vicinity of Lake Tahoe in Douglas County, Nevada (Linsdale 1940, pp. 208–210; Zweifel 1955, p. 231; Jennings 1984, p. 52; Knapp 2013, unpaginated). Since the time of the mountain yellow-legged frog observations of Grinnell and Storer (1924, pp. 664–665), a number of researchers have reported disappearances of these species from a large fraction of their historical ranges in the Sierra Nevada (Hayes and Jennings 1986, p. 490; Bradford 1989, p. 775; Bradford et al. 1994, pp. 323–327; Jennings and Hayes 1994, p. 78; Jennings 1995, p. 133; Stebbins and Cohen 1995, pp. 225–226; Drost and Fellers 1996, p. 414; Jennings 1996, pp. 934–935; Knapp and Matthews 2000, p. 428; Vredenburg et al. 2005, p. 564). The most pronounced declines within the mountain yellow-legged frog complex have occurred north of Lake Tahoe in the northernmost 125-km (78- mi) portion of the range (Sierra Nevada yellow-legged frog) and south of Kings Canyon National Park in Tulare County (the northern DPS of the mountain yellow-legged frog). In the southernmost 50-km (31-mi) portion of the range, only a few populations of the northern DPS of the mountain yellow-legged frog remain (Fellers 1994, p. 5; Jennings and Hayes 1994, pp. 74–78); except for a few small populations in the Kern River drainage, the northern DPS of the mountain yellow-legged frog is entirely extirpated from all of Sequoia National Park (Knapp 2013, unpaginated). CDFW (CDFG (CDFW) 2011, pp. 17– 20) used historical localities from museum records covering the same time interval (1899–1994), but updated recent locality information with additional survey data (1995–2010) to significantly increase proportional coverage from the Vredenburg et al. (2007) study. These more recent surveys failed to detect any extant frog populations (within 1 km (0.63 mi), a metric used to capture interbreeding individuals within metapopulations) at 220 of 318 historical Sierra Nevada yellow-legged frog localities and 94 of 109 historical northern DPS of the mountain yellow-legged frog localities (in the Sierran portion of their range). This calculates to an estimated loss of 69 percent of Sierra Nevada yellow-legged frog metapopulations and 86 percent of northern DPS of the mountain yellow-legged frog metapopulations from historical occurrences. To summarize population trends over the available historical record, estimates range from losses between 69 to 93 percent of Sierra Nevada yellow-legged frog populations and 86 to 92 percent of the northern DPS of the mountain yellow-legged frog. Fish introductions, dams and water diversions, livestock grazing, timber management, road construction and maintenance, packstock use, recreational activities, and fire management activities may have degraded habitat in ways that have reduced its capacity to sustain viable populations and may have fragmented and isolated mountain yellow-legged frog populations from each other. Other threats include predation by bullfrogs, amphibian pathogens (most specifically, the chytrid fungus), climate change, direct and indirect mortality (e.g.,, trampling by livestock, recreational activities), and small population size.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Sierra Nevada Yellow-Legged Frog and Northern Distinct Population Segment of the Mountain Yellow-Legged Frog, and Threatened Species Status for Yosemite Toad; Final Rule. Federal Register, Vol. 79, No. 82, 24256-24310.

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:

Terrestrial Phase: Some individuals exposed to malathion at maximum rates on use sites with higher allowable application rates would experience mortality from foraging on contaminated arthropods or from direct exposure to spray. Mortality is not expected from exposure to spray drift. Effects due to loss of prey are also anticipated.

Aquatic Phase: We anticipate that for most uses, individuals exposed to malathion in bins 2, 5 and 6 would be at high risk of mortality except for Developed, which has a medium risk of mortality for bins 2 and 5, and a low risk of mortality for bin 6. We anticipate individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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)	Terrestrial	Aquatic
Use areas – mortality	<1%	
Spray drift areas – mortality	No effects expected	
Sublethal – growth (G), reproduction (R) and behavior (B)	<1% (G, R – low effects)	G – M R – M B – M
Direct spray or contact with contaminated media	Mortality or sublethal effects if exposed	
Volatilization	Not an appreciable source of exposure	
INDIRECT (all uses except mosquito control)		
Use areas - Prey item mortality	<1%	
Spray drift areas - Prey item mortality	Up to 1.5% invertebrates	H
Plants affected (decline in growth)	N/A	
MOSQUITO CONTROL		
Direct (mortality)	No effects expected	
Sublethal	No effects expected	L
Indirect	9% invertebrates	H

Risk modifiers:

Allowable uses driving effects/other considerations: Overlap with developed and open space developed use sites accounts for most direct effects to the Sierra Nevada yellow-legged frog.

We anticipate effects to the invertebrate prey base from malathion exposure on or near use sites, or from mosquito control applications. Because invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. We anticipate this reduction will be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE

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

Usage data for the whole range based on data from EPA's SUUM:

Use type	Risk to species on terrestrial use sites [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	*	1,056,032	8.73	27,267	0.23	2,5,6	H,H,M
Open Space Developed	D, I	35,579	0.29	1,779	0.01	2,5,6	*,*,*
Developed	D, I	29,472	0.24	1,474	0.01	2,5,6	M,M.L
Pasture	I	19,834	0.16	18,853	0.16	2,5,6	H,H,H
Other Crops	*	1,308	0.01	0	0	2,5,6	H,H,H
Other Grains	*	940	0.01	940	0.01	2,5,6	H,H,H
Wheat	*	494	<0.01	494	<0.01	2,5,6	H,H,H
Vegetables and Ground Fruit	*	258	<0.01	331	<0.01	2,5,6	H,H,H
Orchards and Vineyards	*	160	<0.01	155	<0.01	2,5,6	H,H,H
Corn	*	87	<0.01	0	<0.01	2,5,6	H,H,H
Nurseries	D, I	51	<0.01	51	<0.01	2,5,6	H,H,H
Rice	*	10	<0.01	3	<0.01	2,5,6	*,*,*
Sub-TOTAL (D): *Other uses with direct effects*[3]		65,101	0.54	3,303	0.03		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		84,935	0.70	22,156	0.18		
TOTAL[4]:		1,140,967	9.43	49,423	0.41		

Agricultural usage in California only based on CalPUR data:

Use type	Risk to species[5]	Estimated usage in range[6]	
		acres	%
Pasture	I	0	0.00
Other Crops	*	0	0.00
Other Grains	*	0	0.00
Wheat	*	0	0.00
Vegetables and Ground Fruit	*	0	0.00
Orchards and Vineyards	*	1	0.00
Corn	*	0	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.
[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.
[5] Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)
[6] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[5]	Estimated usage in range[6]	
		acres	%
Nurseries	D, I	0	0.00
Rice	*	0	0.00
	TOTAL[7]:	0	0.00

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in effects to the prey base from spray drift (whether or not the species will utilize the site itself). Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 12,094,869 acres
% of range in California (i.e., where CalPUR data is available): 96%
Range overlap with Federal lands: 10,248,596 acres, 85%

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. We anticipate that, in many cases, these buffers will significantly reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

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

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 Sierra Nevada yellow-legged frog. As discussed below, while the vulnerability is high for this species the risk ranking is low, and 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 will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Sierra Nevada yellow-legged frog has a high vulnerability ranking due to its endangered status, limited distribution, small population size, declining populations, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., fish introductions, dams and water diversions, livestock grazing, timber management, road construction and maintenance, packstock use, recreational activities, and fire management activities). The species has a low risk ranking from labeled uses across the range, primarily from use site mortality and sublethal growth and reproduction effects (less than 1% each). Prey item (invertebrates) mortality from use sites and spray drift areas are also low (less than 1%). Mosquito adulticide effects to prey mortality is estimated to affect 9% of invertebrate prey. The species is at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). Estimated usage is limited to less than 1% of the species range with the largest fraction of that from mosquito adulticide usage (0.2%). Estimated overlap of use with the species range is less than 10% (also primarily from mosquito adulticide), but we anticipate that the usage information represents the more reliable information regarding exposure of this species.

For aquatic life stages, any exposure from use sites or mosquito adulticide applications would need to originate at or near the occupied locale (i.e., from spray drift or runoff as malathion is not approved for use in aquatic systems), not be diluted from the quantities of water within the occupied aquatic site, and then persist at sufficient concentration to have some measurable effect on the species. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the aquatic life stage vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low based on the CalPur usage data. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk to aquatic life stages identified above, and therefore, we do not anticipate species-level effects to occur.

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. Any additional malathion usage that occurs on Federal lands is expected to be extremely low and localized, and carried out with avoidance and minimization measures in place for listed species such as the Sierra Nevada yellow-legged frog based on standard practice and procedures. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Sierra Nevada yellow-legged frog breeds in ponds and spends most of its life history in moist sheltered areas in or around its various aquatic habitats (e.g., high or low-gradient streams, marshy edges and wet meadows). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Sierra Nevada yellow-legged frog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth and reproduction, and small reductions in the forage base over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the forage base would result in species-level effects. After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Sierra Nevada yellow-legged frog.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians (Aquatic)

Scientific Name:	Common Name:	Entity ID:
Typhlomolge rathbuni	Texas blind salamander	189

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:

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 as well as other 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 a possible threat that needs 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 nonnative species pose a significant threat to the listed species due to competition over habitat or diet and/or by modifying habitat, such as affected by nonnative elephant ears (Coloca.sia esculenta) and giant ramshorn snails (Marisa cornuarietis). In addition, some species prey on the listed species. Decreased flow may exacerbate the problem posed by nonnative 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: 1996 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 that risk of mortality and effects on reproduction, behavior and growth to Texas blind salamanders exposed to malathion via all uses in bins 2 and 3 to be high except for developed and mosquito control uses which pose a medium risk of mortality and sublethal effects (reproduction, behavior, and growth) at maximum rates on use sites. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or reduced length, or will experience loss of prey, depending on the use.

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	15.66%
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G – High R – High B – High
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	3.26%
Sublethal	Medium
Indirect	High

Risk modifiers: This species is inhabits the underground waters of the Edwards Aquifer in the San Marcos area of Hays County, Texas. The protection of water quality, in particular of the incoming waters from the recharge area are essential for the protection of this species.

As described 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, and that 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 on terrestrial use sites [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	23,619	3.26	0	0	2,3	H, H
Developed	D,I	18,982	2.62	942	0.13	2,3	M, M
Corn	D,I	14,160	1.95	4130	0.57	2,3	H, H
Other Grains	D,I	13,281	1.83	13,281	1.83	2,3	H, H
Cotton	D,I	5,469	0.75	5,289	0.73	2,3	H, H
Wheat	D,I	5,364	0.74	5,869	0.74	2,3	H, H
Other Crops	D,I	1,889	0.26	0	0	2,3	H, H
Orchards & Vineyards	D,I	64	<0.01	64	<0.01	2,3	H, H
Nurseries	D,I	35	<0.01	35	<0.01	2,3	H, H
Other Row Crops	D,I	25	<0.01	25	<0.01	2,3	H, H
Vegetables & Ground Fruit	D,I	7	<0.01	7	<0.01	2,3	H, H
Pasture	D,I	2	<0.01	2	<0.01	2,3	H, H
Sub-TOTAL (D): *Other uses with direct effects*[3]		59,278	8.2	29,644	4.02		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		59,278	8.2	29,644	4.02		
TOTAL[4]:		82,897	11.46	29,644	4.02		

See above for updated bin 3 and 4 considerations.**# acres in species range:** 724,518 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1 acre, 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

[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.

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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Texas blind salamander.

The Texas blind salamander has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high, as described above. The estimated usage within the range is low based on standard usage data, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We estimate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 15.66% mortality of individuals and 3.26% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift. Other effects include sublethal (as described above) resulting from runoff or spray drift from use sites and mosquito control treatments. Effects to the species prey are anticipated to be high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4.09%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed. While we cannot rule out impacts to the Texas blind salamander, the species is found within the subterranean waters of the Edwards aquifer. Any exposure from use sites or mosquito adulticide applications would need to originate at and enter the aquifers recharge zone (which may occur outside the species range), not be diluted from the large quantities of water within the aquifer, and then reach the areas where this species resides. The typical half-life of malathion (3 to 7 days in soil, 0.5 to 6 days in water), would further reduce the concentration reaching the species occupied habitat. Even though the vulnerability of this species is high, and the risk is high for this species based on labeled uses, the likelihood of exposure to malathion via this exposure pathway is very low.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Texas blind salamander is a reclusive troglobitic salamander inhabiting the Edwards Aquifer. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Texas blind salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. We do not anticipate that the concentration of malathion in this case would lead to the high level of risk identified above. Thus, we expect exposure of individual salamanders and their food resources 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 their forage base. Therefore, we do not anticipate that the proposed Action would result in species-level effects.

Therefore, we do not anticipate that the action would appreciably reduce survival and recovery of the Texas blind salamander in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Eurycea nana	San Marcos salamander	194

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: All populations stable, with none known to be increasing or decreasing
Pesticides noted ☒

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

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 as well as other 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 a possible threat that needs 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 nonnative species pose a significant threat to the listed species due to competition over habitat or diet and/or by modifying habitat, such as affected by nonnative elephant ears (Coloca.sia esculenta) and giant ramshorn snails (Marisa cornuarietis). In addition, some species prey on the listed species. Decreased flow may exacerbate the problem posed by nonnative 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/Comal (Revised) Recovery Plan. Albuquerque, New Mexico. pp. x + 93 with 28 pages of appendices.

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 that risk of mortality and effects on reproduction, behavior and growth to San Marcos salamanders exposed to malathion via all uses in bins 2 and 3 to be high except for developed and mosquito control uses which pose a medium risk of mortality and sublethal effects (reproduction, behavior, and growth) at maximum rates on use sites. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or reduced length, or will experience loss of prey, depending on the use.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	15.66%
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G – Medium R – Medium B - Medium/High
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	3.26%
Sublethal	Low/Medium
Indirect	High

Risk modifiers: The San Marcos salamander is found in the headwater pools (San Marcos Springs, Spring Lake) of the San Marcus River in Hayes County, TX, and a short distance downstream. The headwater pools source water is from the Edwards Aquifer and is subject to pesticide contamination from waters entering the aquifer in the recharge zone and well as other surface water inputs to the system.

As described 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, and that 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 on terrestrial use sites [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		23,619	3.26	0	0	2,3	H,H
Developed		18,982	2.62	942	0.13	2,3	M,M
Corn		14,160	1.95	4130	0.57	2,3	H,H
Other Grains		13,281	1.83	13,281	1.83	2,3	H,H
Cotton		5,469	0.75	5,289	0.73	2,3	H,H
Wheat		5,364	0.74	5,364	0.74	2,3	H,H
Other Crops		1,889	0.26	0	0	2,3	H,H
Orchards and Vineyards		64	<0.01	64	<0.01	2,3	H,H
Nurseries		35	<0.01	35	<0.01	2,3	H,H
Other Row Crops		25	<0.01	25	<0.01	2,3	H,H
Vegetables and Ground Fruit		7	<0.01	7	<0.01	2,3	H,H
Pasture		2	<0.01	2	<0.01	2,3	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		59,278	11.46	29,644	4.02		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		59,278	8.2	29,644	4.02		
TOTAL[4]:		82,897	11.46	29,644	4.02		

See above for updated bin 3 and 4 considerations.**# acres in species range:** 724,518 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1 acre, <0.001%

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

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[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. We anticipate that, in many cases, these buffers will 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 any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 San Marcos salamander.

The San Marcos salamander has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high, as described above. The estimated usage within the range is low based on standard usage data, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We estimate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 15.66% mortality of individuals and 3.26% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift. Other effects include sublethal (as described above) resulting from runoff or spray drift from use sites and mosquito control treatments. Effects to the species prey are anticipated to be high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4.09%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed. The San Marcos salamander inhabits San Marcos springs, portions of Spring Lake, and a small segment of the San Marcos River immediately downriver of Spring Lake dam in Hays County, Texas. The area surrounding the springs, Spring Lake, and the downstream segment of San Marcos River includes forested park, developed areas and a golf course. Little agriculture occurs in the immediate area around the species occupied habitat. Developed areas account for approximately 0.13% of malathion use per year. We anticipate exposure to the species from runoff or drift if developed areas are treated in the vicinity of the species habitat. Additionally, malathion entering the recharge zones in the Edwards aquifer (which may occur outside the species range) are anticipated to reach the springs and Spring Lake where the salamander lives, but due to the low quantity of malathion used on an annual basis, the typical half-life of the chemical (3 to 7 days in soil, 0.5 to 6 days in water) and the large amount of water that flows through the aquifer, it is expected that any malathion that enters the aquifer would be diluted to concentrations that would not lead to the high level of risk described above. Thus, malathion exposure is anticipated to be low.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The San Marcos salamander is a fully aquatic lungless salamander inhabiting Spring Lake and portions of the headwaters of the San Marcos River. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the San Marcos salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the San Marcos salamander in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Eurycea sosorum	Barton Springs salamander	197

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: Small number of individuals in one or more populations
Pesticides noted ☒

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

The Barton Springs salamander has one of the smallest geographical ranges of any vertebrate species in North America (Chippindale et al. 1993, Conant and Collins 1998). The Barton Springs salamander has only been documented at four spring outlets (collectively known as Barton Springs) within the City of Austin's Zilker Park in Travis County, Texas. Barton Springs is an aquifer-fed system consisting of four hydrologically connected springs: (1) Main Springs (also known as Parthenia Springs or Barton Springs Pool); (2) Eliza Springs (also known as the Elks Pit); (3) Sunken Garden Springs (also known as Old Mill or Walsh Springs); and (4) Upper Barton Springs (Pipkin and Frech 1993). Recent searches have documented salamanders at other springs in the Barton Springs Segment of the Edwards Aquifer including Cold Springs and Blowing Sink Cave. Mitochondrial DNA analysis suggests that these salamanders are closely related to one of two haplotypes found in the Barton Springs salamander (Chippindale 2012). The City of Austin initiated salamander surveys in (1) Barton Springs Pool in 1993, (2) Sunken Garden Springs and Eliza Springs in 1995, and (3) Upper Barton Springs in 1997.

Monthly surveys conducted since 1993 have resulted in a number of salamander observations ranging from 1 to 100 (City of Austin 1998b, City of Austin 1993-2003, unpublished data). Surveys at Eliza Springs conducted from 1995 to March 2003 by biologists from the City of Austin using scuba and snorkel equipment have documented an average of 12 salamanders per month with a peak in 1997 (59 salamanders) which was followed by a steady decline. Following efforts to improve habitat conditions in late 2002 and 2003, observed numbers increased to 233 in January 2004. Total numbers of salamanders observed at Sunken Garden Springs have ranged from 0 to 85 over the years (City of Austin and Service 1996-2003, unpublished data). In April 1997, biologists from the City of Austin and Service discovered 14 adult salamanders at Upper Barton Springs, which flows intermittently. Salamander numbers observed since that time have ranged from 0 to 14 at this site (City of Austin 1998b, City of Austin 1997-2004, unpublished data). The primary threats or reasons for listing the Barton Springs salamander were "the degradation of the quality and quantity of water that feeds Barton Springs" as a result of urban expansion over the watershed. The species' restricted range makes it vulnerable to both acute and chronic groundwater contamination. The salamander is also vulnerable to catastrophic hazardous materials spills, increased water withdrawals from the Edwards Aquifer, and impacts to the surface habitat. Pollutants and contaminants occurring within the Barton Springs watershed can affect the salamander and its habitat. Toxic effects to aquatic organisms from contaminants may be either lethal or sublethal and may include morphological and developmental aberrations, lowered reproductive and survival rates, and changes in behavior and certain biochemical processes (Rand et al. 1995). There are several examples of pesticides issues that have been recognized. For example, research has shown that amphibians (particularly eggs and larvae) are sensitive to many contaminants including heavy metals, pesticides, nitrites, salts, and petroleum hydrocarbons (Harfenist et al. 1989). Additionally, atrazine (up to 0.56 µg/l) as well as trace amounts of diazinon, carbaryl, and simazine have been detected in spring discharge water in salamander habitat after a stormwater runoff event (Mahler and Van Metre 2000). There are several conservation measures that have been completed or are currently underway. Examples of these include land acquisitions and conservation easements, water quality protection recommendations, regional water planning, City of Austin's habitat conservation plan covering operation and maintenance of Barton Springs Pool and adjacent springs, captive breeding and water quality monitoring.

From 2019 5-year Review:

Since the previous 5-year review conducted for this species in 2006, Barton Springs salamanders have been determined to occur in 12 additional spring and cave sites (Bendik et al 2013, p. 6; Chippindale 2014, pp. 2-3; Hillis et al. 2015, p. 18; McDermid et al. 2015, pp. 556-557; Devitt and Nissen 2018, p. 297-299; Figure 1).

Although the Barton Springs salamander has recently been found to be more broadly distributed than was previously documented in the Barton Springs Salamander Recovery Plan, its range remains considerably small, and the degree of population connectivity is unknown (Devitt and Nissan 2018, p. 299). Barton Springs salamander populations continue to be at high risk of extinction due to the rapid rate of urbanization across range, the ongoing threats of decreasing water quality and quantity in the aquifer systems on which it depends, and catastrophic spills. Rapid population growth, increased water demands, and a warming climate with more frequent drought conditions continue to place increased stress on the limited water resources required by the Barton Springs salamander to meet its breeding, feeding, and sheltering needs.

EB/CE Source: U.S. Fish and Wildlife Service. 2005. Barton Springs Salamander (Eurycea sosorum) Recovery Plan; amended January 2016 (to include Austin Blind Salamander). U.S. Fish and Wildlife Service, Albuquerque, NM. Excerpt from Status of the Species.

2019 5-year review.

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 that risk of mortality and sublethal effects on reproduction, behavior and growth to Barton Springs salamanders exposed to malathion via all uses in bins 2 and 3 to be high except for developed and mosquito control uses which poses a medium risk of mortality and effects on reproduction and behavior but low effects on growth at maximum rates on use sites. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or some reduced length, or will experience loss of prey, depending on the use..

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	23.17%
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G – Low/Medium R – Medium/High B - Medium/High
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	49.51%
Sublethal	Medium
Indirect	High

Risk modifiers: The Barton Springs salamander has one of the smallest home range of any vertebrate in North America confined to four spring outlets that make up Barton Springs in Zilker Park near downtown Austin, Texas, and at other springs in the Barton Springs segment of the Edwards Aquifer. Water quality and quantity issues are a major threat to this species. Contaminant and pesticide inputs to the aquifer recharge area and discharges to the surface waters are of primary concern from spill or any other releases/sources.

As described 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, and that 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 on terrestrial use sites [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	600,642	49.51	0	0	2,3	H
Developed	D,I	113,446	9.35	8,110	0.47	2,3	M
Corn	D,I	39,430	3.25	4,141	0.24	2,3	H
Other Grains	D,I	24,592	2.03	24,592	2.03	2,3	H
Wheat	D,I	11,241	0.93	11,241	0.93	2,3	H
Cotton	D,I	8,352	0.69	10,871	0.63	2,3	H
Other crops	D,I	3,391	0.28	0	0	2,3	H
Orchards and Vineyards	D,I	515	0.04	345	0.02	2,3	H
Nurseries	D,I	455	0.04	455	0.04	2,3	H
Other Row Crops	D,I	21	<0.01	21	<0.01	2,3	H
Vegetables and Ground Fruit	D,I	9	<0.01	9	<0.01	2,3	H
Pasture	D,I	3	<0.01	3	<0.01	2,3	H
Sub-TOTAL (D): *Other uses with direct effects*[3]		201,455	16.64	59,788	4.40		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		201,455	16.64	59,788	4.40		
TOTAL[4]:		802,097	66.15	59,788	4.40		

See above for updated bin 3 and 4 considerations.**# acres in species range:** 1,725,493 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 45,335 acres, 2.627%

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

[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.

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Barton Springs salamander. As discussed below, the vulnerability and the risk is high for the species; however, we anticipate the likelihood of exposure to malathion to be low due to low usage across the species range, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipated 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 Barton Springs salamander has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high, as described above. The estimated usage within the range is low based on standard usage data. We estimate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 23.17% mortality of individuals and 49.51% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift. Other effects include sublethal (as described above) resulting from runoff or spray drift from use sites and mosquito control treatments. Effects to the species prey are anticipated to be high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4.40%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed. The species current range map used for this analysis is much larger than the area occupied by the species and was likely mapped to account for the surrounding area that influences habitat in the Edwards Aquifer and the spring sites, and thus usage may be overestimated. Areas surrounding occupied habitat largely consists of developed areas and open-space developed (e.g., city and county parks). Agriculture has largely been replaced by development, but still exists sporadically. Developed areas account for approximately 0.47% of malathion use per year.

The City of Austin (City of Austin 2020) tests for a variety of contaminants, including organophosphates. Malathion has been detected on numerous occasions (1994 to 2019) in ground water samples in Barton Creek watershed; however, the majority of samples were not at concentrations that would induce mortality or sublethal effects. A few detections (range from 10-11 ug/L) are considered high enough to impact growth. We anticipate exposure to the species from runoff or drift if developed areas are treated in the vicinity of the species habitat. Additionally, malathion entering the recharge zones in the Edwards aquifer (which may occur outside the species range) is anticipated to reach the occupied habitat where the salamander lives, but due to the low quantity of malathion used on an annual basis, the typical half-life of the chemical (3 to 7 days in soil, 0.5 to 6 days in water) and the large amount of water that flows through the aquifer, it is expected that any malathion that enters the aquifer would be diluted to concentrations that would not lead to the high level of risk described above.

The Barton Springs salamander is confined to four spring outlets that make up Barton Springs in Zilker Park near downtown Austin, Texas, and at 12 other cave and spring sites in the Barton Springs segment of the Edwards Aquifer. While the salamander is found in surface waters at the springs and cave sites, most individuals likely occur within the aquifer itself. Since the species abundance outside of the aquifer is relatively low, we anticipate that exposure to malathion from runoff or drift is low, and thus mortality or sublethal effects to the species would likely be low based on the low usage within the species range. We don't anticipate substantial exposure through aquifer discharge, as any malathion in discharge waters would likely be diluted to a level that would not cause effects. Thus, risk of exposure to malathion is anticipated to be low.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Barton Springs salamander is a fully aquatic salamander inhabiting several hydrologically connected pools of Barton Springs within the Edwards Aquifer. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Barton Springs salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Therefore, since we anticipate that very few individuals would be affected by mortality, sublethal (related to reductions in fecundity, alterations in swimming behavior) and very little reduction in growth (length), or reductions in prey, we do not anticipate species-level effects.

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

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

City of Austin. 2020, July 16. Water Quality Sampling Data. City of Austin. Retrieved July 16, 2020 from <https://data.austintexas.gov/Environment/Water-Quality-Sampling-Data/5tye-7ray/data>.

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Necturus lewisi	Neuse River waterdog	2932

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 Neuse River Waterdog is a permanently aquatic salamander species endemic to the Tar-Pamlico 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. Waterdogs prefer clean water with permanent flow and are not tolerant of siltation and turbidity (Ashton 1985, entire). Benthic critters such as the waterdog have disproportionate rates of imperilment and extirpation because stream bottoms are often the first habitats affected by pollution (Midway et al. 2010, p.325). Furthermore, the Neuse River Waterdog could be considered an "intolerant" species, meaning the species is most affected by environmental perturbations (Ashton 1985, p.104-105). Streams with urbanized or agriculturally dominated riparian corridors are subject to increased sediment-loading from unstable banks and/or impervious surface run-off, resulting in less suitable in-stream habitat for waterdogs as compared to habitat with forested corridors (Allan et al., 1997, p.156).

Estimates of current and future resiliency for Neuse River Waterdog are moderate to low, as are estimates for representation and redundancy. The Neuse River Waterdog faces a variety of risks from declines in water quality, loss of stream flow, riparian and instream fragmentation, and deterioration of instream habitats. These risks, which are expected to be exacerbated by urbanization and climate change, were important factors in our assessment of the future viability of the Neuse River Waterdog. Given losses of resiliency, populations become more vulnerable to extirpation, in turn, resulting in concurrent losses in representation and redundancy. Predictions of Neuse River Waterdog habitat conditions and population factors suggest possible extirpation in two of three currently extant populations. The one population predicted to remain extant (Tar) is expected to be characterized by low occupancy and abundance in the future.

EB/CE Source: U.S. Fish and Wildlife Service. 2017. Species status assessment report for the Neuse River Waterdog (Necturus lewisi). Version 1.0. May, 2017. Atlanta, GA. Also, Final Rule; Endangered and Threatened Wildlife and Plants; Endangered Species Status for Black Warrior Waterdog and Designation of Critical Habitat. 83 FR 17. Pages 257-284.

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 that risk of mortality to the Neuse River waterdog will be high from exposure to malathion on all use sites at maximum rates except developed and mosquito control, which have a medium level of risk . We anticipate low levels of sublethal effects for all uses.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	High, except developed uses, which is Medium
Sublethal – growth (G), reproduction (R) and behavior (B)	G – Low R -Low B - Medium
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	High
Sublethal	Low
Indirect	High

Risk modifiers:

Allowable uses driving effects/other considerations:

A reassessment of crop UDL showed that usage data in the “Other Row Crops” 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 (Idaho, Oregon, and Washington), with some small farms in Florida (Gadsden county) reporting occasional hop production. Given the highly specific regions that hops are grown in, we can assume that the potential exposure to malathion from “other row crops” use sites is 0 outside the areas indicated above and is thus not applicable to this species.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	658,094	12.57	0	0	2	2M
Other Crops	D, I	44,417	0.85	0	0	2	2H
Other Row Crops	D, I	1,922,145	0.37	3873	0.07	2	2H
Open Space Developed	D, I	315,821	6.03	15,791	0.3	2	2H
Other Grains	D, I	7,145	0.14	2,614	0.05	2	2H
Corn	D, I	183,696	3.5	2,230	0.04	2	2H
Cotton	D, I	48,665	0.93	11,177	0.21	2	2H
Developed	D, I	156,057	2.98	7,803	0.15	2	2H
Wheat	D, I	343,576	0.26	12,975	0.02	2	2H
Vegetables & Ground Fruit	D, I	847,166	0.14	2,253	0.04	2	2H
Orchards & Vineyards	D, I	2,321	0.04	242	<0.01	2	2H
Pasture	D, I	1,520	0.06	64	<0.01	2	2H
Nurseries	D, I	1,205	0.02	1,979	0.04	2	2H
Sub-TOTAL (D): *Other uses with direct effects*[3]		3,873,734	15.32	61,000	1.16		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		3,873,734	15.32	61,000	1.16		
TOTAL[4]:		4,531,828	27.89	61,000	1.16		

 # acres in species range: 5,236,256 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 171,929 acres, 2.534%

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Neuse River waterdog.

The Neuse River waterdog has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is estimated to be high. We estimate that across the species range, annual malathion uses pursuant to the labels would be high if exposed to the chemical via runoff or spray drift from all use sites and mosquito adulticide application sites. For those individuals that do not die, they are anticipated to be impacted by sublethal effects (growth, reproduction, behavior). Effects to the species prey are anticipated to be high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species' range will be low (0.89%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed.

The species range is very large (>5 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 are expected to 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. Based upon the usage estimates, we anticipate exposure to malathion would be low.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Neuse River waterdog is a fully aquatic salamander that utilizes low to moderate-gradient streams with low current velocities. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Neuse River waterdog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Thus, while we anticipate small numbers of individuals would be affected by mortality, sublethal, (related to reductions in fecundity, alterations in swimming behavior), and very little reductions in growth (length), or reductions in prey, we do not anticipate species-level effects.

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

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Necturus alabamensis	Black warrior waterdog, (=Sipsey Fork)	5065

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 Black Warrior waterdog (waterdog) is found only within streams within the Black Warrior River Basin (Basin) in Alabama. The waterdog inhabits streams above the Piedmont Fall Line (the contact between the Coastal Plain and the adjacent Upland provinces) within the Basin in Alabama, including parts of the North River, Locust Fork, Mulberry Fork, and Sipsey Fork drainages and their tributaries. There are a total of 11 historical records from sites in Blount, Tuscaloosa, Walker, and Winston Counties, Alabama. Since 1990, the species has been reported from only 14 sites. These sites are in Blount (Blackburn Fork of the Little Warrior River), Marshall (Slab Creek, tributary to Locust Fork), Tuscaloosa (Yellow Creek, North River, Carroll Creek, Lye Branch, Mulberry Fork), Walker (Lost Creek, Little Blackwater Creek), and Winston (Sipsey Fork, Blackwater Creek, Browns Creek, Brushy Creek, Capsey Creek) Counties, Alabama. No waterdogs were recently captured at any historic localities outside of William Bankhead National Forest (BNF). Therefore, we believe the populations are in decline outside of BNF. Water quality degradation is the primary threat to the continued existence of the Black Warrior waterdog. Sources of point (point source discharge) and nonpoint (land surface runoff) pollution in the Basin have been numerous and widespread. Point pollution is generated from inadequately treated effluent from industrial plants, sanitary landfills, sewage treatment plants, and drain fields from individual private homes (Service 2000, pp. 12–13). Nonpoint pollution originates from agricultural activities, poultry and cattle feedlots, abandoned mine runoff, construction, silviculture, failing septic tanks, and contaminated runoff from urban areas (Deutsch et al. 1990, pp. 1–62, Upper Black Warrior Technical Task Force 1991, p. 1; O'Neil and Sheppard 2001, p. 2). Forestry operations and road construction are also sources of nonpoint pollution when best management practices (BMPs) are not followed to protect streamside management zones (Hartfield 1990, pp. 4–6; Service 2000, p. 13). Surface mining represents another threat to the biological integrity of streams in the Basin and has undoubtedly, in the past, affected the distribution of the Black Warrior waterdog (Bailey 1995, p. 10). Creation of large impoundments, behind Bankhead, Lewis, and Holt dams, within the Basin has flooded thousands of square hectares (acres) of habitat previously considered appropriate for the Black Warrior waterdog. The Service considers the Black Warrior waterdog vulnerable to other natural or manmade factors, because low population densities combined with fragmentation of habitat renders the Black Warrior waterdog populations extremely vulnerable to inbreeding depression (negative genetic effects of small populations) (Wright et al. 2008, p. 833) and catastrophic events such as flood, drought, or chemical spills (Black Warrior River Watershed Management Plan n.d., p. 4.4).

EB/CE Source: U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Black Warrior Waterdog (Necturus alabamensis), Proposed Rule. Federal Register, Vol. 81, No. 194, 69500-69508. U.S. Fish and Wildlife Service. 2013. Species Assessment and Listing Priority Assignment Form for the Black Warrior Waterdog (Necturus alabamensis). U.S. Fish and Widlife Service, Southeast Region, Atlanta, GA.

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 that Black warrior water dogs exposed to malathion via all uses in bins 3 and 4 will be at high risk for mortality for all uses except for developed and mosquito control which will be a medium risk of mortality. This species will experience loss of prey (invertebrates and vertebrates) and sub-lethal effects (some reductions in growth, fecundity, and alterations in swimming behavior) from all use sites.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	10.66%
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G: High except Low for developed R: Low B: High except Low for developed
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Invertebrate prey: H Fish prey: High except for Low for developed
MOSQUITO CONTROL	
Direct (mortality)	16.17%
Sublethal	G :Low R: Low B: Low
Indirect	Invertebrate prey: High

	Fish prey: Medium

Risk modifiers:

The Black Warrior waterdog inhabits streams above the Fall Line (the contact between the coastal plain and the adjacent upland provinces) within the Black Warrior River Basin (Basin) in Alabama. Rocks, submerged ledges, and other cover probably play an important role in determining habitat suitability (Ashton and Peavy 1986, p. 64). Semi-permanent leaf beds (where they exist) are likely visited frequently (Ashton and Peavy 1986, p. 64). Larvae and adult waterdogs are reliably found only in these submerged leaf beds and they may use them for both shelter and foraging habitat (Bailey 2000, p. 3). Guyer (1997, found that Black Warrior waterdogs were associated with clay substrates lacking silt; wide and/or shallow stream morphology; increased snail and dusky salamanders *(Desmognathus spp*.) abundance; and decreased Asiatic clam (*Corbicula fluminea*) occurrence. At a regional scale, Black Warrior waterdogs were associated with stream depths of 1 to 4 meters (m) (3.3 to 13.1 feet (ft)), reduced sedimentation, and large leaf packs supporting mayfly (*Ephemeroptera*) and caddis fly (Trichoptera) larvae.

As described 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, and that 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 on terrestrial use sites [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	719,074	16.1	18,167	0.41	3,4	3H 4H
Developed	D,I	175,323	3.94	8,766	0.2	3,4	3H 4H
Corn	D,I	18,851	0.42	585	0.01	3,4	3M 4M

[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 on terrestrial use sites [1]	Use overlap with range		Estimated usage in range[2]		Bins associated with use type^	Effect associated with bin (H, M, L)
		Acres	%	Acres	%		
Cotton	D,I	8,948	0.2	8,043	0.18	3,4	3H 4H
Other Crops	D,I	5,530	0.12	0	0	3,4	3H 4H
Other Row Crops	D,I	956	0.02	956	0.02	3,4	3H 4H
Wheat	D,I	818	0.02	310	< 0.01	3,4	3H 4H
Other Grains	D,I	506	0.01	367	< 0.01	3,4	3H 4H
Vegetables & Ground Fruit	D,I	419	< 0.01	181	< 0.01	3,4	3H 4H
Nurseries	D,I	260	< 0.01	260	< 0.01	3,4	3H 4H
Orchards & Vineyards	D,I	28	< 0.01	28	< 0.01	3,4	3H 4H
Pasture	D,I	12	< 0.01	6	< 0.01	3,4	3H 4H
Christmas trees	D,I	3	< 0.01	3	< 0.01	3,4	3H 4H
Sub-TOTAL (D): *Other uses with direct effects*[3]		211,654	4.78	19,505	0.49		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		211,654	4.78	19,505	0.49		
TOTAL[4]:		930,729	20.95	37,6742	0.90		

^See above for updated bin 3 and 4 considerations.# **acres in species range:** 4,445,770 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 357,159 acres, 8.034%

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 Black Warrior waterdog.

The Black Warrior waterdog has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high, as described above. The estimated usage within the range is low based on standard usage data, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We estimate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 10.66% mortality of individuals and 16.17% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift. Other effects include sublethal (as described above) resulting from runoff or spray drift from use sites and mosquito control treatments. Effects to the species prey are anticipated to be low to high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species' range will be low (0.9%), 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. Mosquito adulticide applications account for 0.41% of this use. Since 1990, the Black Warrior waterdog has only been reported from 14 sites. No waterdogs were recently captured at any historic localities outside of Bankhead National Forest. Only the Sipsey Fork and Brushy Creek populations, in Bankhead National Forest, appear to be maintaining numbers sufficient enough to be captured regularly. We anticipate that there will be a loss of a small number of individuals or individuals will be subjected to sublethal effects if malathion is used within the range of the species, particularly in the absence of conservation measures. Additionally, we anticipate a small loss of prey resources. Even though the vulnerability is high and risk is high for this species, past malathion usage overlaps such a small portion of the species range (0.9%), and we anticipate similar levels of usage in the future. Thus, we expect that the likelihood of exposure to malathion is low.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers and residential use label changes will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Black Warrior waterdog is an endemic salamander and a habitat specialist, preferring to inhabit clay or bedrock substrates with abundant crevices for shelter and laying eggs. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Black Warrior waterdog when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Additionally, the most abundant populations occur on the Bankhead National Forest, where we expect malathion usage to be low.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Black Warrior waterdog in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	**Common Name:**	**Entity ID:**
Eurycea naufragia	Georgetown Salamander	5434

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 habitats of the Georgetown and Salado salamanders occur in the Northern Segment of the Edwards Aquifer. The recharge and contributing zones of this segment of the Edwards Aquifer are found in portions of Travis, Williamson, and Bell Counties, Texas (Jones 2003, p. 3). The Georgetown salamander is known from springs along five tributaries (South, Middle, and North Forks; Cowan Creek; and Berry Creek) to the San Gabriel River (Pierce 2011a, p. 2) and from two caves (aquatic, subterranean locations) in Williamson County, Texas. The Service is currently aware of 17 Georgetown salamander localities (15 in or around a spring opening and 2 in caves). We have recently received confirmation that Georgetown salamanders occur at two additional spring sites (Hogg Hollow II Spring and Garey Ranch Spring) (Covey 2013, pers. comm., Covey 2014, pers. comm.). This species has not been observed in more than 20 years at San Gabriel Spring and more than 10 years at Buford Hollow Spring, despite several survey efforts to find it (Chippindale et al. 2000, p. 40, Pierce 2011b, c, Southwestern University, pers. comm.). We are unaware of any population surveys in the last 10 years from a number of sites (such as Cedar Breaks Hiking Trail, Shadow Canyon, and Bat Well). Georgetown salamanders continue to be observed at the remaining 12 sites (Avant Spring, Swinbank Spring, Knight Spring, Twin Springs, Cowan Creek Spring, Cedar Hollow Spring, Cobbs Spring/Cobbs Well, Garey Ranch Spring, Hogg Hollow Spring, Hogg Hollow II Spring, Walnut Spring, and Water Tank Cave) (Pierce 2011c, pers. comm.; Gluesenkamp 2011a, TPWD, pers. comm.). Recent mark-recapture studies suggest a population size of 100 to 200 adult salamanders at Twin Springs, with a similar population estimate at Swinbank Spring (Pierce 2011a, p. 18). Population sizes at other sites are unknown, but visual surface counts result in low numbers (Williamson County 2008, pp. 3–35). In fact, through a review of survey data available in our files and provided during the peer review and public comment period for the proposed rule, we found that the highest numbers observed at each of the other spring sites during the last 10 years is less than 50 (less than 5 salamanders at Avant Spring, Bat Well Cave, Cobbs Spring/CobbsWell, Shadow Canyon, and Walnut Spring; 0 salamanders at Buford Hollow Spring and San Gabriel Spring). There are other springs in Williamson County that may support Georgetown salamander populations, but access to the private lands where these springs are found has not been allowed, which has prevented surveys being done at these sites (Williamson County 2008, pp. 3–35).

Threats to the species include water quality degradation (urbanization, hazardous material spills, underground storage tanks, highways, water and sewage lines, construction activities, quarries, contaminants and pollutants, pesticides, nutrients), changes to water chemistry, changes in prey base community, water quantity degradation (groundwater pumping, drought, climate change), and physical modification of surface habitat (sedimentation, impoundments, flooding, livestock, human visitation/recreation), small population size, stochastic events, UV-B radiation, and synergistic and additive interactions among stressors (e.g., contaminants, UV-B radiation, pathogens).

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Determination of Threatened Species Status for the Georgetown Salamander and Salado Salamander Throughout Their Ranges; Final Rule. Federal Register, Vol. 79, No. 36, 10236-10293.

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 that risk of mortality and sublethal effects on reproduction, behavior and growth to the Georgetown salamander exposed to malathion via all uses in bins 2 and 3 to be high at maximum rates on use sites. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, reduced growth (length), and will experience loss of prey.

Risk to the species from labeled uses across the range:

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	33.3%
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G: High R: High for cotton B: High for all except developed
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Invertebrate prey: High
MOSQUITO CONTROL	
Direct (mortality)	79.44%
Sublethal	High
Indirect	High

Risk modifiers:

Surface-dwelling Georgetown salamanders inhabit spring runs, riffles, and pools with gravel and cobble rock substrates (Pierce et al., 2010). This species prefers larger cobble and boulders to use as cover (Pierce et al., 2010). Georgetown salamanders are found within 164 ft (50 m) of a spring opening (Pierce et al., 2011a), but they are most abundant within the first 16.4 ft (5 m) (Pierce et al., 2010). It also occurs in subsurface (within caves or other underground areas within the Edwards Aquifer) habitats. It may travel an unknown depth into interstitial spaces within the spring or streambed substrate that provide foraging habitat and protection from predators and drought conditions (Cole, 1995; Pierce and Wall, 2011). It may also use deeper passages of the aquifer that connect to the spring opening (Dries 2011, City of Austin (COA), pers. comm.). (USFWS, 2014).

As described 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, and that 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..

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. As aquatic and terrestrial invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	959,836	79.44	41,174	3.1	2,3	2H 3
Corn	D,I	135,649	11.23	4,101	0.34	2,3	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 on terrestrial use sites [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	D,I	76,600	6.34	3,830	0.32	2,3	2M 3
Other Grains	D,I	39,057	3.23	39,057	3.23	2,3	2H 3
Wheat	D,I	28,456	2.36	28,456	2.22	2,3	2H 3
Cotton	D,I	17,282	1.43	15,664	1.3	2,3	2H 3
Other Crops	D,I	4,760	0.39	0	0	2,3	2H 3
Orchards & Vineyards	D,I	353	0.03	92	<0.01	2,3	2H 3
Nurseries	D,I	134	0.01	134	0.01	2,3	2H 3
Vegetables & Ground Fruit	D,I	29	<0.01	28	<0.01	2,3	2H 3
Other Row Crops	D,I	17	<0.01	17	<0.01	2,3	2H 3
Pasture	D,I	6	<0.01	7	<0.01	2,3	2H 3
Sub-TOTAL (D): *Other uses with direct effects*[3]		302,342	25.05	91,386	7.47		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		302,342	25.05	91,386	7.47		
TOTAL[4]:		1,262,179	104.49	132,560	10.57		

See above for updated bin 3 and 4 considerations.**# acres in species range:** 1,208,218 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 17,404 acres, 1.440%

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

[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.

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Georgetown salamander.

The Georgetown salamander has a high vulnerability based on its status, distribution, and trends. Georgetown salamanders are known from 21 localities (19 springs, 2 caves); although the species has only been continuously observed at 12 of these locations. Georgetown salamanders are found in subsurface waters (within caves or other underground areas within the Edwards Aquifer) and in surface waters, including spring runs, riffles and pools within 164 feet (50 meters) of a spring opening, although they are most abundant within the first 16.4 feet (5 meters). Seventeen of the known Georgetown salamander localities are within the City of Georgetown's jurisdiction for residential and commercial development.

The risk to the species posed by labeled uses across the range is high, as described above. The estimated usage within the range is high (10.59%) based on standard usage data, with mosquito adulticides accounting for 3.1% of the use and 7.47% from other uses. We estimate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 33.3% mortality of individuals and 79.44% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift. Other effects include sublethal (as described above) resulting from runoff or spray drift from use sites and mosquito control treatments. Effects to the species prey are anticipated to be high pursuant to labeled uses.

If use sites occur adjacent to cave/spring openings and the aquatic habitat directly downstream, individual salamanders would be anticipated to die or be subjected to sublethal effects or have reductions in the prey resources where exposure occurs. However, the City of Georgetown enacted ordinances that are directed at alleviating threats to the Georgetown salamander from urban development by requiring geologic assessments prior to construction, establishing occupied site protections through stream buffers, maintaining water quality through best management practices, developing a water quality management plan for the City of Georgetown, and monitoring occupied spring sites by an adaptive management working group. Eight of these sites are on City parkland or U.S. Army Corps of Engineers property around Lake Georgetown. Malathion entering the recharge zones in the Edwards aquifer (which may occur outside the species range) is anticipated to reach the occupied habitat where the salamander lives, but due to the amount of malathion used on an annual basis (10.57%), the typical half-life of the chemical (3 to 7 days in soil, 0.5 to 6 days in water) and the large amount of water that flows through the aquifer, it is expected that any malathion that enters the aquifer would be diluted to concentrations that would not lead to the high level of risk described above

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Georgetown salamander is a spring-associated endemic found only in the Edwards Aquifer. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Georgetown salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Georgetown salamander in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Eurycea waterlooensis	Austin blind Salamander	6346

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 Austin blind salamander occurs in Barton Springs in Austin, Texas. These springs are fed by the Barton Springs Segment of the Edwards Aquifer. The Austin blind salamander is found in three of the four Barton Springs outlets in the City of Austin's Zilker Park, Travis County, Texas: Parthenia (Main) Springs, Eliza Springs, and Sunken Garden (Old Mill or Zenobia) Springs where the Barton Springs salamander also occurs (Dries 2012, p. 4). The salamanders in these three springs comprise the only known population of Austin blind salamander. From January 1998 to December 2000, there were only 17 documented observations of the Austin blind salamander. During this same timeframe, 1,518 Barton Springs salamander observations were made (Hillis et al. 2001, p. 273). The abundance of Austin blind salamanders increased slightly from 2002 to 2006, but fewer observations have been made in more recent years (2009 to 2010) (COA 2011a, pp. 51–52). In fact, during an 11-month period of drought conditions from 2008 to 2009, neither the Austin blind salamander nor the Barton Springs salamander was seen at all (Dries 2012, p. 17), despite almost monthly survey attempts (Dries 2012, p. 7). When they are observed, Austin blind salamanders occur in relatively low numbers (COA 2011a, pp. 51–52; Dries 2012, p. 4) within the surface habitat. The primary factor threatening the Austin blind and Jollyville Plateau salamanders is the present or threatened destruction, modification, or curtailment of its habitat or range. Degradation of habitat, in the form of reduced water quality and quantity and disturbance of spring sites (surface habitat), is the primary threat to the Austin blind and Jollyville Plateau salamanders. Reductions in water quality occur primarily as a result of urbanization, which increases the amount of impervious cover in the watershed and exposes the salamanders to more hazardous material sources. Impervious cover increases storm flow, erosion, and sedimentation. Impervious cover also changes natural flow regimes within watersheds and increases the transport of contaminants common in urban environments, such as oils, metals, and pesticides. Construction activities are a threat to both water quality and quantity because they can increase sedimentation and exposure to contaminants, as well as dewater springs by intercepting aquifer conduits. Other threats include drought, groundwater pumping, climate change, invasive species, UV-B radiation, and increased risk to stochastic events due to small population size.

2019 5-year Review: The Austin blind salamander continues to be at high risk of extinction due to the rapid rate of urbanization in the contributing and recharge zones of the Barton Springs segment of the Edwards Aquifer, and to ongoing threats of decreasing water quality and quantity in the aquifer on which it depends. Rapid human population growth, increased water demands, and a warming climate with more frequent drought conditions continue to place increased stress on the limited water resources required by the Austin blind salamander to meet its breeding, feeding, and sheltering needs.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Austin Blind Salamander and Threatened Species Status for the Jollyville Plateau Salamander Throughout Their Ranges; Final Rule. Federal Register, Vol. 78, No. 161, 51278-51326.

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 that risk of mortality and sublethal effects on reproduction, behavior and growth to the Austin blind salamander exposed to malathion via all uses in bins 2 and 3 to be high except for developed which poses a medium risk of mortality and sublethal effects (reproduction, behavior, and growth) at maximum rates. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or reduced growth (length), and will experience loss of prey, depending on the use.**Risk to the species from labeled uses across the range:**

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	30.32
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G – Medium R – Medium B- Medium, High
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	71.49
Sublethal	Medium
Indirect	Medium

Risk modifiers: The Austin blind Salamander is found in the Barton Springs near downtown Austin, TX. The source of water is the recharge zone is found in Travis and Hayes counties and surface water inputs. Contaminant and pesticide inputs through the aquifer recharge zone and surface water runoff to Barton Springs pose threats to this species. Water quality and quantity has been identified as the primary threat.

Allowable uses driving effects/other considerations:

As described 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, and that 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 on terrestrial use sites [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	854,288	71.49	0	0	2,3	H, H
Developed	D,I	147,239	12.32	7409	0.62	2,,3	M,M
Corn	D,I	42,878	3.59	4063	0.34	2,3	H,H
Other Grains	D,I	23,216	1.95	23,182	1.94	2,3	H,H
Wheat	D,I	11,135	0.93	10,874	0.91	2,3	H,H
Cotton	D,I	6,893	0.58	5975	0.50	2,3	H,H
Other Crops	D,I	3,331	0.28	0	0	2,3	H,H
Orchards and Vineyards	D,I	677	0.06	358	0.03	2,3	H,H
Nurseries	D,I	624	0.05	625	0.05	2,3	H,H
Other Row Crops	D,I	9	<0.01	9	<0.01	2,3	H,H
Vegetables and Ground Fruit	D,I	6	<0.01	6	<0.01	2,3	H,H
Pasture	D,I	3	<0.01	6	<0.01	2,3	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		444,956	19.79	52,507	4.43		
Sub-TOTAL (I):		444,956	19.79	52,507	4.43		

[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 on terrestrial use sites [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 indirect effects[3]							
TOTAL[4]:		1,299,244	91.28	52,507	4.43		

See above for updated bin 3 and 4 considerations.**# acres in species range:** 1,194,980 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 45,334 acres, 3.794%

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. We anticipate that, in many cases, these buffers will 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 substantially 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

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

allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Austin blind salamander. As discussed below, the vulnerability and the risk is high for the species; however, we anticipate the likelihood of exposure to malathion to be low due to low usage across the species range, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipated 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 Austin blind salamander 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 or medium 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 (91%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be low (4.43%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed. The species current range map used for this analysis is much larger than the area occupied by the species and was likely mapped to account for the surrounding area that influences habitat in the Edwards Aquifer and the spring sites, and thus usage may be overestimated. Areas surrounding occupied habitat largely consists of developed areas and open-space developed (e.g., city and county parks). Agriculture has largely been replaced by development, but still exists sporadically. Developed areas account for approximately 0.62% of malathion use per year.

The City of Austin (City of Austin 2020) tests for a variety of contaminants, including organophosphates. Malathion has been detected on numerous occasions (1994 to 2019) in ground water samples in Barton Creek watershed; however, the majority of samples were not at concentrations that would induce mortality or sublethal effects. A few detections (range from 10-11 ug/L) are considered high enough to impact growth. We anticipate exposure to the species from runoff or drift if developed areas are treated in the vicinity of the species habitat. Additionally, malathion entering the recharge zones in the Edwards aquifer (which may occur outside the species range) are anticipated to reach the occupied habitat where the salamander lives, but due to the low quantity of malathion used on an annual basis, the typical half-life of the chemical (3 to 7 days in soil, 0.5 to 6 days in water) and the large amount of water that flows through the aquifer, it is expected that any malathion that enters the aquifer would be diluted to concentrations that would not lead to the high level of risk described above.

The species range is extremely small and limited to four Barton Spring outlets in the City of Austin's Zilker Park. In general, low counts and virtually nonexistent recapture rates for Austin blind salamander continue to support the hypothesis that the species primarily occurs within the aquifer (City of Austin 2019). Since the species is rarely encountered outside of the aquifer, we anticipate that exposure to malathion from runoff or drift is low, and thus mortality or sublethal effects to the species would likely be low based on low usage within the species range. We do not anticipate substantial exposure through aquifer discharge, as any malathion in discharge waters would likely be diluted to a level that would not cause effects.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Austin blind salamander is an endemic spring-associated troglobitic species within the Edwards Aquifer. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Austin blind salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Austin blind salamander in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

City of Austin. 2020, July 16. Water Quality Sampling Data. City of Austin. Retrieved July 16, 2020 from <https://data.austintexas.gov/Environment/Water-Quality-Sampling-Data/5tye-7ray/data>.

City of Austin. 2019. Annual Report January, 2018 - December, 2018: Endangered Species Act Section l0(a)l(B) Permit for the Incidental Take of the Barton Springs Salamander (*Eurycea sosorum*) and Austin Blind Salamander (*Eurycea waterlooensis*) for the Operation and Maintenance of Barton Springs Pool and Adjacent Springs. City of Austin Watershed Protection Department, Austin, Texas.

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Eurycea chisholmensis	Salado Salamander	7610

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 habitats of the Georgetown and Salado salamanders occur in the Northern Segment of the Edwards Aquifer. The recharge and contributing zones of this segment of the Edwards Aquifer are found in portions of Travis, Williamson, and Bell Counties, Texas (Jones 2003, p. 3). The Salado salamander is known historically from four spring sites near the village of Salado, Bell County, Texas: Big Boiling Springs (also known as Main, Salado, or Siren Springs), Lil' Bubbly Springs, Lazy Days Fish Farm Springs (also known as Critchfield Springs), and Robertson Springs (Chippindale et al. 2000, p. 43; TPWD 2011, pp. 1–2). These springs bubble up through faults in the Northern Segment of the Edwards Aquifer and associated limestone along Salado Creek (Brune 1975, p. 31). The four spring sites all contribute to Salado Creek. In August 2009, TPWD discovered a population of salamanders at a new site (Solana Spring #1) farther upstream on Salado Creek in Bell County, Texas (TPWD 2011, p. 2). Salado salamanders were recently confirmed at two additional spring sites (Cistern and Hog Hollow Springs) on the Salado Creek in March 2010 (TPWD 2011, p. 2). In total, the Salado salamander is currently known from seven springs. Solana salamanders are observed infrequently and population numbers are currently unknown. Threats to the species include water quality degradation (urbanization, hazardous material spills, underground storage tanks, highways, water and sewage lines, construction activities, quarries, contaminants and pollutants, pesticides, nutrients), changes to water chemistry, changes in prey base community, water quantity degradation (groundwater pumping, drought, climate change), physical modification of surface habitat (sedimentation, impoundments, flooding, livestock, human visitation/recreation), small population size, stochastic events, UV-B radiation, and synergistic and additive interactions among stressors (e.g., contaminants, UV-B radiation, pathogens). Conservation efforts have been implemented for the Salado salamander and represent over half of the known spring sites occupied by the species.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Determination of Threatened Species Status for the Georgetown Salamander and Salado Salamander Throughout Their Ranges; Final Rule. Federal Register, Vol. 79, No. 36, 10236-10293.

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 that risk of mortality and sublethal effects on reproduction, behavior and growth to the Salado salamander exposed to malathion via all uses in bins 2 and 3 to be high except for developed which poses a medium risk of mortality and sublethal effects (reproduction, behavior, and growth) at maximumrates. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or reduced length, or will experience loss of prey, depending on the use site.**Risk to the species from labeled uses across the range:**

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	31.01
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G – Low, Medium R – Low, Medium B - Low, Medium, High
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	9.57
Sublethal	Low, Medium
Indirect	High

Risk modifiers: The Salado Salamander is found in seven springs along Salado Creek in Salado, Bell County, Texas. The source of water to these springs are the Edwards aquifer and surface water runoff. Identified threats to this species include degraded water quality and quantity which is impacted by releases of contaminants and pesticides through ground water recharge and surface water inputs.

As described 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, and that 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..

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. As aquatic and terrestrial invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	108,006	9.57	0	0	2,3	H,H
Corn	D,I	125,458	11.12	4,062	0.36	2,3	H,H
Other Grains	D,I	50,267	4.45	49,987	4.43	2,3	H,H
Wheat	D,I	47,096	4.17	8,350	0.74	2,3	H,H
Developed	D,I	40,661	3.6	11,735	1.04	2,3	M,M
Cotton	D,I	13,059	1.16	11,735	1.04	2,3	H,H
Other Crops	D,I	3,862	0.34	0	0	2,3	H,H
Orchards and Vineyards	D,I	723	0.06	564	0.05	2,3	H,H
Pasture	D,I	63	<0.01	63	<0.01	2,3	H,H
Nurseries	D,I	55	<0.01	55	<0.01	2,3	H,H
Other Row Crops	D,I	46	<0.01	46	<0.01	2,3	H,H
Vegetables and Ground Fruit	D,I	24	<0.01	24	<0.01	2,3	H,H
Sub-TOTAL (D): *Other uses with direct effects*[3]		281,314	24.94	86,621	7.71		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		281,314	24.94	86,621	7.71		
TOTAL[4]:		389,320	34.51	86,621	7.71		

See above for updated bin 3 and 4 considerations.**# acres in species range:** 1,128,375 acres
% of range in California (i.e., where CalPUR data is available): 0%

[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.

Range overlap with Federal lands: 130,089 acres, 11.529%

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Salado salamander. As discussed below, the vulnerability and risk is high for the species if exposed and usage is medium across the species range. 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 Salado salamander 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 items (mortality) are anticipated to be high. 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 (35%), as described above.

However, we anticipate usage within the non-Federal portion of the species' range will be medium (7.71%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed. The species current range map used for this analysis is much larger and likely mapped to account for the surrounding area that influences habitat in the northern segment of the Edwards Aquifer and the spring sites, and thus usage may be overestimated. Areas surrounding occupied habitat at four springs sites near the village of Salado largely consists of developed areas and open-space developed (e.g., city and county parks) and the other three springs sites are surrounded by pasture (presumably used for grazing). Usage on developed areas and pasture account for approximately 1% of annual malathion use within the species range.

The species range is extremely small and is only known from the seven spring sites described above. Recent surveys at many of the springs have not detected individuals and where they were detected there numbers have been small. It is believed that this species or most individuals spend most of their life in the subterranean environment of the Edwards aquifer. We anticipate the species to be exposed to malathion from runoff or drift if developed areas or pastures are treated in the vicinity of the species habitat, but since the usage data indicates that applications are low for these uses that surround the springs, we anticipate that the chance of exposure is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. Additionally, malathion entering the recharge zones in the Edwards aquifer (which may occur outside the species range) could reach the occupied habitat where the salamander lives, but due to the low quantity of malathion used on an annual basis, the typical half-life of the chemical (3 to 7 days in soil, 0.5 to 6 days in water) and the large amount of water that flows through the aquifer, it is expected that any malathion that enters the aquifer would be diluted to concentrations that would not lead to the high level of risk described above.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Salado salamander is a spring-associated endemic within the Edwards Aquifer. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (in runoff) to the Salado salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. For these reasons, we anticipate that very few individuals would be affected by mortality, sublethal (related to reductions in fecundity, alterations in swimming behavior), and very little reduction in growth (length), or reductions in prey, we do not anticipate species-level effects.

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

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Cryptobranchus alleganiensis bishopi	Ozark hellbender	7847

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 Ozark Hellbender historically occurred in portions of the Spring, White, Black, Eleven Point, and Current rivers and their tributaries (North Fork of the White River, Bryant Creek, and Jacks Fork) (LaClaire 1993). Currently, Ozark Hellbender populations are known to occur in Bryant Creek, North Fork of the White River, Eleven Point River, and Current River, with some individuals possibly still present in the White River, Spring River, and Jacks Fork. Surveys of historic sites indicate that populations in each river have declined by at least 70 percent since the 1980's (Trauth et al. 1992, Wheeler et al. 2003), and no population is considered stable. In 2006, the total number of Ozark Hellbender individuals in the wild was estimated to be approximately 590 individuals (Briggler et al. 2007). In addition, it appears that there has been a shift in age class structure to older individuals and a reduction in recruitment (Wheeler et al. 2003). The primary threats to the Ozark Hellbender are habitat loss and degradation (e.g., construction of dams, sedimentation, reduced water quality - agricultural runoff), over collection, disease, severe physical abnormalities resulting from unknown causes, potential predation by non-native fish, small population size, and climate change. Captive breeding is currently underway, with approximately 1,500 Ozark Hellbenders larvae/juveniles being reared in captivity.

2020 5-year Review

Population monitoring indicates that Ozark hellbender populations are continuing to decline, with an estimated 915 adults remaining in the wild. The Spring River population is now considered functionally extirpated, and the North Fork White River population, once considered the stronghold of the species, was severely impacted by record flooding in 2017. The populations are continuing to senesce with the collection of young individuals still rare compared to historical samples, indicating that there is little recruitment occurring in the wild. In addition, a large percentage of captured individuals continue to exhibit severe physical abnormalities, such as necrotic limbs, missing digits, and swollen toe pads, although the rates no longer appear to be increasing.

The exact cause of population declines continues to be unclear. However, the primary threats believed to currently contribute to population declines are habitat degradation and disease. Habitat throughout the Ozark hellbender's range is degraded to varying extents due to sedimentation, with the degradation particularly pronounced in the Eleven Point River in Arkansas. The sources of sedimentation include legacy effects from historical timber clearing, gravel dredging that does not follow appropriate BMPs and alters stream hydrology, poor land use practices (indiscriminate land clearing, allowing livestock in riparian areas for long periods of time), current timber harvests that do not implement appropriate BMPs, and gravel/unpaved roads. The sedimentation reduces suitable habitat for all life stages of the Ozark hellbender, increases water temperature, reduces dissolved oxygen, and increases exposure to pollutants. Amphibian chytrid fungus (Bd) continues to be present in all Ozark hellbender populations and the belief among species experts remains the same as it was at the time of listing - that the Bd pathogen may cause some hellbenders to be more susceptible to other infections, including those responsible for lesions and appendage loss, but that additional unknown factors are underlying the increased vulnerability. To date, Ranaviruses have not been definitively documented in any Ozark hellbender populations.

Though recruitment continues to be limited in the wild, we hope that the populations are being temporarily stabilized by augmentation efforts. Over 7,000 Ozark hellbender larvae and juveniles have been released to date, and nests are consistently found in the wild, allowing for the removal of eggs for head-starting. In addition, Ozark hellbenders now breed successfully in captivity at the Saint Louis Zoo. However, the number of released individuals that are recaptured is small and the success of augmentation efforts remains unknown. Because many of the released individuals are young juveniles, we hope that as they reach larger sizes and their detection rates increase, that a higher proportion are recaptured. Even with success of the augmentation program, however, the threats will need to be identified and addressed for the Ozark hellbender to recover.

EB/CE Source: U.S. Fish and Wildlife Service. 2012. Recovery Outline for the Ozark Hellbender. Columbia, Missouri. 13 pp.

U.S. Fish and Wildlife Service. 2020. 5-year Review. Missouri Ecological Services Field Office. Columbia, Missouri. 30 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 that risk of mortality and sublethal effects on reproduction, behavior and growth the Ozark hellbender exposed to malathion via all uses in bins 3 and 4 to be high except for developed which poses a medium risk of mortality and sublethal effects (reproduction, behavior, and growth) at maximum rates. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or reduced length, and will experience loss of prey, depending on the use site.**Risk to the species from labeled uses across the range:**

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	5.63%
Sublethal – growth (G), reproduction (R) and behavior (B)	G: High except M for developed R: Low B: High except M for developed
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Invertebrate prey: H Fish prey: H
MOSQUITO CONTROL	
Direct (mortality)	5.39%
Sublethal	Low
Indirect	High

Risk modifiers:

Rocky, clear creeks and rivers, usually where there are large shelter rocks. Usually avoids water warmer than 20 degrees Celsius. Males prepare nests beneath large flat rocks or submerged logs. Inhabits creek, medium rivers, poll, riffle, and benthic environments (NatureServe, 2015). Adult Ozark hellbenders are frequently found beneath large rocks in moderate to deep (less than 3 feet (ft.) to 9.8 ft. (less than 1 meter (m) to 3 m)), rocky, fast-flowing streams in the Ozark plateau (Johnson 2000, p. 42; Fobes and Wilkinson 1995, pp. 5-7). Hellbenders are habitat specialists that depend on consistent levels of dissolved oxygen, temperature, and flow (Williams et al. 1981, p. 97) (USFWS, 2010).

Allowable uses driving effects/other considerations:

As described 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, and that 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.. 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.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. As aquatic and terrestrial invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

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

Use type	Risk to species on terrestrial use sites [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	404,300	5.39	108,900	1.45	3,4	3H 4H
Corn	D,I	19,861	0.26	7,866	0.1	3,4	3H 4H
Developed	D,I	54,129	0.72	2,706	0.04	3,4	3M 4M
Other Grains	D,I	3,726	0.05	3,464	0.05	3,4	3H 4H
Wheat	D,I	2,713	0.04	2,316	0.03	3,4	3H 4H
Cotton	D,I	51	< 0.01	27	< 0.01	3,4	3H 4H
Other Crops	D,I	24,444	0.33	0	0	3,4	3H 4H
Orchards & Vineyards	D,I	130	< 0.01	91	< 0.01	3,4	3H 4H
Nurseries	D,I	181	< 0.01	181	< 0.01	3,4	3H 4H
Vegetables & Ground Fruit	D,I	236	< 0.01	230	< 0.01	3,4	3H 4H
Other Row Crops	D,I	956	0.01	325	< 0.01	3,4	3H 4H
Pasture	D,I	644	< 0.01	596	< 0.01	3,4	3H 4H
Sub-TOTAL (D): *Other uses with direct effects*[3]		107,073	1.46	17,802	1.01		
Sub-TOTAL (I):		107,073	1.46	17,802	1.01		

[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 on terrestrial use sites [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 indirect effects[3]							
TOTAL[4]:		511,373	6.85	126702	2.46		

See above for updated bin 3 and 4 considerations.

 # acres in species range: 7,504,399 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,235,317 acres, 16.461%

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. We anticipate that, in many cases, these buffers will 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 substantially 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

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

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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 Ozark hellbender.

The Ozark hellbender has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high, as described above. The estimated usage within the range is low based on standard usage data. We estimate that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 5.63% mortality of individuals and 5.39% mortality of individuals from mosquito control efforts if exposed to the chemical via runoff or spray drift. Other effects include sublethal (as described above) resulting from runoff or spray drift from use sites and mosquito control treatments. Effects to the species prey are anticipated to be high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species’ range will be low (2.46%), based primarily on the usage data we acquired, as described in the Opinion and summarized for this species above, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. 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. Mosquito adulticide applications account for 1.45% of this use. According to the 2012 recovery outline for the Ozark hellbender, surveys of historic sites indicate that populations in each river have declined by at least 70 percent since the 1980's. Four populations are known to exist, while scattered individuals may persist at three other historic sites. In 2019, it was estimated that only 915 individuals remained in the wild. We anticipate that there will be a loss of a small number of individuals or individuals will be subjected to sublethal effects if malathion is used within the range of the species, particularly in the absence of conservation measures. Additionally, we anticipate a small loss of prey resources. Even though the vulnerability is high and risk is high for this species, the likelihood of exposure to malathion is very low because past malathion usage overlaps such a small portion of the species range (2.46%), and we anticipate similar levels of usage in the future.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Ozark hellbender is an endemic and prefers swift-moving streams with consistent levels of dissolved oxygen, temperature and water flow. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Ozark hellbender when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Thus, we anticipate only small numbers of individuals of this species will experience mortality, effects to growth, reproduction, and behavior, and small reductions in the invertebrate prey over the duration of the Action. However, we do not anticipate the loss of small numbers of individuals, or the low levels of expected sublethal take and reductions in the food base would result in species-level effects. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the species. Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the FWS's Biological Opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Ozark hellbender in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	**Common Name:**	**Entity ID:**
Eurycea tonkawae	Jollyville Plateau Salamander	8231

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 Jollyville Plateau salamander occurs in the Jollyville Plateau and Brushy Creek areas of the Edwards Plateau in northern Travis and southern Williamson Counties, Texas (Chippindale et al. 2000, pp. 35–36; Bowles et al. 2006, p. 112; Sweet 1982, p. 433). Upon classification as a species, Jollyville Plateau salamanders were known from Brushy Creek and, within the Jollyville Plateau, from Bull Creek, Cypress Creek, Long Hollow Creek, Shoal Creek, and Walnut Creek drainages (Chippindale et al. 2000, p. 36). Since it was described, the Jollyville Plateau salamander has also been documented within the Lake Creek drainage (O'Donnell et al. 2006, p. 1). Jollyville Plateau salamanders are known from 1 cave in the Cypress Creek drainage and 15 caves in the Buttercup Creek cave system in the Brushy Creek drainage (Chippindale et al. 2000, p. 49; Russell 1993, p. 21; Service 1999, p. 6; HNTB 2005, p. 60). There are 106 known surface sites for the Jollyville Plateau salamander. Some Jollyville Plateau salamander populations have likely experienced decreases in abundance in recent years. Survey data collected by City of Austin staff indicate that four of the nine sites that were regularly monitored by the COA between December 1996 and January 2007 had statistically significant declines in salamander abundance over 10 years (O'Donnell et al. 2006, p. 4). Bendik (2011a, pp. 5, 12–24, 26, 27) reported statistically significant declines in Jollyville Plateau salamander counts over a 13-year period (1996–2010) at six monitored sites with high impervious cover (18 to 46 percent) compared to two sites with lower (less than 1 percent) impervious cover. These results are consistent with Bowles et al. (2006, p. 111), who found lower densities of Jollyville Plateau salamanders at urbanized sites. The primary factor threatening the Jollyville Plateau salamander is the present or threatened destruction, modification, or curtailment of its habitat or range. Degradation of habitat, in the form of reduced water quality and quantity and disturbance of spring sites (surface habitat), is the primary threat to the Austin blind and Jollyville Plateau salamanders. Reductions in water quality occur primarily as a result of urbanization, which increases the amount of impervious cover in the watershed and exposes the salamanders to more hazardous material sources. Impervious cover increases storm flow, erosion, and sedimentation. Impervious cover also changes natural flow regimes within watersheds and increases the transport of contaminants common in urban environments, such as oils, metals, and pesticides. Construction activities are a threat to both water quality and quantity because they can increase sedimentation and exposure to contaminants, as well as dewater springs by intercepting aquifer conduits. Other threats include drought, groundwater pumping, climate change, invasive species, UV-B radiation, and increased risk to stochastic events due to small population size.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Austin Blind Salamander and Threatened Species Status for the Jollyville Plateau Salamander Throughout Their Ranges; Final Rule. Federal Register, Vol. 78, No. 161, 51278-51326.

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 that risk of mortality and sublethal effects on reproduction, behavior and growth the Jollyville plateau salamander exposed to malathion via most uses in bins 2 and 3 to be medium or high except for developed which poses a medium risk of mortality and low risk of sublethal effects (reproduction, behavior, and growth) at maximum rates. We anticipate that individuals will die, exhibit reductions in fecundity, alterations to swimming behavior, or reduced growth (length), and will experience loss of prey, depending on the use site.**Risk to the species from labeled uses across the range:**

The table below summarizes the risk of direct or indirect mortality or direct sub-lethal effects 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	30.47
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G – Low, Medium R – Low, Medium B- Low, Medium, High
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	71.92
Sublethal	Medium
Indirect	High

Risk modifiers: The Jollyville Plateau Salamander is in the Jollyville Plateau region northwest of Austin, TX in Travis and Williamson counties. Water quality has been identified as a threat to this species. Sources of contaminants and pesticides may contaminant the salamanders habitat through groundwater recharge and surface water inputs.

As described 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, and that 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..

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. As aquatic and terrestrial invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	1,383,827	71.93	29,614	2.14	2,3	H,H
Developed	D,I	160,671	8.35	8081	0.42	2,3	M,M
Corn	D,I	141,706	7.37	4040	0.21	2,3	H,H
Other Grains	D,I	47,280	2.46	47330	2.46	2,3	H,H
Wheat	D,I	31,161	1.62	29437	1.53	2,3	H,H
Cotton	D,I	18,763	0.98	16931	0.88	2,3	H,H
Other Crops	D,I	6,571	0.34	0	0	2,3	H,H
Orchards and Vineyards	D,I	907	0.05		0.02	2,3	H,H
Nurseries	D,I	656	0.03	656	0.03	2,3	H,H
Vegetables & Ground Fruit	D,I	32	<0.01	32	<0.01	2,3	H,H
Other Row Crops	D,I	24	<0.01	24	<0.01	2,3	H,H
Pasture	D,I	8	<0.01	8	<0.01	2,3	H,H
Sub-TOTAL (D):		415,879	21.23	2,775	5.59		

[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 on terrestrial use sites [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]		415,879	21.23	2,775	5.59		
		1,799,706	93.16	32,389	7.73		

See above for updated bin 3 and 4 considerations.

 # acres in species range: 1,923,970 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 45,335 acres, 2.356%

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. We anticipate that, in many cases, these buffers will 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 substantially 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%

[3] Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will 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 Jollyville Plateau salamander. As discussed below, the vulnerability and risk is high for the species if exposed and usage is medium across the species range, 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 will be affected over the duration of the proposed action, we do not expect species level effects to occur.

The Jollyville Plateau salamander 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 items (mortality) are anticipated to be high. 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 (93%), as described above. Areas for mosquito adulticide applications account for the greatest overlap (72%).

However, we anticipate usage within the non-Federal portion of the species' range will be medium (7.73%), 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. Mosquito adulticide applications account for 2.14% of the total usage. The species current range map used for this analysis is much larger and likely mapped to account for the surrounding area that influences habitat in the Jollyville Plateau and Brush Creek areas of the

Edwards Plateau in northern Travis and southern Williamson Counties, and thus usage may be overestimated. Areas surrounding critical habitat, which accounts for approximately 55% of the occupied sites, consists of developed areas and open-space developed (e.g., city and county parks) and forested areas. Land use on the other sites is unknown, but likely similar. Usage on developed areas and mosquito adulticide application areas (assuming developed areas are more likely to be treated) account for 2.56% of annual malathion use within the species range.

The species range is small (covering less than two counties), but is known to occur from 16 caves and 106 surface sites. It is not known how many populations these sites represent, nor is there a clear indication on the size of the population(s). The salamander occurs in wetted caves and where water emerges from the ground as a spring-fed stream. Within the spring ecosystem, proximity to the springhead is presumed important because of the appropriate stable water chemistry and temperature, substrate, and flow regime. *Eurycea* salamanders are rarely found more than 66 ft (20 m) from a spring source and are known to retreat underground to wetted areas (such as the aquifer) for habitat when surface habitats go dry. We anticipate the species to be exposed to malathion from runoff or drift if developed areas or mosquito adulticide application areas are treated or other agricultural sites adjacent to caves and springs are treated in the vicinity of the species habitat. However, even though overall usage is medium, we don't anticipate that many of the agricultural use areas overlap or are adjacent to the occupied areas, at least for 55% of the occupied sites. In addition, salamanders will spend time in the subterranean environment and rarely venture far from the cave or spring source limiting their exposure. Additionally, malathion entering the recharge zones in the Edwards aquifer (which may occur outside the species range) could reach the occupied habitat where the salamander lives, but due to the low quantity of malathion used on an annual basis, the typical half-life of the chemical (3 to 7 days in soil, 0.5 to 6 days in water) and the large amount of water that flows through the aquifer, it is expected that any malathion that enters the aquifer would be diluted to concentrations that would not lead to the high level of risk described above.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Jollyville Plateau salamander is a spring-associated endemic requiring high water quality (e.g., clarity and stable temperature and water chemistry). As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Jollyville Plateau salamander when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers, reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. For these reasons, we anticipate that limited individuals would be affected by mortality, sublethal (related to reductions in fecundity, alterations in swimming behavior), and very little reduction in growth (length), or reductions in prey, we do not anticipate species-level effects.

or prey base effects, and therefore, we do not anticipate species-level effects.

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

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Amphibians *(Aquatic)*

Scientific Name:	Common Name:	Entity ID:
Cryptobranchus alleganiensis alleganiensis	Eastern hellbender	11569

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:

The Eastern Hellbender is a large, entirely aquatic salamander found in perennial streams. Historically, the species was widespread across 15 states from northeastern Mississippi, northern Alabama, and northern Georgia northeast to southern New York, with disjunct populations occurring in east-central Missouri. The primary stressor to Eastern Hellbender is sedimentation, caused by multiple sources, which is occurring throughout much of the species' range. As documented in literature, other major stressors include water quality degradation, habitat destruction and modification, disease, and direct mortality or removal of hellbenders from a population by collection, persecution, recreation, or gravel mining. Additional risk factors include climate change, small population effects, and increased abundance of native and non-native predators. Conservation measures for the species include habitat restoration and management, and captive propagation, augmentation, and reintroduction. Long-term success of reintroductions, however, is unknown. Data show that 570 Eastern Hellbender populations existed across 15 states, and we assumed all historic populations were healthy. Currently, 68 populations (12%) are extirpated or functionally extirpated (PX or FX), 393 (69%) are extant, and 109 (19%) are unknown status (US). Of the 393 extant populations, 57 are declining (D), 35 are likely healthy (SR), and 301 have unknown trend (UT, UR). The experts provided their judgments to the likely status of the 109 populations with unknown status. Incorporating the experts' estimates, 225 populations are extirpated and 345 populations are believed extant; of these extant populations, 126 are healthy and 219 are declining.

EB/CE Source: U.S. Fish and Wildlife Service. 2018. Species status assessment report for the Eastern Hellbender (Cryptobranchus alleganiensis alleganiensis). 104 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: Due to the high degree of dilution expected within Bin 3 and 4 aquatic habitats, the risk of direct effects to the Eastern hellbender are medium. This species will experience loss of prey (invertebrates and vertebrates) and but only low levels of sub-lethal effects from all use sites.

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	Medium
Sublethal – growth (G), reproduction (R) and behavior (B) sensory (S) enzyme (E)	G - Low R - Low B - Low
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	High
MOSQUITO CONTROL	
Direct (mortality)	Medium
Sublethal	Low
Indirect	High

Risk modifiers:

As described 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, and 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.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications. As aquatic and terrestrial invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

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

USAGE

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

Use type	Risk to species on terrestrial use sites [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	314,646	6.35	NA	NA	3, 4	3M 4M
Other Crops	D,I	233	0.02	70	0	3, 4	3H 4H
Open Space Developed	D,I	182,704	3.69	9,135	0.18	3, 4	3H 4H
Other Grains	D,I	524	0.01	480	0.01	3, 4	3H 4H
Corn	D,I	14,429	0.29	6,145	0.12	3, 4	3H 4H
Developed	D,I	91,000	1.84	4,549	0.13	3, 4	3H 4H
Wheat	D,I	26,190	0.03	1,221	0.02	3, 4	3H 4H
Nurseries	D,I	325	0.01	325	0.01	3, 4	3H 4H
Pasture	D,I	9	0.04	461	0.01	3, 4	3H 4H
Rice	D,I	837	<0.01	0	0	3, 4	3H 4H
Vegetables and Fruit	D,I	67	<0.01	1	<0.01	3, 4	3H 4H
Orchards and Vineyards	D,I	4	<0.01	3	<0.01	3, 4	3H 4H
Sub-TOTAL (D): *Other uses with direct effects*[3]		316,322	5.96	22,390	0.5		
Sub-TOTAL (I): *Other uses with indirect effects*[3]		316,322	5.96	22,390	0.5		
TOTAL[4]:		630,968	12.31	22,390	0.5		

 # acres in species range: 7,594,106 acres
% of range in California (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 1,124,162 acres, 14.803%

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. We anticipate that, in many cases, these buffers will 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 substantially 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, which specify on the label a distance from water bodies where pesticides are not to be applied, 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 eastern hellbender.

The eastern hellbender has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is estimated to be medium, mostly due to high risk from loss of prey items. We estimate that across the species range, annual malathion uses pursuant to the labels would be high if exposed to the chemical via runoff or spray drift from all use sites and mosquito adulticide application sites. For those individuals that do not die, they are anticipated to be impacted by sublethal effects (growth, reproduction, behavior). Effects to the species prey are anticipated to be high pursuant to labeled uses.

However, we anticipate usage within the non-Federal portion of the species' range will be low (0.56%), 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. Mosquito adulticide applications have not been documented within the species range during the six-year time frame we accessed.

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 are expected to 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. We anticipate that malathion exposure will be low.

Furthermore, we anticipate the additional conservation measures above, including rain restrictions, aquatic habitat buffers, and residential use label changes will further reduce the likelihood of exposure of the species, their prey, and their habitat. The Eastern hellbender is a large aquatic salamander and prefers swift-moving streams with consistent levels of dissolved oxygen, temperature and water flow. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Eastern hellbender when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Lastly, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Thus, while we anticipate small numbers of individuals would be affected by mortality, sublethal, (related to reductions in fecundity, alterations in swimming behavior), and very little reduction in length or reductions in prey, we do not anticipate species-level effects.

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

Conclusion: Not likely to jeopardize