# Integration and Synthesis Summary for Fish

This Integration and Synthesis Summary includes our jeopardy analysis for any species that we or EPA determined will "likely be adversely affected" by the proposed action. Our jeopardy analysis of the proposed action's impacts to listed species is split into three major factors: vulnerability, exposure, and toxicity. The tables below contain summaries of our rankings (high, medium, low) for vulnerability, exposure, and toxicity. Data and information used to determine each individual species' rankings, including environmental baselines, cumulative effects, exposure information, and expected toxic effects for all species, and a template worksheet to show how rankings were assessed and combined are in Appendix E. Status of the species for each species can be found in Appendix B.

### Vulnerability

For the fish species that we or EPA determined are "likely to be adversely affected" by the proposed action, we considered several factors to summarize the current vulnerability of that species to additional stressors. This effort allows us to consider whether a species' current condition is moving toward recovery or further decline. In general, we expect the species' vulnerability to additional stressors to be higher if they are moving toward further decline than if they their condition is improving. We also identify which species are most (and least) susceptible to additional stressors in general based on information that could be surmised from species listing and recovery documents, or other sources as cited and considered in the *Status* section of this biological opinion.

Our assessment of vulnerability focuses on six factors: (1) the species listing status and recent 5-year status review recommendation (if available), (2) distribution, (3) number of populations, (4) species population trends, (5) if pesticides have been noted as a threat, and (6) impacts from activities associated with environmental baseline and cumulative effects. We obtained the information to create the vulnerability summary from the Status of the Species accounts (Appendix B), the overarching Environmental Baseline section of this Opinion, five-year species status reviews, species recovery plans, species status assessments, and other sources containing the best available scientific information for the species.

We scored each of the six vulnerability components with high, medium, or low scores. We assigned a high vulnerability ranking to a species if all vulnerability components were scored as medium or high. We assigned a medium vulnerability ranking if a species' scores were a mix of high, medium, and low (though exceptions were allowed for species that have a low status score or have an uplisting recommendation). We assigned a low vulnerability ranking to species with only low scores. Considerations regarding specific aspects of the species' vulnerability or beyond what was included in the vulnerability ranking were applicable for some species depending on unique aspects of their life history. This information is reflected in the rationales for conclusion below.

**Exposure**

We anticipate fish will primarily be exposed to methomyl through contact with contaminated water in their habitats. We assume all methomyl that is transported off-site, whether through spray drift or runoff, is likely to end up in local water bodies, which may distribute methomyl residues throughout the entire watershed. Methomyl degrades quickly (i.e., within a few days) in aerobic aquatic habitats and as such is not likely to persist in water bodies for long periods of time, be transported long distances in surface waters, or occur in groundwater sources.

We characterize the expected level of exposure using overlap data, past methomyl usage data, and any species-specific considerations such as life history information (e.g., habitat preferences, dispersal behavior) and existing protections or conservation actions. Species with greater than 10% overlap between their range and methomyl use sites are assigned a high overlap score, species with 5-10% overlap are assigned a medium overlap score, and species with less than 5% total overlap are assigned a low overlap score. In addition to range overlaps with methomyl use sites, we considered past methomyl usage data within a species' range to determine how much of a species' range we expect to be treated with methomyl each year of the proposed action. Except where otherwise noted, usage data is provided by EPA applying data from their National and State Summary Use and Usage Matrix, as described in the *Usage Analysis* section of this biological opinion. Species that data indicate will have a large portion of their range (>10%) treated with methomyl each year are assigned a high usage score. Species that will have a medium portion of their range (5-10%) treated with methomyl each year are assigned a medium usage score, and species that data indicate will have a low portion of their range (<5%) treated with methomyl each year are assigned a low usage score.

We determine the overall exposure ranking by qualitatively considering both the total overlap and total usage, as well as any additional exposure considerations that might modify the level of exposure likely to occur. When overlap and usage scores are the same, we assign the overall exposure ranking the same score (e.g., if both overlap and usage is high, the overall exposure ranking is high). In cases where overlap is high and usage is medium or when overlap is medium and usage is low, we use the overlap score as the overall exposure ranking to maintain conservative exposure assumptions. As usage is a subset of overlap, the overlap score will always be greater than the usage score. In cases where overlap is high and usage is low, we anticipate a moderate portion of the range may be treated over the duration of the proposed action even if only a small portion of the range is treated in any given year (particularly if the areas treated occur in different locations each year), leading to an overall exposure ranking of medium. Past usage data for methomyl is not available for species located on Pacific or Caribbean islands, including Hawai'i and Puerto Rico. Therefore, in the absence of additional exposure considerations for these species, our ranking is based on the total overlap of methomyl use sites for species that occur in these areas. For all species, where there are additional exposure considerations, we adjust the overall exposure ranking to reflect this additional information, as appropriate.

**Toxicity**

We characterize the expected toxic effect to species based on the anticipated level of direct and indirect[1] adverse effects to individuals. Our analysis of toxicity assumes individuals are exposed to methomyl at levels estimated by EPA's environmental exposure modeling and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Direct effects are based on the anticipated level of mortality and sublethal effects (e.g., reduced growth) likely to occur in exposed individuals. Indirect effects are based on the impact a listed species is likely to experience when the organisms they rely on, such as those that act as food or habitat resources, are exposed to methomyl and experience adverse effects.

We consider estimated concentrations of methomyl on the landscape or within the environment and effects reported in available toxicity studies to determine the level of direct and indirect adverse effects to listed species or critical habitat. Concentrations of methomyl can vary greatly among different regions and aquatic habitat types (e.g., low flow or low water volume habitats accumulate high levels of methomyl whereas fast flowing or large water volume habitats accumulate only low levels of methomyl). Based on available toxicity data, we anticipate fish are moderately sensitive to methomyl and are likely to experience high levels of mortality in habitats that accumulate higher levels of methomyl. In contrast, individuals exposed in habitats that accumulate only low levels of methomyl are not likely to experience any direct effects at all. Toxicity data indicate that sublethal effects (e.g., reduced growth and reproduction) may occur with methomyl exposure. We primarily focus our assessment of sublethal effects to species where we do not anticipate high levels of mortality.

We anticipate fish species that only rely on plant-based resources, such as algae and detritus for food or emergent aquatic vegetation as habitat, are not likely to experience any indirect adverse effects, as available toxicity data in plants indicate no reductions in plant survival or growth are likely to occur with methomyl exposure. In contrast, species that rely on arthropods for food resources may experience high levels of indirect adverse effects as methomyl exposure will likely reduce the abundance and availability of prey.

We determine the overall toxicity ranking for fishes by qualitatively assessing both the expected levels of direct adverse effects (i.e., mortality, reduced growth, and reproduction) and indirect effects (i.e., prey loss). Given that mortality is the most adverse of direct effects to an individual of a species, we assign the most weight to direct adverse effects resulting in mortality when determining the toxicity ranking. As mentioned previously, available toxicity data indicate fish

[1] While our Opinion considers all consequences of the proposed action (per the definition of effects of the action at 50 CFR Part 402.02), the terms "direct" and "indirect" effects were used in EPA's BE, and are used in environmental risk assessment terminology in general, and do not have the same meaning as used in ESA regulations. As used in the effects analysis section, direct effects to species are those caused by the pesticide itself through dietary, dermal, or inhalation routes of exposure. Indirect effects occur when the pesticide acts on elements of the ecosystem that are required by the species, such as alterations to prey or shelter. Thus, in the effects analysis section, we may use these terms to link back to the analysis in EPA's BE.

are moderately sensitive to methomyl and are likely to experience variable levels of direct adverse effects dependent on the concentration of methomyl in the habitat.

**Summary of Fish Conclusions**

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of methomyl, and the cumulative effects, it is our biological opinion that the registration of methomyl, as proposed, is not likely to jeopardize the continued existence of the 122 fish species in this Appendix.

In our analysis below, some species that had the same or very similar rationales for their conclusions were grouped together, to increase efficiency and avoid repetition. Relevant information and data unique to each individual species was considered when assigning species to groups and incorporated into the rationales as appropriate. Species-specific information (e.g., environmental baseline, cumulative effects, status of the species, exposure, and toxicity) was considered for all species, including those species in the grouped analyses, and are presented in full in Appendices B and E. Species with rationales that did not fit in a group, or warranted a separate rationale because of their life history, conservation status, or other information indicated that effects could be different, have an individual discussion to provide additional explanation. This approach allowed us to streamline our discussion in this Opinion by avoiding repeating our findings when species in the respective groupings would be expected to be affected similarly. The use of these groupings, therefore, does not mean that our evaluation failed to evaluate each individual species. On the contrary, our process and analysis for each species remained the same, regardless of the format of the discussion presented below.

**Experimental, non-essential populations**

The EPA included the experimental, non-essential populations for the following fish species in the consultation: boulder darter, bull trout, Colorado pikeminnow (=squawfish), duskytail darter, pygmy madtom, Rio Grande silvery minnow, slender chub, smoky madtom, spotfin chub, Topeka shiner, woundfin, and yellowfin madtom. We do not provide separate analyses and make jeopardy determinations for these populations independently. Rather, we treat any experimental and non-experimental populations as a single listed species for the purposes of conducting jeopardy analyses and making jeopardy determinations. By definition, a "non-essential experimental population" is not essential to the continued existence of the species. In cases where our assessment of the non-experimental population(s) of the species leads to a “not likely to jeopardize” determination, we generally assume any added effects to the experimental population will not change these determinations. However, we consider the role of the experimental population on the survival and recovery of the species and consider this information in our jeopardy analyses as appropriate.

## Species proposed for delisting

The following species are proposed for delisting (Table 1). While we present some specific information about the species in Table 1 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

**Table 1. Fish species recommended for delisting.**

| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | Change in status | Draft Determination |
|---|---|---|---|---|---|---|
| *Etheostoma sellare* | Maryland darter | High | Medium | High | Recommend delisting due to extinction | No Jeopardy |

The 2021 5-Year Review for the Maryland darter recommended delisting the species due to extinction. Because the available information indicates this species is no longer extant in the wild, and because there are no captive individuals, we do not anticipate the proposed action will appreciably reduce the likelihood of either the survival or recovery of the species. Therefore, we do not expect the proposed action will jeopardize the continued existence of the Maryland darter.

## Species with low concern of adverse effects

The species in Table 2 are grouped together as they have low concern of adverse effects due to either 1) low exposure and low toxicity with high vulnerability or 2) low exposure with low or medium vulnerability and variable toxicity. While we present some specific information about the species in Table 2 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

**Table 2. Species with low concern of adverse effects.**

| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | Draft Determination |
|---|---|---|---|---|---|
| *Acipenser oxyrinchus (=oxyrhynchus) desotoi* | Atlantic sturgeon (Gulf subspecies) | Medium | Low | High | No Jeopardy |
| *Amblyopsis rosae* | Ozark cavefish | Medium | Low | Low | No Jeopardy |
| *Chasmistes liorus* | June sucker | Medium | Low | High | No Jeopardy |
| *Cottus paulus (=pygmaeus)* | Pygmy sculpin | High | Low | Low | No Jeopardy |
| *Crenichthys baileyi baileyi* | White River springfish | Medium | Low | High | No Jeopardy |
| *Crenichthys nevadae* | Railroad Valley springfish | Medium | Low | High | No Jeopardy |
| *Cyprinella formosa* | Beautiful shiner | Medium | Low | High | No Jeopardy |
| *Eremichthys acros* | Desert dace | Medium | Low | High | No Jeopardy |
| *Erimonax monachus* | Spotfin chub | High | Low | Low | No Jeopardy |
| *Erimystax cahni* | Slender chub | High | Low | Low | No Jeopardy |
| *Etheostoma akatulo* | Bluemask (jewel) darter | Medium | Low | High | No Jeopardy |
| *Etheostoma okaloosae* | Okaloosa darter | Low | Low | High | No Jeopardy |
| *Etheostoma percnurum* | Duskytail darter | High | Low | Low | No Jeopardy |
| *Etheostoma scotti* | Cherokee darter | Medium | Low | Low | No Jeopardy |
| *Eucyclogobius newberryi* | Tidewater goby | Low | Low | High | No Jeopardy |
| *Gila cypha* | Humpback chub | Medium | Low | High | No Jeopardy |
| *Gila ditaenia* | Sonora chub | Medium | Low | High | No Jeopardy |
| *Gila elegans* | Bonytail chub | High | Low | Low | No Jeopardy |
| *Gila purpurea* | Yaqui chub | Medium | Low | High | No Jeopardy |
| *Hypomesus transpacificus* | Delta smelt | High | Low | Low | No Jeopardy |
| *Moapa coriacea* | Moapa dace | Medium | Low | High | No Jeopardy |

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| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | Draft Determination |
|---|---|---|---|---|---|
| *Notropis buccula* | Smalleye shiner | High | Low | Low | No Jeopardy |
| *Notropis oxyrhynchus* | Sharpnose shiner | High | Low | Low | No Jeopardy |
| *Notropis simus pecosensis* | Pecos bluntnose shiner | Medium | Low | Low | No Jeopardy |
| *Noturus flavipinnis* | Yellowfin madtom | Medium | Low | Low | No Jeopardy |
| *Noturus stanauli* | Pygmy madtom | High | Low | Low | No Jeopardy |
| *Oncorhynchus aguabonita whitei* | Little Kern golden trout | Medium | Low | High | No Jeopardy |
| *Oncorhynchus clarkii henshawi* | Lahontan cutthroat trout | Medium | Low | High | No Jeopardy |
| *Oncorhynchus clarkii seleniris* | Paiute cutthroat trout | Medium | Low | High | No Jeopardy |
| *Oncorhynchus gilae* | Gila trout | Medium | Low | High | No Jeopardy |
| *Percina antesella* | Amber darter | High | Low | Low | No Jeopardy |
| *Percina aurolineata* | Goldline darter | Medium | Low | Low | No Jeopardy |
| *Percina aurora* | Pearl darter | High | Low | Low | No Jeopardy |
| *Percina jenkinsi* | Conasauga logperch | High | Low | Low | No Jeopardy |
| *Percina pantherina* | Leopard darter | High | Low | Low | No Jeopardy |
| *Percina rex* | Roanoke logperch | Medium | Low | Low | No Jeopardy |
| *Phoxinus cumberlandensis* | Blackside dace | Medium | Low | High | No Jeopardy |
| *Poeciliopsis occidentalis* | Gila topminnow (incl. Yaqui) | Medium | Low | High | No Jeopardy |
| *Ptychocheilus lucius* | Colorado pikeminnow (squawfish) | Medium | Low | High | No Jeopardy |
| *Salvelinus confluentus* | Bull trout | Medium | Low | High | No Jeopardy |
| *Xyrauchen texanus* | Razorback sucker | Medium | Low | High | No Jeopardy |

In our review of the current status of the species, and the environmental baseline, and cumulative effects for the action area, determined we determined that the following species have low vulnerability, low exposure, and high toxicity rankings: the Okaloosa darter and the tidewater goby. While these species have a high toxicity ranking, indicating that adverse effects, such as mortality, are likely to occur if exposed to methomyl, we expect very few individuals will experience such adverse effects given their low exposure ranking. The ranges for these two species have a very low overlap with the action area (ranging from 0.007%-2.5% total overlap) and have only have a small portion of range likely to be treated each year (up to 1.7% of the range treated annually). While we cannot completely rule out the possibility of exposure to individuals, these exposure metrics indicate that exposure is likely to be limited to a very small number of individuals in localized areas. Additionally, these three species have low vulnerability rankings and none of them have pesticides specifically noted as threat to their continued existence, indicating that these species are likely more robust to the low level of adverse effects that might occur with methomyl use.

The Roanoke logperch and Pecos bluntnose shiner have medium vulnerability, low exposure, and low toxicity rankings: While these two species have a medium vulnerability ranking, indicating that they may be less robust to adverse effects, both species will experience only low levels of exposure as USDA's Census of Agriculture indicates very little usage of any insecticide has occurred within these species' ranges in the past (up to 3.86% and 0.59% of the range treated annually, respectively). Individuals that are exposed will not experience any mortality and only low levels of sublethal effects as predicted methomyl concentrations in these species' habitats are lower than levels where toxicity studies have observed any adverse effects to survival, growth, or reproduction. This low level of adverse effect, coupled with the low exposure potential, indicate that no more than a very small number of individuals are likely to experience any adverse effects from methomyl use.

The following species have medium vulnerability, low exposure, and high toxicity rankings: humpback chub, Moapa dace, Colorado pikeminnow, Gila topminnow, Gila trout, Paiute cutthroat trout, Lahontan cutthroat trout, yellowfin madtom, Little Kern golden trout, Sonora chub, Ozark cavefish, Yaqui chub, desert dace, Cherokee darter, beautiful shiner, Railroad Valley springfish, White River springfish, Atlantic sturgeon (Gulf subspecies), June sucker, razorback sucker, blackside dace, goldline darter, bull trout, bluemask darter. These species all have medium vulnerability rankings, indicating that these species, while not particularly sensitive to threats, may be less robust in response to adverse effects from methomyl than other species. Aside from the Atlantic sturgeon, Moapa dace, and June sucker, all other species in this group have low overlap between their ranges and the action area (total overlap ranges from 0.03-3.48%). While the Atlantic sturgeon, Moapa dace, and June sucker have higher total overlaps (5.7-16.8% total overlap), we have high confidence that only a small portion of their ranges will be treated with methomyl based on all insecticide usage data from USDA's Census of Agriculture, which indicate only up to 1.3-4% of these ranges will likely be treated with any insecticide annually. As such, we expect only small numbers of individuals, at most, are likely to experience any exposure to methomyl. These species also have a high toxicity ranking, indicating that mortality is likely to occur for these species. However, we anticipate these species (aside from the blackside dace and the Sonora chub) will only die in areas where there is low flow rate or low water volume and are not likely to experience any adverse effects in other areas of their habitat (e.g., areas of higher flow or large volume of water), suggesting that only individuals occupying certain parts of exposed habitat are likely to experience adverse effects. As we anticipate only small numbers of individuals are likely to be exposed, and only individuals exposed in certain habitats are likely to experience adverse effects, we anticipate only a very small number of individuals are likely to be impacted by the proposed action. While the blackside dace and Sonora chub only occur in areas that will accumulate high levels of methomyl if exposed, we anticipate only a small area of the range is likely to be exposed as methomyl use sites overlap just 1.2 and 0.1% with these species' ranges respectively, indicating only small numbers of individuals are likely to be exposed and experience adverse effects. While these species have high vulnerability, we expect the number of individuals adversely affected by the proposed action is not likely to appreciably impact the species as a whole.

The following species have high vulnerability, low exposure, and low toxicity rankings: spotfin chub, leopard darter, pygmy sculpin, slender chub, bonytail chub, pygmy madtom, amber darter, Conasauga logperch, Delta smelt, duskytail darter, sharpnose shiner, pearl darter, smalleye shiner. Pesticides are noted as a threat for all these species. While these species may be less robust to adverse effects given their high vulnerability, we anticipate only a small number of individuals are likely to experience effects from exposure to methomyl. The leopard darter, duskytail darter, slender chub, amber darter, spotfin chub, pearl darter, Conasauga logperch, pygmy sculpin, and bonytail chub all have a low extent of overlap (total overlaps range from 0.1-2.6%), and low usage (up to 0.6% of the range treated with methomyl and up to 1.32% of the range treated with any insecticide). While the pygmy madtom, sharpnose shiner, smalleye shiner, and Delta smelt have larger overlaps between their ranges and the action area (4.8% to 16.4%), we have high confidence that very little usage will occur based on all insecticide usage data from the Census of Agriculture (and the California Pesticide Use Report for the Delta smelt, specifically). As such, we have high confidence that only a small number of individuals of these species are likely to be exposed to methomyl. Each of these species occur in habitat that are not expected the accumulate more than low levels of methomyl (e.g., high flow or large volume waterbodies) and so we expect these species will not likely experience any mortality and only low levels of adverse sublethal effects. Thus, while these species have high vulnerabilities and may be less robust to adverse effects, we anticipate very few individuals are likely to be exposed to methomyl and only a fraction of those exposed are likely to experience any adverse effects.

In summary, while the vulnerability and toxicity rankings vary across the species listed in Table 2 above, we expect all these species are likely to experience no more than low levels of exposure to methomyl. This low level of exposure is either coupled with a low or medium vulnerability, which makes the species more robust against any adverse effects that will result from losses or sublethal effects to exposed individuals, or is coupled with a low toxicity ranking, indicating that exposure will not result in more than low levels of adverse effects to the species. While pesticides are noted as a threat to many of the fish species in this group, adverse effects from methomyl exposure are anticipated to be limited to the loss and sublethal effects of small numbers of individuals in localized areas. Therefore, we determine the overall risk of adverse effects these species is low and that the proposed action will not appreciably reduce the survival and recovery of these fish species. We expect the proposed action will not jeopardize the continued existence of the species in Table 2 in the wild.

There are non-essential experimental populations for the following species in Table 2: bull trout (Entity ID: 10037), Colorado pikeminnow (Entity ID: 2142), duskytail darter (Entity IDs: 6503 and 9502), pygmy madtom (Entity ID: 9503), slender chub (Entity ID: 9504), spotfin chub (Entity IDs: 1934, 9505, and 9061), and yellowfin madtom (Entity IDs: 2956, 4496, and 9506).

## Species with low exposure (informed by low overlap with agriculture), high vulnerability, and high toxicity

The species listed here are grouped together as they all have low exposure informed by low overlap with agricultural sites where methomyl is registered for use (Table 3). While we present some specific information about the species in Table 3 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

**Table 3. Fish species with low exposure (informed by low overlap with agriculture), high vulnerability, and high toxicity.**

| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | Total Action Area Overlap | Determination |
|---|---|---|---|---|---|---|
| *Catostomus santaanae* | Santa Ana sucker | High | Low | High | 1.0 | No Jeopardy |
| *Catostomus warnerensis* | Warner sucker | High | Low | High | 1.1 | No Jeopardy |
| *Chasmistes brevirostris* | Shortnose sucker | High | Low | High | 4.2 | No Jeopardy |
| *Chasmistes cujus* | Cui-ui | High | Low | High | 0.3 | No Jeopardy |
| *Chrosomus saylori* | Laurel dace | High | Low | High | 1.5 | No Jeopardy |
| *Crenichthys baileyi grandis* | Hiko White River springfish | High | Low | High | 0.2 | No Jeopardy |
| *Crystallaria cincotta* | Diamond darter | High | Low | High | 3.6 | No Jeopardy |
| *Cyprinella caerulea* | Blue shiner | High | Low | High | 4.4 | No Jeopardy |
| *Cyprinodon bovinus* | Leon Springs pupfish | High | Low | High | 0.9 | No Jeopardy |
| *Cyprinodon elegans* | Comanche Springs pupfish | High | Low | High | 0.9 | No Jeopardy |
| *Cyprinodon nevadensis mionectes* | Ash Meadows Amargosa pupfish | High | Low | High | 0 | No Jeopardy |
| *Cyprinodon radiosus* | Owens pupfish | High | Low | High | 0.2 | No Jeopardy |
| *Dionda diaboli* | Devils River minnow | High | Low | High | 0.3 | No Jeopardy |
| *Empetrichthys latos* | Pahrump poolfish | High | Low | High | 0.1 | No Jeopardy |

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| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | Total Action Area Overlap | Determination |
|---|---|---|---|---|---|---|
| *Etheostoma chermocki* | Vermilion darter | High | Low | Low | 0.4 | No Jeopardy |
| *Etheostoma etowahae* | Etowah darter | High | Low | Low | 1.2 | No Jeopardy |
| *Etheostoma moorei* | Yellowcheek darter | High | Low | Low | 0.1 | No Jeopardy |
| *Etheostoma nuchale* | Watercress darter | High | Low | Low | 0.3 | No Jeopardy |
| *Etheostoma osburni* | Candy darter | High | Low | High | 0.4 | No Jeopardy |
| *Etheostoma phytophilum* | Rush darter | High | Low | Low | 3.2 | No Jeopardy |
| *Etheostoma spilotum* | Kentucky arrow darter | High | Low | High | 0.2 | No Jeopardy |
| *Etheostoma susanae* | Cumberland darter | High | Low | High | 0.2 | No Jeopardy |
| *Gambusia gaigei* | Big Bend gambusia | High | Low | High | 0 | No Jeopardy |
| *Gambusia heterochir* | Clear Creek gambusia | High | Low | High | 1.0 | No Jeopardy |
| *Gambusia nobilis* | Pecos gambusia | High | Low | High | 1.7 | No Jeopardy |
| *Gasterosteus aculeatus williamsoni* | Unarmored threespine stickleback | High | Low | High | 2.0 | No Jeopardy |
| *Gila bicolor ssp.* | Hutton tui chub | High | Low | High | 0 | No Jeopardy |
| *Gila bicolor ssp. mohavensis* | Mohave tui chub | High | Low | High | 0.2 | No Jeopardy |
| *Gila bicolor ssp. snyderi* | Owens tui chub | High | Low | High | 0.2 | No Jeopardy |
| *Gila intermedia* | Gila chub | High | Low | High | 0.4 | No Jeopardy |
| *Gila nigrescens* | Chihuahua chub | High | Low | High | 0.4 | No Jeopardy |
| *Gila robusta jordani* | Pahranagat roundtail chub | High | Low | High | 0.2 | No Jeopardy |
| *Gila seminuda (=robusta)* | Virgin River chub | High | Low | High | 0.2 | No Jeopardy |
| *Hybognathus amarus* | Rio Grande silvery minnow | High | Low | Low | 0.7 | No Jeopardy |
| *Ictalurus pricei* | Yaqui catfish | High | Low | High | 3.7 | No Jeopardy |

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| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | Total Action Area Overlap | Determination |
|---|---|---|---|---|---|---|
| *Lepidomeda albivallis* | White River spinedace | High | Low | High | 0.6 | No Jeopardy |
| *Lepidomeda mollispinis pratensis* | Big Spring spinedace | High | Low | High | 0.4 | No Jeopardy |
| *Lepidomeda vittata* | Little Colorado spinedace | High | Low | High | 0 | No Jeopardy |
| *Meda fulgida* | Spikedace | High | Low | High | 0.4 | No Jeopardy |
| *Notropis cahabae* | Cahaba shiner | High | Low | Low | 1.2 | No Jeopardy |
| *Noturus baileyi* | Smoky madtom | High | Low | Low | 1.5 | No Jeopardy |
| *Noturus munitus* | Frecklebelly madtom | High | Low | Low | 1.4 | No Jeopardy |
| *Oncorhynchus clarkii stomias* | Greenback cutthroat trout | High | Low | High | 3.1 | No Jeopardy |
| *Percina williamsi* | Sickle darter | High | Low | Low | 1.2 | No Jeopardy |
| *Plagopterus argentissimus* | Woundfin | High | Low | High | 0.3 | No Jeopardy |
| *Rhinichthys osculus lethoporus* | Independence Valley speckled dace | High | Low | High | 0.1 | No Jeopardy |
| *Rhinichthys osculus nevadensis* | Ash Meadows speckled dace | High | Low | High | 0 | No Jeopardy |
| *Rhinichthys osculus oligoporus* | Clover Valley speckled dace | High | Low | High | 0.5 | No Jeopardy |
| *Rhinichthys osculus thermalis* | Kendall Warm Springs dace | High | Low | High | 0 | No Jeopardy |
| *Salmo salar* | Atlantic salmon | Medium | Low | Medium | 2.6 | No Jeopardy |
| *Tiaroga cobitis* | Loach minnow | High | Low | High | 0.5 | No Jeopardy |

All the species listed in Table 3 have a high vulnerability ranking, indicating that the species may be less robust to any adverse effects that occurs to individuals within the species. The Kendall Warm Springs dace, watercress darter, Pecos gambusia, smoky madtom, Hutton tui chub, Devil's River minnow, loach minnow, Ash Meadows Amargosa pupfish, Cahaba shiner, Little Colorado spinedace, blue shiner, Etowah darter, vermilion darter, chucky madtom, laurel dace, and Kentucky arrow darter and Rio Grande silvery minnow all have pesticides listed as a specific threat to the species. The Rio Grande silvery minnow includes a non-essential experimental population (Entity ID 10052), although it was considered unsuccessful and is no longer extant (USFWS 2023). All the species in this group have low total overlap with registered methomyl use sites, indicating that only a small number of individuals are likely to experience any exposure to methomyl.

Of these species, the Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, Big Bend gambusia, and Kendall Warm Springs dace all primarily occur on federal lands (e.g., national parks, national wildlife refuge) where we do not anticipate agricultural activities are likely to occur. Given that methomyl is only registered for agricultural use, we anticipate these species are not likely to experience any exposure. Similarly, Hutton Tui chub and the Little Colorado spinedace's ranges do not overlap with methomyl use sites (i.e., 0% overlap), indicating that no individuals are likely to be exposed to methomyl. Thus, while these species have a high vulnerability ranking and will theoretically experience high levels of adverse effects if exposed, we anticipate no individuals will experience any mortality or adverse effects to growth or reproduction.

Of the remaining species in this group, all species have a high vulnerability ranking, indicating that they may not be able to withstand additional stressors in their environment, including adverse effects from methomyl exposure. However, we anticipate these species (aside from the Cumberland darter, Hiko White River springfish, and Independence Valley speckled dace) will only die in areas where there is low flow rate or low water volume and are not likely to experience any adverse effects in areas of their habitat that consist of higher flow rates or large volumes of water. As such, we expect that only individuals occupying certain parts of exposed habitat are likely to experience adverse effects. Given that we anticipate only a small number of individuals are likely to be exposed to methomyl, and that only those exposed in certain habitats with specific characteristics like low flow rates or low water volume, we anticipate very few individuals are likely to experience adverse effects from the proposed action.

While the Cumberland darter, Hiko White River springfish, and Independence Valley speckled dace only occur in areas that will accumulate high levels of methomyl if exposed, we anticipate only a small area of the range is likely to be exposed as the species only have up to 0.2% total overlap, indicating only very small numbers of individuals are likely to experience exposure and adverse effects. While these species have high vulnerability, we expect the number of individuals adversely affected by the proposed action is not likely to appreciably impact the species as a whole.

Coupled with low agricultural overlap (up to 2.6% of their ranges have been treated with methomyl in the past), the frecklebelly madtom, sickle darter, and Atlantic salmon occur in waterbodies that we expect will accumulate very low levels of methomyl. Exposure will result in no mortality for these species and, at most, sublethal (i.e., reduced growth and reproduction) and indirect (i.e., loss of prey) effects for the sickle darter and Atlantic salmon. For the frecklebelly madtom, we do not expect any adverse effects to occur from methomyl exposure based on expected environmental concentrations.

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In summary, while all the species in this group have a high vulnerability ranking and toxicity rankings ranging from low to high, we expect all these species are likely to experience no more than low levels of exposure to methomyl based on the low level of exposure as informed by the low level of total overlap. The total overlap metric we use is a conservative estimate of exposure as it does not fully account for redundancy between use site layers, assumes exposure is occurring in all possible overlapping areas, and does not consider information on past methomyl usage. Thus, given the low level of overlap all the species in Table 3 have with the action area, we have high confidence that only a small number of individuals are likely to experience exposure. While pesticides are noted as a threat to many of the fish species in this group, adverse effects from methomyl exposure are anticipated to be limited to the loss of, at most, small numbers of individuals in localized areas. Therefore, we determine the overall risk of adverse effects these species is low and that the proposed action will not appreciably reduce the survival and recovery of these fish species. We expect the proposed action will not jeopardize the continued existence of the species in Table 3 in the wild.

There are non-essential experimental populations for the following species in Table 3: Rio Grande silvery minnow (Entity ID: 10052), smoky madtom (Entity ID: 5981), and woundfin (Entity ID: 2599).

**References:**

U.S. Fish and Wildlife Service. 2023. Rio Grande Silvery Minnow (*Hybognathus amarus*) 5-Year Status Review: Summary and Evaluation. Albuquerque, New Mexico. 10 pp.

## Species with low exposure (confirmed by low past usage from USDA Census of Agriculture), high vulnerability, and high toxicity

The species in Table 4 are grouped together because they all have low exposure confirmed by low levels of past insecticide usage within their ranges, as informed by the USDA's Census of Agriculture (CoA) data. While we present some specific information about the species in Table 4 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

**Table 4. Species with low exposure (% range treated with insecticides, informed the USDA Census of Agriculture), high vulnerability, and high toxicity.**

| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | % Range Treated | Determination |
|---|---|---|---|---|---|---|
| *Acipenser transmontanus* | White sturgeon (Kootenai River DPS) | High | Low | Low | 2.8 | No Jeopardy |
| *Cyprinodon macularius* | Desert pupfish | High | Low | High | 4.0 | No Jeopardy |
| *Deltistes luxatus* | Lost River sucker | High | Low | High | 0.9 | No Jeopardy |
| *Etheostoma fonticola* | Fountain darter | High | Low | Low | 2.7 | No Jeopardy |
| *Etheostoma nianguae* | Niangua darter | High | Low | Medium | 2.2 | No Jeopardy |
| *Etheostoma rubrum* | Bayou darter | High | Low | Low | 2.6 | No Jeopardy |
| *Etheostoma trisella* | Trispot darter | High | Low | Low | 3.0 | No Jeopardy |
| *Notropis albizonatus* | Palezone shiner | High | Low | Low | 3.4 | No Jeopardy |
| *Notropis mekistocholas* | Cape Fear shiner | High | Low | Low | 3.4 | No Jeopardy |

In our review of the current status of the species, and the environmental baseline, and cumulative effects for the action area, we determined that the vulnerability of the species in Table 4 are high. Our evaluation of the effects of the proposed action on these species indicates a low extent of exposure due mainly to the low past usage of all insecticides within their ranges. Toxicity is expected to be low or medium, with no mortality or sublethal effects anticipated for most of the species in this group. The only two exceptions are the desert pupfish and lost river sucker, which have high toxicity at predicted environmental concentrations of methomyl expected to occur in these species' habitats that are likely to cause high levels of mortality, in addition to growth and reproductive effects, where exposed in localized areas. Additionally, all of the species in this group, except for the cape fear shiner, are also likely to experience indirect effects as we anticipate there will be reductions in the abundance of invertebrate prey species at the predicted concentrations of methomyl likely to occur in their habitats where exposed in localized areas. We anticipate these prey losses will lead to reductions in fitness, growth, or survival of a very small number of individuals of these species, except for the Niangua darter, which is a dietary specialist so a higher level of effects is anticipated, but still with only small numbers of Niangua darters expected to experience indirect effects.

While species in Table 4 are highly vulnerable and likely to experience high levels of adverse effects if exposed to methomyl, we anticipate only a small number of individuals of these species are likely to experience exposure. The low level of usage reported by the USDA Census of Agriculture indicates that very little insecticide usage (of any type) occurred in the past in the counties where these species' ranges occur. Given that this reporting broadly includes all insecticide usage, we consider Census of Agriculture data to be conservative estimates of methomyl usage that indicate very little of the species' ranges are likely to be treated. We anticipate individuals exposed to methomyl in low flow or low water volume habitat will die. Individuals exposed in areas of high flow or large water volume are not likely to experience any mortality and only low levels of sublethal effects. Given that we anticipate only a small number of individuals are likely to be exposed to methomyl, and that we anticipate mortality only for those exposed in certain habitats, we anticipate very few individuals are likely to experience adverse effects from the proposed action. Thus, while these species have high vulnerability and from low to high toxicity rankings, we anticipate only a small number of individuals will likely experience any adverse effects. Therefore, we determine the overall risk of adverse effects these species is low and that the proposed action will not appreciably reduce the survival and recovery of these fish species. We expect the proposed action will not jeopardize the continued existence of the species in Table 4 in the wild.

## Species with low exposure (based on habitat characteristics)

The species in Table 5 occurs in the Edwards Aquifer system, where we expect no more than low levels of methomyl will accumulate and we expect exposure to the species will be low. While we present some specific information about the species in Table 5 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

**Table 5. Fish species with low exposure (based on the characteristics of their preferred habitat)**

| Scientific Name | Common Name | Vulnerability Ranking | Exposure Ranking | Toxicity Ranking | % Range Treated | Determination |
|---|---|---|---|---|---|---|
| *Satan eurystomus* | Widemouth blindcat | High | Low | Low | 0.8 | No Jeopardy |
| *Trogloglanis pattersoni* | Toothless blindcat | High | Low | Low | 0.8 | No Jeopardy |

The widemouth and toothless blindcats have high vulnerability rankings, indicating that they may be especially susceptible to species-level impacts from additional stressors in their environment, such as adverse effects to individuals from methomyl exposure. Additionally, pesticides are noted as a threat. Available toxicity data indicate that the species would experience low levels of mortality (up to 1%) in the low flow/volume waterbodies where they are found if exposure occurs. The widemouth blindcat feeds on amphipods, decapods, and isopods, all of which are expected to be sensitive to methomyl exposure. The toothless blindcat feeds on detritus and microbial food, which we do not expect to be affected by methomyl exposure.

Despite having high vulnerability and toxicity rankings, we anticipate only a small number of individuals, at most, are likely to be exposed to methomyl based on the unique characteristics of the habitat they occupy. The widemouth and toothless blindcats are subterranean fish species endemic to the San Antonio segment of the Edwards Aquifer in Bexar County, Texas. Methomyl is not able to reach the springs associated with this aquifer system because of its low persistence in water. In addition, high flow rate waters where these fish are found dilute methomyl to minimal concentrations. As such, we anticipate only a small number of individuals, if any, are likely to be exposed to methomyl.

In addition, while the ranges for both species encompass the entire state of Texas, these fish are exclusively found within the unique subterranean ecosystem of the Edwards Aquifer in Bexar County. The rest of the state, outside of this aquifer system, does not provide suitable habitat for these species. Therefore, the species range as described for data analysis purposes includes extensive areas where the species are not present. Consequently, the percentage of the range treated with methomyl (as presented above) is based on the entire range and overestimates the actual level of exposure that is reasonably likely to occur within the aquifer where these fish reside.

In summary, we anticipate the Edwards Aquifer where blindcats are found is not likely to accumulate more than low levels of methomyl as we expect the majority of methomyl residues will degrade before entering the aquifer. In addition, high flow rate waters where these fish are found will dilute any residues that do enter the aquifer to minimal concentrations. Thus, while some individuals could die if exposed and pesticides are noted as a threat to the species, we anticipate few, if any, individuals are likely to experience exposure. We determine the overall risk of adverse effects of methomyl to the widemouth and toothless blindcats is low and losses of small numbers of individuals from the proposed action will not likely appreciably reduce the survival and recovery of these fish species. We expect the proposed action will not jeopardize the continued existence of the species in Table 5 in the wild.

## Species with Individual Integration and Synthesis summaries

For the species in Table 6, our preliminary exposure and toxicity rankings indicated that the proposed action may result in moderate to high adverse effects. As such, we discuss each species in more detail in individual Integration and Synthesis summaries below. In some cases, we modified initial exposure and toxicity rankings due to additional information regarding exposure and effects for individual species, as described below.

**Table 6. Fish with moderate to high adverse effects anticipated from the proposed action. We addressed each species in individual Integration and Synthesis summaries.**

| Scientific Name | Common Name | Draft Determination |
|---|---|---|
| *Speoplatyrhinus poulsoni* | Alabama cavefish | No Jeopardy |
| *Etheostoma boschungi* | Slackwater darter | No Jeopardy |
| *Menidia extensa* | Waccamaw silverside | No Jeopardy |
| *Scaphirhynchus suttkusi* | Alabama sturgeon | No Jeopardy |
| *Noturus placidus* | Neosho madtom | No Jeopardy |
| *Etheostoma wapiti* | Boulder darter | No Jeopardy |
| *Notropis girardi* | Arkansas River shiner | No Jeopardy |
| *Scaphirhynchus albus* | Pallid sturgeon | No Jeopardy |
| *Notropis topeka (=tristis)* | Topeka shiner | No Jeopardy |
| *Etheostoma chienense* | Relict darter | No Jeopardy |
| *Cottus specus* | Grotto sculpin | No Jeopardy |
| *Fundulus julisia* | Barrens topminnow | No Jeopardy |
| *Noturus furiosus* | Carolina madtom | No Jeopardy |
| *Noturus crypticus* | Chucky madtom | No Jeopardy |
| *Elassoma alabamae* | Spring pygmy sunfish | No Jeopardy |
| *Spirinchus thaleichthys* | Longfin smelt | No Jeopardy |
| *Macrhybopsis tetranema* | Peppered chub | No Jeopardy |

# Integration and Synthesis Summary: Alabama cavefish

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Speoplatyrhinus poulsoni* | Alabama cavefish | 236 |

## Species Overview

In reviewing the status of the Alabama cavefish, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a low extent of exposure. Exposed individuals are unlikely to experience mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of crucial aquatic prey species. Given that both exposure and indirect effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Alabama cavefish in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Alabama cavefish. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 3/29/2021; Wherever found; *States within the range:* AL. Figure 1 depicts the species' range.

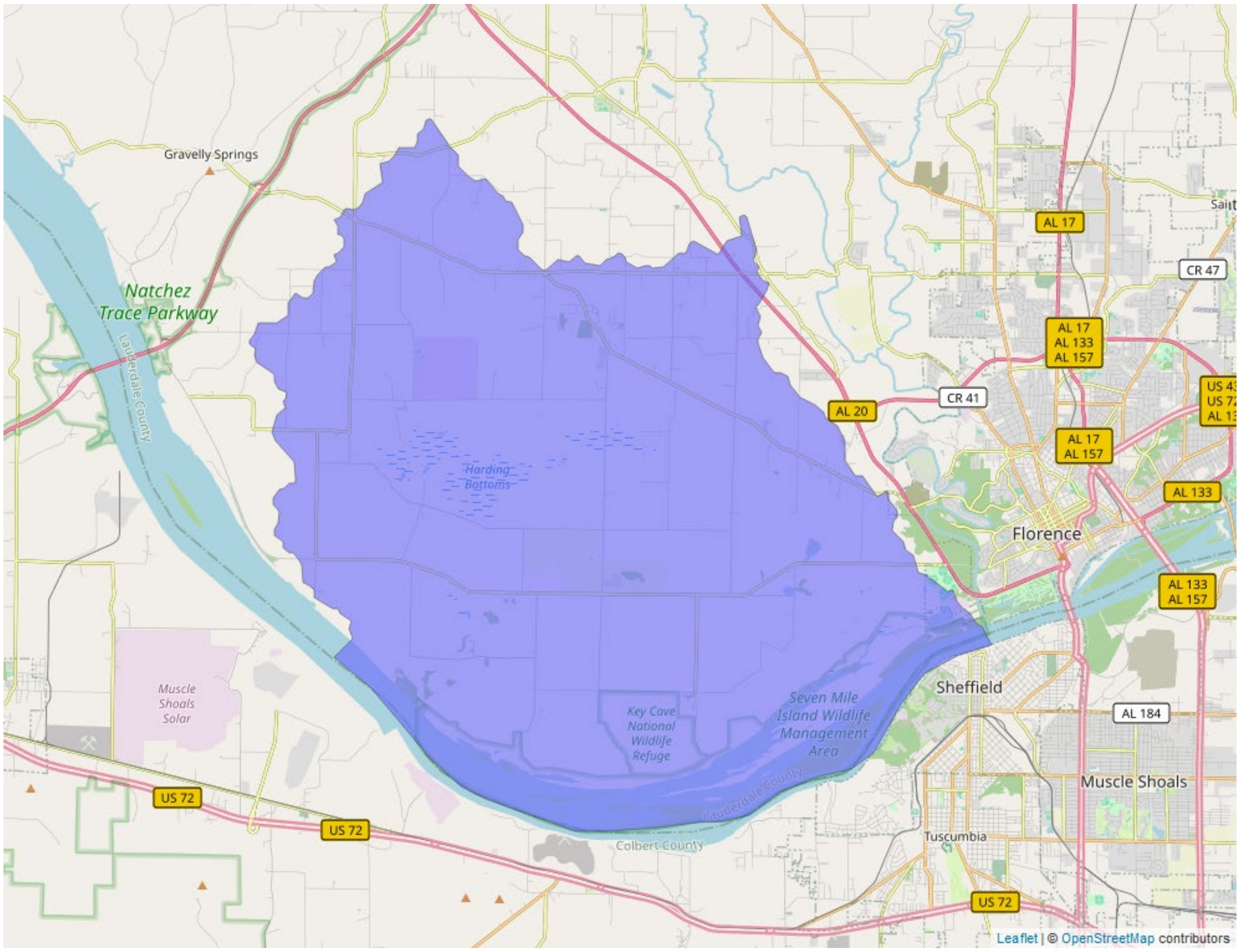


**Figure 1. Range map of Alabama cavefish (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/50.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function not only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Endangered

**Most recent 5-Year Status Review recommendation:** No change in Status

**Most recently completed 5-Year Status Review:** 5/31/2023

**Distribution:** Small, endemic, constrained, and/or isolated population(s)

**Number of populations:** Single population

**Species trends:** Unknown population trends

**Pesticides noted in Service documents as a threat to the species:** yes

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

The Alabama cavefish is known only from Key Cave (formerly known as Coffee Cave) in Key Cave National Wildlife Refuge, a satellite unit of the Wheeler National Wildlife Refuge complex situated on Tennessee Valley Authority land in Lauderdale County, northwest Alabama. This species is considered extremely rare, with a total population estimated to be less than 100 individuals. Surveys conducted in 2018, 2019, and 2021 confirm the population's stability but highlight its critically low numbers. Key Cave is part of the recharge area for the Mississippian-aged Tuscumbia Limestone aquifer, which discharges groundwater into the Tennessee River, primarily via Collier Spring and Woodland Spring. The cave system's water quality is influenced by surface runoff, seasonal rainfall variations, and solubility conditions between the surrounding limestone and groundwater. Recent studies by the Geological Survey of Alabama from 2017 to 2019 have shown that water quality in Key Cave is highly variable and seasonally dependent, with contaminant levels peaking during low precipitation periods (USFWS 2023).

The Alabama cavefish does not reproduce every year and has low fecundity. Fluctuations in water levels and quality challenge the species' reliance on a stable environment, exacerbated by urban and industrial development in the recharge area. This development threatens the aquifer by lowering the water table and altering hydrological patterns, which can lead to diminished winter flows and increased pollution. The gray bat (*Myotis grisescens*) colonies within the cave are a primary source of organic matter through guano deposition, which is critical for the cave ecosystem. However, the bat populations have been declining due to white-nose syndrome, which has reduced their numbers, and the guano deposits are critical for nutrient cycling within the cave system (USFWS 2017). Despite the habitat protection the Key Cave National Wildlife Refuge provides, the Alabama cavefish remains under significant threat from urban and industrial development. These activities, particularly their impacts on the aquifer and water quality, pose a direct risk to the survival of this species. The ongoing agricultural practices on the surrounding private lands, including pesticide runoff, further exacerbate these risks. Currently, management efforts within the refuge focus on erosion control, maintenance of buffer zones, and gradual conversion of agricultural land to native vegetation to enhance water quality and habitat stability for the cavefish. Despite these efforts, the Alabama cavefish remains highly vulnerable due to its limited range, small population size, and significant environmental pressures from human activities. The most recent 5-Year Review (2023) highlighted the need for conservation efforts to prioritize collaboration with private landowners to enhance habitat protection throughout the recharge area. Continued monitoring of water quality and hydrological changes, alongside adaptive management practices, is essential to mitigate the impacts of urban development, agricultural practices, and climate variability.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 38.7% of the species range will contain use sites (Table 7).

### Usage

Past usage data indicate that up to 1.9 % of the species' range has been treated with methomyl annually (Table 7).

**Table 7. Overlap and annual usage data (% Range Treated) for the Alabama cavefish. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| **Corn**[2] | 22.9 | 1.1 |
| Cotton | 15.5 | 0.8 |
| Other Grains | 0.2 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | <0.1 | <0.1 |
| Soybeans | 20.1 | 1 |
| Vegetables and Ground Fruit | <0.1 | <0.1 |
| Wheat | NA | NA |
| **Total** | **38.7** | **1.9** |

[2] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Additional Exposure Considerations**

The entrance to the cave and about 429 acres of surface property above the cave is protected by the Key Cave National Wildlife Refuge, however, some portions of the surface recharge area and sink holes occur on private lands. We generally do not anticipate exposure is likely to occur as there are no recorded instances of methomyl usage on National Wildlife Refuge property. While methomyl use on private lands in recharge areas or near sink holes may still result in some exposure to methomyl, we anticipate this will be limited as we do not anticipate methomyl will persist for long periods of time in aquatic systems and expect most methomyl residues will degrade by the time runoff reaches the cavefish's habitat.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. The entrance to the species' cave habitat, along with a few hundred hectares of surface recharge area, are protected by the Key Cave National Wildlife Refuge. Available pesticide usage data in National Wildlife Refuge indicates no methomyl has been used on refuge property previously, suggesting a low likelihood of usage in the future. While methomyl can be used on private property containing sinkholes or recharge areas that feed the cavefish's habitat, we anticipate only a low level of exposure is likely to occur as usage in this smaller area, in addition to the relatively quick degradation rate of methomyl, will likely result in the exposure of only a few individuals.

**Overall Exposure:** Low

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**Conservation Measures:**

**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 8 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states “Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds”.

## Effects of the Action: Toxicity

### Direct Effects

Maximum predicted environmental concentrations within the habitat that the Alabama cavefish occupies can reach up to 12.86 µg/L (Table 8). Based on available toxicity data on methomyl in fish species, we anticipate this range of exposure concentrations is not likely to cause any mortality or sublethal adverse effects (e.g., reduced growth or reproduction) of exposed individuals. These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies.

**Table 8. Predicted environmental concentrations of methomyl within the Alabama cavefish’s habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| Large volume waterbodies | HUC 6 | 12.86 | 0 |

### Indirect Effects:

The Alabama cavefish likely consumes invertebrate species like copepods, isopods, amphipods, and small crayfish as a food resources. While available toxicity data indicate that invertebrate species are generally sensitive to methomyl, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. While there will be reductions in the availability of some prey species, we anticipate sufficient food resources in the form of other prey species that are less sensitive to methomyl exposure will be present for individuals. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of adverse indirect effect to the Alabama cavefish.

### Toxicity Summary

Based on the predicted environmental concentrations of methomyl within the aquatic habitats that the Alabama cavefish is found in, we do not expect any mortality or sublethal adverse effects are likely to occur. We expect only low levels of indirect effects are likely to occur as we presume the Alabama cavefish is a generalist invertivore and is likely more robust to temporary losses of come species of invertebrate prey species. As such, we anticipate the species will has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Alabama cavefish has a low exposure ranking. While there is a high extent of overlap between the action area and the species' range (38.7% total overlap), there is a low level of past usage within the species range, indicating only a small area of the range is likely treated annually (up to 1.9% range treated). Additionally, much of the species' range is protected by the Key Cave National Wildlife Refuge, which has not recorded any instances of methomyl usage in the past. While some exposure may occur as a result of methomyl use on private land near sinkholes or recharge areas, we anticipate this will be limited as we do not anticipate methomyl will persist for long periods of time in aquatic systems and expect most methomyl residues will degrade by the time runoff reaches the cavefish's habitat.

The species has a low toxicity ranking. In the rare instances when we anticipate methomyl residues reach the cave system, predicted environmental concentrations within the Alabama cavefish's habitat will not cause mortality or sublethal adverse effects to individuals. While there may be some reductions in the abundance of prey species, we anticipate only low levels of indirect effects are likely as the species is a generalist feeder and can likely rely on prey species that are less sensitive to methomyl for food resources.

Given the low exposure potential coupled with the low level of adverse effects anticipated at the concentrations of methomyl predicted to occur in the species' habitat, we expect, at most, only a small number of individuals are likely to experience any adverse effects. Thus, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The endangered Alabama cavefish inhabits a delicate and highly specialized ecosystem within Key Cave. Despite its ecological needs and low reproductive rate, surveys indicate a stable population without significant fluctuations in recent years. Although the cavefish is highly vulnerable due to its restricted range, small population size, and specialized habitat requirements, methomyl usage within its range is minimal, and overall risk of adverse effects is low. This, along with the largely protected status of its habitat, significantly reduces the risk of pesticide exposure from agricultural activities. Considering these factors and the limited direct toxicity of methomyl, we anticipate only localized, minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Alabama cavefish in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Alabama cavefish.

## References

U.S. Fish and Wildlife Service. 2023. Alabama Cavefish (*Speoplatyrhinus poulsoni*) 5-Year Review: Summary and Evaluation. Daphne, Alabama. pp. 11.

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

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

# Integration and Synthesis Summary: Slackwater darter

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Etheostoma boschungi* | Slackwater darter | 239 |

## Species Overview

In reviewing the status of the slackwater darter, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience significant mortality but may face moderate levels of sublethal effects, primarily through reductions in growth and reproduction. Given that exposure is medium and adverse effects are moderate, we assess the risk of adverse effects to the species as moderate. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the slackwater darter in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the slackwater darter. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 5/4/2020; Wherever found; *States within the range:* AL, TN. Figure 2 depicts the species' range.

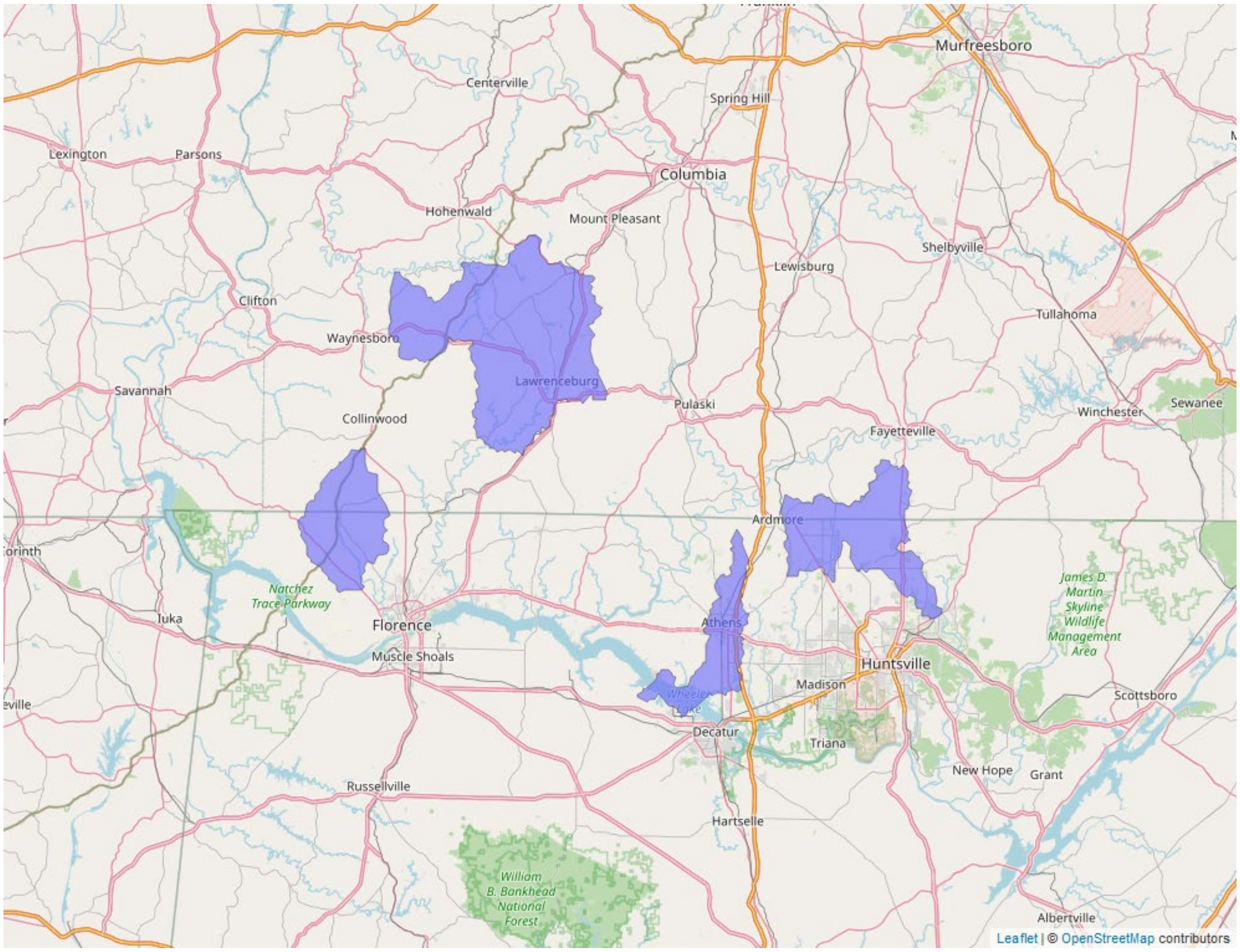


**Figure 2. Range map of slackwater darter (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/8058.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Threatened

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 3/21/2024

**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 in Service documents as a threat to the species:** yes

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

The slackwater darter is a rare species found predominantly in tributary streams to the south bend of the Tennessee River in the southwestern Highland Rim of the Nashville Basin in Tennessee and northern Alabama. This species is known for its dependency on specific habitat types: primarily small to moderately large gravel-bottomed pools with slow currents for non-breeding and shallow waters originating from spring seeps for breeding (USFWS 1984). The slackwater darter exhibits a distinct migratory behavior, moving to breeding habitats in November and returning to non-breeding habitats in April or early May.

Recent surveys up to 2022 indicate that slackwater darters are currently found in five main systems of the middle Tennessee River, with the only confirmed spawning locations in recent years being in Limestone and Lauderdale Counties, Alabama (USFWS 2024). These surveys have demonstrated a decline in both distribution and abundance compared to historical data, with an approximate 45% reduction in range and discovery of new sites suggesting ongoing but uneven population dynamics.

Threats to the slackwater darter have not diminished over time and include habitat degradation from urbanization and development, which impacts water quality and stream morphology (USFWS 2008). Specific concerns include increased sedimentation from construction and agriculture, disruption by cattle, and loss of habitat connectivity due to infrastructural barriers such as culverts. Degradation of surface and groundwater caused by the intrusion of toxins, pesticides, herbicides, fertilizers, as well as industrial and domestic wastes from sewage/septic tank seepage, and stockyard runoff are current threats to the slackwater darter by reducing their survival and reproductive capacity. Farming and cattle are the principal industries surrounding the darter's habitat, increasing indirect habitat modifications through organic run-off and chemical run-off from surrounding land use practices. Since the breeding habitats are so limited, even a small chemical spill or biological pollutant could completely exterminate a breeding population. Additionally, environmental changes such as climate-induced alterations in temperature and precipitation patterns pose emerging threats that could affect water availability and quality, impacting both breeding and non-breeding habitats. Conservation efforts have focused on protecting natural stream channels, riparian zones, and improving water quality through erosion and sediment control measures. However, existing regulatory protections under state and federal laws have proven insufficient to fully mitigate these threats. The slackwater darter continues to be classified as a threatened species, requiring ongoing monitoring and adaptive management strategies to ensure its survival and recovery (USFWS 1984, 2008, 2024).

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 20.6% of the species range will contain use sites (Table 9).

### Usage

Past usage data indicate that up to 1.2 % of the species' range has been treated with methomyl annually (Table 9).

**Table 9. Overlap and annual usage data (% Range Treated) for the slackwater darter. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 11.9 | 0.6 |
| Cotton | 5.2 | 0.3 |
| Other Grains | 0.3 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | <0.1 | <0.1 |
| **Soybeans**[3] | 14.8 | 0.7 |
| Vegetables and Ground Fruit | 0.2 | 0.2 |
| Wheat | NA | NA |
| **Total** | **20.6** | **1.2** |

[3] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Additional Exposure Considerations**

For the-majority-of the year, slackwater darter live in small (60 cm wide to 15 cm deep) to moderately large (12 m wide and up to 2 m deep) gravel-bottomed pools of creeks where current is usually slow. Individuals prefer streams with slow current or “slack” water. In November, slackwater darters migrate to their breeding habitat. The breeding habitat is shallow water (5 to 10 cm deep), which originates in spring seeps, spring boils, or flooded fields that slowly run off into adjacent streams. In April to early May, juveniles migrate to the non-breeding habitat.

**Exposure Summary**

There is a high extent of overlap between the action area and the species’ range. Based on past usage data, we expect a low level of usage within the species’ range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: “Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office.” This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 10 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states “Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds”.

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## Effects of the Action: Toxicity

### Direct Effects:

Maximum predicted environmental concentrations within the habitat that the slackwater darter occupies can reach up to 164.7 µg/L (Table 10). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data on methomyl in fish species, we anticipate this range of exposure concentrations is not likely to cause any mortality to exposed individuals. While some sublethal adverse effects (e.g., reduced growth or reproduction) might occur in low flow or low volume waterbodies, we anticipate these adverse effects will occur infrequently as we anticipate typical exposure concentrations will not be high enough to cause sublethal adverse effects.

**Table 10. Predicted environmental concentrations of methomyl within the slackwater darter's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 6 | 23.4 | 0.00 |
| Low flow/Low volume waterbodies | HUC 6 | 164.7 | 0.01 |

### Indirect Effects:

The slackwater darter can consume a wide variety of invertebrate species as food resources and has been documented to shift its diet depending on the habitat it occupies. While available toxicity data indicate that invertebrate species are generally sensitive to methomyl, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. Given that available life history information available for the slackwater darter indicates it is an invertebrate prey generalist, we anticipate individuals are likely more robust to temporary losses of certain invertebrate prey species as they can likely switch to use other species whose abundance is not as greatly reduced by methomyl exposure. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of adverse indirect effect to the slackwater darter.

### Toxicity Summary

Based on the predicted environmental concentrations of methomyl within the aquatic habitats where the slackwater darter is found, we expect there will not be any mortality to exposed individuals. We expect, at most, only a low level of sublethal adverse effects is likely to occur to individuals occupying low flow and low volume waterbodies. We anticipate only low levels of indirect effects are likely to occur as the species is a generalist invertivore, suggesting that individuals can switch to more abundant prey resources when methomyl exposure reduces the abundance of more sensitive prey species. While we expect only low levels of indirect effects, the high level of direct effects, including the high level of anticipated mortality, indicates that this species has a high toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The slackwater darter has a medium exposure ranking. While there is a low level of past annual usage within the species' range (up to 1.2% range treated annually), there is a large extent of overlap between the species' range and the action area (20.6% total overlap), indicating that, over the duration of the proposed action, a large portion of the species' range is likely to be treated. As such, we expect a moderate number of individuals are likely to experience exposure.

The slackwater darter has a low toxicity ranking. We do not anticipate predicted environmental concentrations of methomyl will cause any mortality and will only result in, at most, low levels of sublethal effects to growth or reproduction to individuals occupying low flow or low volume waterbodies.

Therefore, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The threatened slackwater darter inhabits specific habitats within tributary streams of the Tennessee River in the southwestern Highland Rim. Despite its ecological requirements and declining population trends, recent surveys indicate the species persists in five main systems, with breeding populations primarily confirmed in Limestone and Lauderdale Counties, Alabama. The slackwater darter is highly vulnerable due to its restricted range, specific habitat needs, and threats from habitat degradation and chemical exposure. While there is a high extent of overlap between the action area and the species' range, past methomyl usage within its range has been low. Predicted concentrations of methomyl in aquatic habitats may result in minor sublethal effects on growth and reproduction in low flow environments, as well as low levels of adverse effects to prey species. However, the darter's ability to use alternative prey species and the limited direct toxicity of methomyl reduce the likelihood of impacts. Considering these factors, we anticipate only localized and minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the slackwater darter in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the slackwater darter.

## References

U.S. Fish and Wildlife Service. 2024. Slackwater Darter (*Etheostoma boschungi*) 5 Year Review: Summary and Evaluation. Daphne, Alabama. pp. 11.

U.S. Fish and Wildlife Service. 2008. Slackwater Darter (*Etheostoma boschungi*) 5 Year Review: Summary and Evaluation. Jackson, Mississippi. pp. 15.

U.S. Fish and Wildlife Service. 1984. Slackwater Darter Recovery Plan. Atlanta, Georgia. pp. 60.

## Integration and Synthesis Summary: Waccamaw silverside

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Menidia extensa* | Waccamaw silverside | 243 |

### Species Overview

In reviewing the status of the Waccamaw silverside, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience significant mortality or sublethal effects but may face low levels of indirect effects, primarily through temporary reductions in the availability of prey species. Given that exposure is medium and the level of indirect effects is low, we assess the overall risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Waccamaw silverside in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Waccamaw silverside. We discuss our rationale for this conclusion for the species in the sections below.

### Species range

Based on range map dated: 2/15/2018; Wherever found; *States within the range:* NC. Figure 3 depicts the species' range.

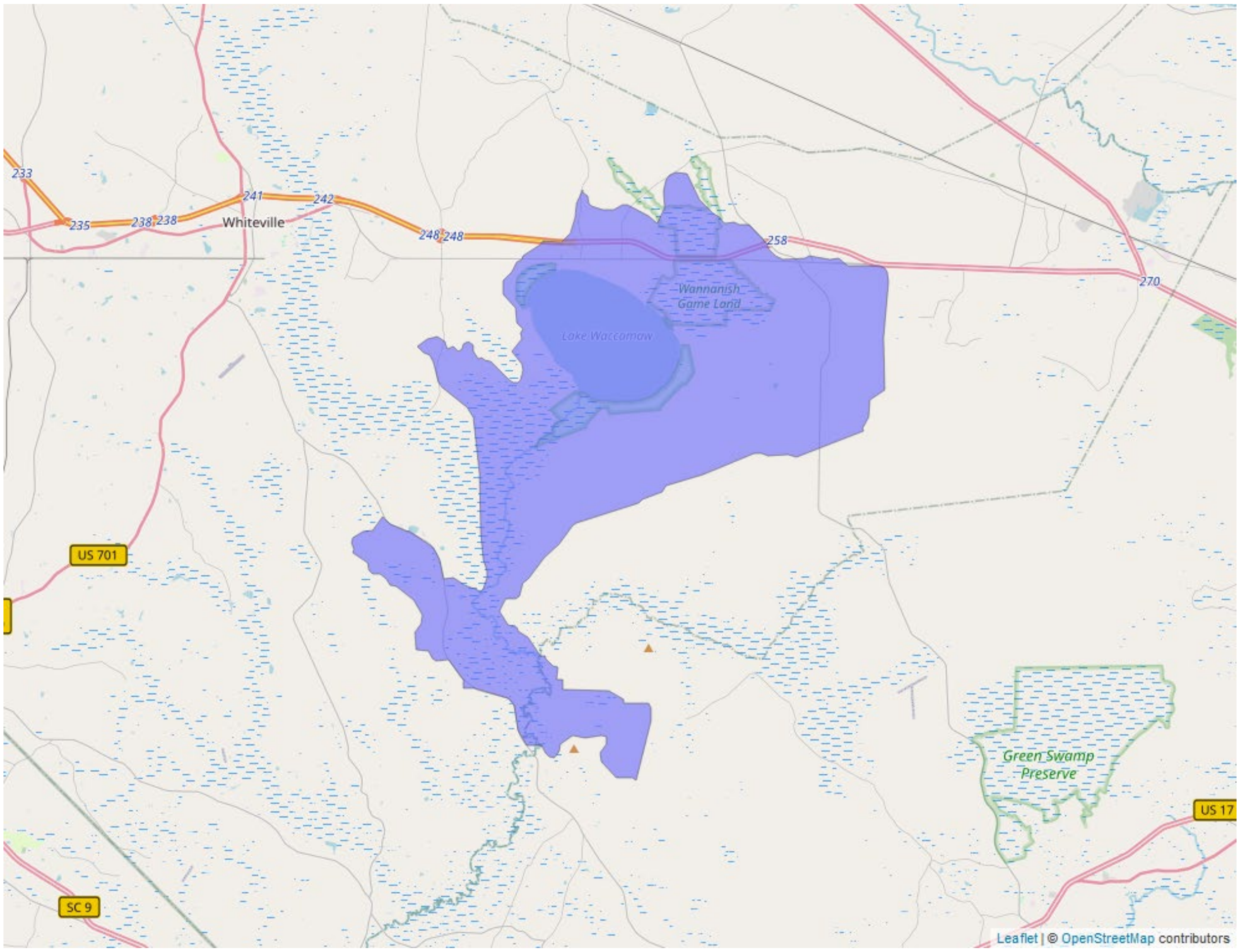


**Figure 3. Range map of Waccamaw silverside (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/8137.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Threatened

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 9/29/2020

**Distribution:** Small, endemic, constrained, and/or isolated population(s)

**Number of populations:** Single population

**Species trends:** All populations stable, with none known to be increasing or decreasing

**Pesticides noted in Service documents as a threat to the species:** yes

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

The Waccamaw silverside (*Menidia extensa*) is known only from Lake Waccamaw, the lower stretch of Big Creek, and a short stretch of the Waccamaw River just downstream from the Lake Waccamaw Dam in Columbus County, North Carolina. Recent and historical surveys conducted between 1981 and 2019 consistently showed stable populations along the north and northeast shores of the lake. Lake Waccamaw is designated an Outstanding Resource Water by the NC Division of Water Quality. This classification is intended to preserve water quality and protect the lake from degradation. Despite this protective status, challenges persist due to increasing development along the shoreline. The development has led to several water quality and quantity issues, including nutrient loading from fertilizers and herbicides, sedimentation from logging activities, and pollution from recreational boating activities. Additionally, outdated sewer and septic systems contribute to the degradation by seeping waste into the lake, representing some of the most significant threats to its water quality. The lake's ecosystem faces further challenges from invasive species. The introduction of hydrilla in 2012 has significantly altered the habitat by forming dense mats that disrupt water flows, impacting the silverside's preferred open-water habitats. Efforts to manage this invasive plant through fluridone treatments have been necessary since 2013.

Moreover, the predatory flathead catfish, documented in the lake since 2014, directly threatens the Waccamaw silverside by preying on their eggs and juveniles. Although genetic research has indicated that the Waccamaw silverside has unique genetic traits conducive to its survival in Lake Waccamaw's specific conditions, comprehensive genetic studies remain limited. Approximately 1,700 acres of land surrounding Lake Waccamaw are protected as part of the state park, which helps to shield the lake from further development impacts and preserves its habitat quality. However, despite these protections, the species' limited range and specialized habitat requirements make it particularly vulnerable to rapid environmental changes, including those induced by human activity. Given the ongoing environmental pressures from development, invasive species, and climate change, the Waccamaw silverside continues to be classified as a threatened species.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 10.6% of the species range will contain use sites (Table 11).

**Usage**

Past usage data indicate that up to 0.8 % of the species' range has been treated with methomyl annually (Table 11).

**Table 11. Overlap and annual usage data (% range treated) for the Waccamaw silverside. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 8.4 | 0.4 |
| Cotton | 0.5 | <0.1 |
| Other Grains | 0.3 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.4 | 0.2 |
| **Soybeans**[4] | 9.3 | 0.5 |
| Vegetables and Ground Fruit | <0.1 | 0.1 |
| Wheat | NA | NA |
| **Total** | **10.6** | **0.8** |

**Additional Exposure Considerations**

The Waccamaw silverside forages in areas of shallow, open water over a clean, dark sand substrate with no vegetation and spawns in open-water areas near the shoreline.

[4] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 12 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations within the habitat of the Waccamaw silverside can reach up to 34.82 µg/L (Table 12). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies . Based on available toxicity data in fish species, we anticipate this range of exposure concentrations is not likely to cause any mortality or sublethal adverse effects (e.g., reduced growth or reproduction) of exposed individuals.

**Table 12. Predicted environmental concentrations of methomyl within the Waccamaw silverside's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---|---|
| High flow waterbodies | HUC 3 | 34.82 | 0 |
| Large volume waterbodies | HUC 3 | 18.67 | 0 |

**Indirect Effects:**

The Waccamaw silverside primarily consumes invertebrate prey species (like ostracods and cladocerans). Available toxicity data in aquatic invertebrates indicate that these two groups of crustaceans are likely sensitive to methomyl exposure and are likely to experience high levels of mortality with methomyl exposure. However, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. Furthermore, based on methomyl's low persistence in water and planktonic drift, we anticipate any localized reductions in invertebrate prey as a food source will be quickly replenished by nearby source populations. As such, while we anticipate large reductions in the availability of prey will occur, we anticipate these impacts will be localized and temporary, that the prey community will recover quickly, and that there will still be sufficient food resources for individuals, resulting in low levels of indirect adverse effects to the species.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats where the Waccamaw silverside is found, we expect there will not be any mortality or sublethal adverse effects to exposed individuals. We anticipate low levels of indirect effects through the loss of prey species is also likely as prey communities will not completely die with exposure to methomyl and will recover quickly after residues degrade. As such, the Waccamaw silverside has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Waccamaw silverside has a medium exposure ranking. While there is a low level of past annual usage within the species' range (up to 0.8% range treated annually), there is a large extent of overlap between the species' range and the action area (10.6% total overlap), indicating that a moderate portion of the species' range may be treated over the duration of the proposed action. As such, we expect a moderate number of individuals are likely to experience exposure.

The Waccamaw silverside has a low toxicity ranking. We do not anticipate any individuals will die or experience any adverse effects to growth or reproduction at predicted environmental concentrations of methomyl. Because the species' main prey is highly sensitive to methomyl exposure, we anticipate a large reduction in available food resources. However, we expect these indirect effects will be localized and temporary and that the overall risk of adverse effects to the species is low.

We anticipate a moderate number of individuals are likely to experience exposure. However, we do not anticipate any exposed individuals will experience direct adverse effects.

## Conclusion

The threatened Waccamaw silverside inhabits Lake Waccamaw and adjacent waterways in North Carolina, relying on specific shallow, open-water habitats free of vegetation. Despite its stable population trends in recent decades, the species is highly vulnerable due to its restricted range, specialized habitat requirements, and ongoing threats from shoreline development, pollution, and invasive species. While there is a high extent of overlap between the action area and the species' range, past methomyl usage within its range has been low. Predicted concentrations of methomyl in aquatic habitats are not anticipated to cause mortality or adverse sublethal effects on growth and reproduction. Indirect effects, such as reductions in key prey species sensitive to methomyl exposure, are expected to be localized and temporary, allowing for prey community recovery and minimal long-term impacts on the silverside's food resources. Considering these factors, we anticipate only localized and minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Waccamaw silverside in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Waccamaw silverside.

## References

U.S. Fish and Wildlife Service. 2011. Waccamaw Silverside (*Menidia extensa*) 5-Year Review: Summary and Evaluation. Raleigh, North Carolina. 14 pp.

U.S. Fish and Wildlife Service. 1993. Waccamaw Silverside Recovery Plan. Atlanta, GA. 24 pp.

# Integration and Synthesis Summary: Alabama sturgeon

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Scaphirhynchus suttkusi* | Alabama sturgeon | 252 |

## Species Overview

In reviewing the status of the Alabama sturgeon, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a moderate overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a low extent of exposure. Exposed individuals are unlikely to experience significant mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species. Given that exposure is low and the level of indirect effects is low, we assess the overall risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Alabama sturgeon in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Alabama sturgeon. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 3/29/2021; Wherever found; *States within the range:* AL. Figure 4 depicts the species' range.

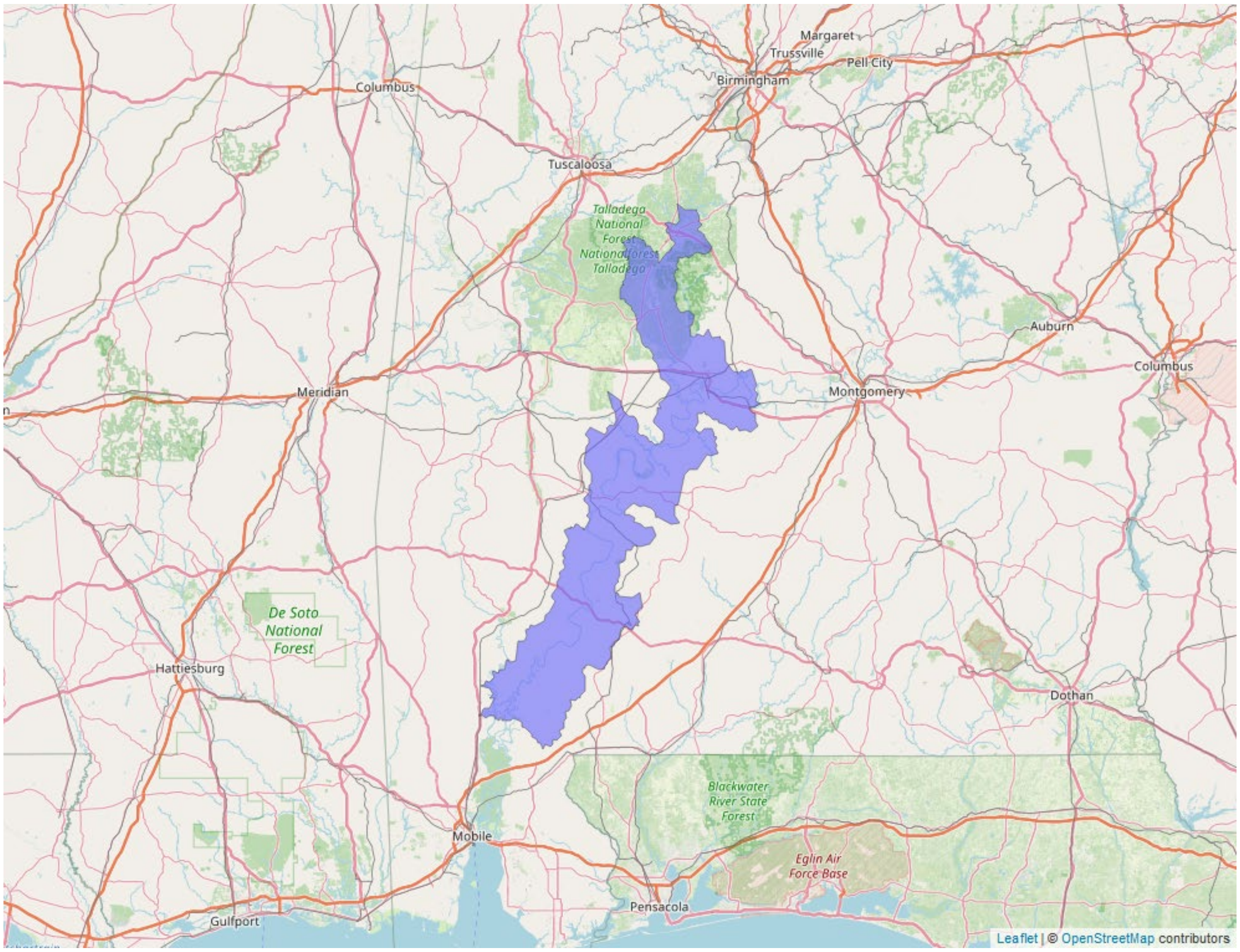


**Figure 4. Range map of Alabama sturgeon (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/2552.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 8/11/2020

**Distribution:** Species/Populations neither constrained nor widespread

**Number of populations:** Population size/location(s) unknown

**Species trends:** Declining population(s) - one or more populations declining

**Pesticides noted in Service documents as a threat to the species:** no

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

Since 1990, all reports or collections of the Alabama sturgeon have been extremely rare, despite significant publicity and notoriety surrounding the species, and concentrated efforts to capture the species. Collections and reports have been restricted to the Alabama River and the Cahaba River. Only nine confirmed Alabama sturgeon captures have occurred, despite focused efforts to collect the species. Of these, two were released apparently unharmed, five died in captivity, one is known to have died shortly after release, and the fate of one is unknown. Additional efforts and observations have been made, although not all have been confirmed as Alabama sturgeon. The collection history of the Alabama sturgeon, supported by anecdotal reports from commercial fishermen, suggest that the species has disappeared from at least 85% of its historical range, and has experienced a significant decline in the remaining range since the 1960s. The species has been extirpated from the upper Tombigbee, lower Black Warrior, lower Tallapoosa, upper Alabama, and middle Cahaba rivers, where it was last reported in the 1960s; the Mobile-Tensaw Delta, last reported in 1985; the lower Coosa River, last reported ca. 1970; the lower Tombigbee River, last reported ca. 1975; (Clemmer et al., 1975; Burke and Ramsey 1985, 1995; Williams and Clemmer, 1991; Mayden and Kuhajda, 1996; M. Mettee, GSA, pers comm., 2005). The species continues to be only rarely collected from the lower portion of the Cahaba River and in the Alabama River from R.F. Henry Lock and Dam downstream to its confluence with the Tombigbee River (Burke and Ramsey 1985, 1995; N. Nichols, ADCNR, pers comm. 2005; Rider and Hartfield 2007; Rider et al. 2009; Rider and Powell 2009). The primary issue currently affecting the Alabama sturgeon is its small population size and its apparent inability to offset mortality rates with current recruitment rates. As noted previously, incidental captures of the Alabama sturgeon have steadily diminished over the last two decades. Although there are no population estimates available for the Alabama sturgeon, recent collection efforts demonstrate its increasing rarity. It is possible that Alabama sturgeon currently number fewer than 50 individuals and it is unknown at this point, given the current operations at the Alabama River dams, the amount of suitable riverine habitat available. It is likely that Alabama sturgeon migrate upstream during late winter and spring to spawn. Post-spawning downstream movements of shovelnose sturgeon have also been documented (Delonay, 2005). The capture of 12 individuals (including several gravid females) during a single collection trip near the mouth of the Cahaba River on 21 March 1969 suggests directional movements during the spawning season (Williams and Clemmer, 1991). Sexual maturity of the Alabama Sturgeon is believed to occur between 5 to 7 years of age. Spawning frequency of both sexes is likely influenced by food supply and fish condition, and presumably like the similar shovelnose sturgeon, may only occur at 2-3 year intervals (Mayden and Kuhajda 1996). Life span of the Alabama sturgeon is unknown. Although few individuals probably exceed 12 to 15 years of age (Mayden and Kuhajda 1996), it is possible the species may live longer. Adult Alabama sturgeon may exhibit seasonal downstream migrations in search of feeding and summer refugia.

The historical decline of the Alabama sturgeon was presumably triggered by unrestricted commercial harvesting between the end of the 19th century and the early 20th century (CAS 2000). Although there are no reports of commercial harvests of Alabama sturgeon after the U.S. Comm. Fish & Fisheries 1898 report, it is likely that the sturgeon continued to be affected by commercial fishing, even if there was no market. Although commercial harvesting may have significantly reduced sturgeon numbers initially, the more recent decline in the Alabama Sturgeon's range and numbers, since 1960, is more likely the result of cumulative impacts as the rivers of the Mobile River basin were developed for navigation, hydropower production, flood control, recreation, waste assimilation and other human uses (65 FR 26438). While these existing structures and activities appear to be permanent in the Mobile Basin, the present effects of their operations, such as flow regulation and navigation maintenance activities, on the Alabama sturgeon are poorly understood. The majority of rivers in the Mobile River basin are now controlled by more than 25 locks and/or dams forming a series of impoundments that are interspersed with short, free-flowing reaches. Prior to the construction of locks and dams (L&Ds) in the Mobile Basin, Alabama sturgeon could move freely between feeding areas, and from feeding areas to sites that were suitable for spawning and development of eggs and larvae. Additionally, the sturgeon may have also used large tributary streams or deep mainstem pools as thermal refugia during the summer months. Sturgeon movements were likely extensive and covered long distances. Other Scaphirhynchus species like the pallid (S. albus) and shovelnose (S. platorynchus) have been reported to migrate greater than 250 km (155 mi) (Moos 1978, Bramblet 1996, Delonay in litt. 2005).

With their migration routes impeded by dams, isolated subpopulations of Alabama sturgeon were unable to successfully recruit adequate numbers to replenish the population. Reduced numbers of recruited sturgeon and surviving adult fish became more vulnerable to localized declines in water and habitat quality caused by hydropower releases, local riverine and land management practices, or by polluted discharges. Dams also reduced the possibility that sturgeon could re-colonize certain areas when subpopulations became extirpated (CAS 2000). Several conservation efforts, including those by state and federal agencies, universities, and private organizations, have been implemented since about 1990 to prevent further population declines and extinction of the Alabama sturgeon. These include (1) a report jointly prepared by the U.S. Army Corps of Engineers (Corps) and Service to address Corps activities in the Alabama River, (2) a conservation plan developed by the Alabama Department of Conservation and Natural Resources (DNR), (3) a voluntary conservation agreement and strategy prepared by the Corps, Alabama DNR, Alabama-Tombigbee Rivers Coalition, and the Service, (4) a multi-species recovery plan for the Mobile Basin, (5) a sturgeon sound detection study, (6) creation of a national repository for tissues and specimens, and (7) a habitat and feeding investigation.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 4.9% of the species range will contain use sites (Table 13).

### Usage

Past usage data indicate that up to 0.7% of the species' range has been treated with methomyl annually (Table 13). The use layers with the highest usage are other row crops (0.4%) and cotton (0.2%).

**Table 13. Overlap and annual usage data (% Range Treated) for the Alabama sturgeon. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 1 | 0.1 |
| Cotton | 2.1 | 0.1 |
| Other Grains | 0.2 | <0.1 |
| Other Orchards | <0.1 | 0.1 |
| Other Row Crops | 1 | 0.4 |
| **Soybeans**[5] | 1.5 | 0.1 |
| Vegetables and Ground Fruit | <0.1 | <0.1 |
| Wheat | NA | NA |
| **Total** | **4.9** | **0.7** |

[5] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Additional Exposure Considerations**

The low usage rate presented above is corroborated by additional data from USDA's Census of Agriculture, which indicates that only 2.6% of the range has been treated with any insecticides in recent years. Given that methomyl usage is likely only a small portion of insecticides included in the Census of Agriculture and that this usage data is specific to the counties that the species' range occurs in, we have high confidence that little methomyl is likely used within the species' range.

**Exposure Summary**

There is a low extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range, which is corroborated by the low level of insecticide usage within the species' range as reported by the USDA Census of Agriculture. The additional information from the Census of Agriculture increases our confidence that exposure is unlikely to occur. As such, we expect only a small number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Low

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 14 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

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## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations within the Alabama sturgeon's habitat can reach up to 28.93 µg/L (Table 14). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish species, we anticipate this range of exposure concentrations will not cause any mortality or sublethal adverse effects (e.g., reduced growth or reproduction) to exposed individuals.

**Table 14. Predicted environmental concentrations of methomyl within the Alabama sturgeon's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 3 | 28.93 | 0 |

**Indirect Effects:**

The Alabama sturgeon is an opportunistic forager and can consume a wide range of prey species, including larval aquatic insects, oligochaetes, mollusks, fish eggs, and fishes. can consume a wide variety of invertebrate species as food resources. While available toxicity data indicate that arthropod species (like aquatic insects) are generally sensitive to methomyl, available data on mollusks, annelids, and other benthic invertebrates indicate that these species of invertebrates are not sensitive to methomyl and are not likely to experience any mortality or sublethal effects as a result of exposure. Thus, while we anticipate a reduction in the abundance of sensitive prey species (like aquatic insect larvae), we expect this will not result in substantial levels of adverse indirect effects as individuals can easily switch to prey resources that are not sensitive to methomyl and will remain abundant. As such, we anticipate the Alabama sturgeon will not experience more than low levels of adverse indirect effects.

**Toxicity Summary**

We do not anticipate any direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) will occur at predicted environmental concentrations of methomyl within the Alabama sturgeon's habitat. Similarly, we anticipate only low levels of indirect adverse effects are likely as the species is a generalist invertivore that can capitalize on food resources whose availability is not reduced by methomyl exposure. Thus, we determine the Alabama sturgeon has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Alabama sturgeon has a low exposure ranking. There is a moderate extent of overlap between its range and the action area (4.9% total overlap) and a low level of past methomyl usage (up to 0.7% range treated annually). This low level of usage is corroborated by all insecticide usage data from USDA's Census of Agriculture, which reports up to 2.6% of the range is likely to be treated with any insecticide. Given the additional support of the Census of Agriculture data, we are confident that only a small portion of the range is likely to be treated, resulting in only a small number of individuals experiencing exposure.

The Alabama sturgeon has a low toxicity ranking. We do not anticipate any mortality of sublethal adverse effects to growth or reproduction are likely to occur at predicted environmental exposures of methomyl. Given that the Alabama sturgeon is an opportunistic forager than can consume a wide range of prey (including taxa that we expect are not sensitive to methomyl and will not experience any mortality from exposure), we anticipate only low levels of indirect adverse effects in the form of prey loss are likely to occur. As such, we anticipate the risk of adverse effects to the species overall is low.

## Conclusion

The endangered Alabama sturgeon is a rare species endemic to the Alabama River and portions of the Cahaba River. Despite its ecological adaptability as an opportunistic forager, the species is highly vulnerable due to its limited range, small population size, and ongoing habitat fragmentation from river modifications such as locks and dams. While there is a moderate overlap (4.9%) between the action area and the species' range, methomyl usage within its range is low (up to 0.7% annually treated), which limits potential exposure. Predicted environmental concentrations of methomyl are not expected to cause mortality or adverse sublethal effects to growth or reproduction. Indirect effects, such as reductions in prey availability, are anticipated to be minimal due to the sturgeon's ability to forage on a wide range of prey, including species not sensitive to methomyl exposure. Considering these factors, we anticipate only localized and minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Alabama sturgeon in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Alabama sturgeon.

## References

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

# Integration and Synthesis Summary: Neosho madtom

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Noturus placidus* | Neosho madtom | 270 |

## Species Overview

In reviewing the status of the Neosho madtom, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is medium past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience significant mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species. Given that exposure is medium and the level of indirect effects is low, we assess the overall risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Neosho madtom in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Neosho madtom. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 11/10/2022; Wherever found; *States within the range:* KS, MO, OK. Figure 5 depicts the species range.

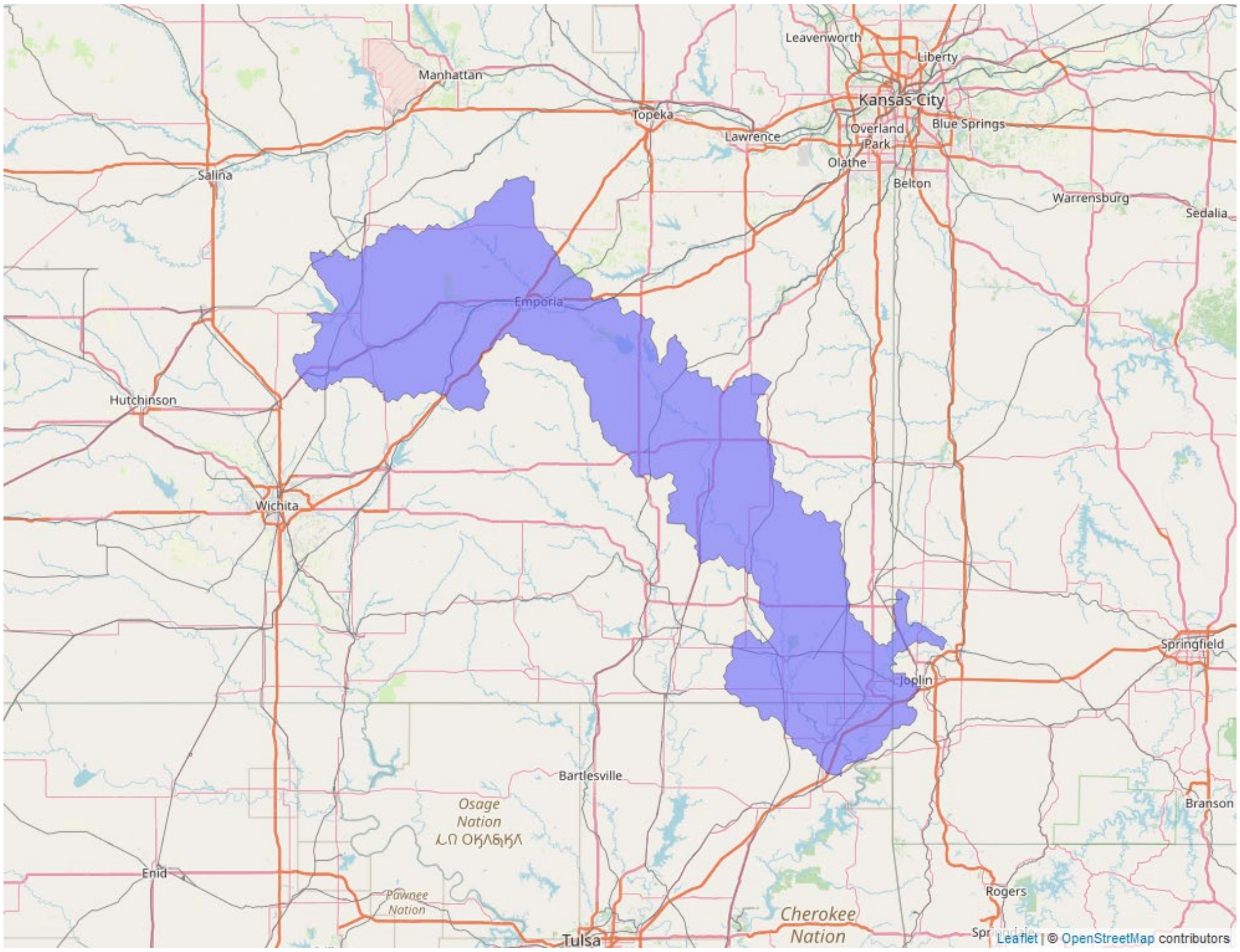


**Figure 5. Range map of Neosho madtom (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/2577.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Threatened

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 2/11/2020

**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 in Service documents as a threat to the species:** yes

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

The Neosho madtom was listed as a threatened species in May 1990. At the time of listing, three populations were known, and their status was assumed to be stable. Habitat loss for the species was extensive due to construction of reservoirs. Known threats to the Neosho madtom include gravel bar removal, drought, chemical pollution, sedimentation, alteration of flow regimes, and interspecific competition. Knowledge of the species' reproductive ecology and population biology was lacking.

Since the Neosho madtom was listed, four generalized populations have been recognized. The population in the Neosho and Cottonwood Rivers upstream of John Redmond Reservoir appears stable and is characterized by high numbers of individuals per unit area. This stream reach has a relatively natural hydrograph and generally moderate to high quality habitat with a low magnitude and immediacy of threat. The Neosho River population downstream of John Redmond Reservoir is generally low in abundance and has exhibited a slow decline in numbers since monitoring began in 1991. The species in this reach is subject to rapid increases and decreases in flows due to dam releases; unnatural periods of high attenuated flows that may impact reproduction and recruitment; and has a mix of low to high quality habitat, with quality generally increasing as the stream flows south. This population has a moderate magnitude of ongoing threat. The Spring River population upstream from the confluence of Turkey Creek appears stable, but is characterized by low numbers, likely resulting from minimal amounts of suitable habitat present. Threats to species in this reach are believed low in magnitude and non-imminent. The population in the Spring River downstream of Empire Lake was not known to exist until 1994, and the species has only been captured five times in this reach. Little work has been completed in this section of river to document habitat availability and quality, and the species' distribution. However, it is likely impacted to some degree by lead and zinc contamination resulting from past mining activity.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where

individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 27.1% of the species range will contain use sites (Table 15).

**Usage**

Past usage data indicate that up to 1.6 % of the species' range has been treated with methomyl annually (Table 15).

**Table 15. Overlap and annual usage data (% Range Treated) for the Neosho madtom. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Alfalfa | 0.9 | 0.1 |
| Citrus | NA | NA |
| Corn | 17.4 | 0.9 |
| Cotton | <0.1 | <0.1 |
| Other Grains | 2.9 | 0.1 |
| Other Orchards | 0.2 | 0.2 |
| Other Row Crops | <0.1 | <0.1 |
| **Soybeans**[6] | 23.1 | 1.2 |
| Vegetables and Ground Fruit | <0.1 | <0.1 |
| Wheat | NA | NA |
| **Total** | **27.1** | **1.6** |

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

[6] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: “Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office.” This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 16 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states “Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds”.

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations within the Neosho madtom’s habitat can reach up to 48.83 µg/L (Table 16). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies (]. Based on available toxicity data in fish species, we do not anticipate any mortality or sublethal adverse effects (e.g., reduced growth or reproduction) will occur to exposed individuals.

**Table 16. Predicted environmental concentrations of methomyl within the Neosho madtom’s habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 10a | 23.26 | 0 |
| High flow waterbodies | HUC 11a | 48.83 | 0 |

**Indirect Effects:**

The Neosho madtom can consume a wide variety of invertebrate species as food resources. While available toxicity data indicate that invertebrate species are generally sensitive to methomyl, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. Given that the Neosho madtom is an invertebrate prey generalist, we anticipate individuals are likely more robust to temporary losses of certain invertebrate prey species as they can likely switch to use other species whose abundance is not as greatly reduced by methomyl exposure. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of adverse indirect effect to the Neosho madtom.

**Toxicity Summary**

We do not expect any direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) will occur at predicted environmental concentrations of methomyl within the species' habitat. Similarly, we anticipate only low levels of indirect adverse effects are likely as the species is a generalist invertivore that can capitalize on food resources whose availability is not reduced by methomyl exposure. Thus, we determine the Neosho madtom has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Neosho madtom has a medium exposure ranking. While there is a low level of past methomyl usage within the species' range (up to 1.6% range treated annually), the high level of overlap (27.1% total overlap) indicates that a moderate portion of the range may be treated over the duration of the proposed action. Thus, we anticipate that a moderate number of individuals are likely to be exposed to methomyl.

The Neosho madtom has a low toxicity ranking. We do not anticipate any mortality or sublethal effects to growth and reproduction are likely to occur at predicted environmental concentrations. We also do not anticipate more than low levels of indirect effects as the Neosho madtom is a generalist invertivore that can use a wide range of insect species as a food resource. Thus, while there will be a reduction in the availability of some insect prey species, we expect individuals will be able to use other prey species that are not as sensitive to methomyl.

While we anticipate a moderate number of individuals are likely to experience exposure over the duration of the proposed action, we do not anticipate mortality, reduced growth or reproduction, or reduced availability of prey species, are likely to occur. Therefore, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The threatened Neosho madtom is a small, benthic catfish endemic to gravel-bottomed streams in the Neosho, Cottonwood, and Spring River systems. Despite its ecological adaptability as a generalist invertivore, the species is highly vulnerable due to its restricted range, small population size, and ongoing habitat degradation caused by sedimentation, altered flow regimes, and pollution. While there is a significant overlap (27.1%) between the action area and the species' range, methomyl usage within its range is relatively low (up to 1.6% annually treated), which limits potential exposure. Predicted environmental concentrations of methomyl are not expected to cause mortality or adverse sublethal effects to growth and reproduction. Indirect effects, such as reductions in prey availability, are anticipated to be minimal due to the madtom's ability to forage on a wide range of prey, including species not sensitive to methomyl exposure. Considering these factors, we anticipate only localized and minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Neosho madtom in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Neosho madtom.

## References

U.S. Fish and Wildlife Service. 2020. 5-Year Review for the Neosho Madtom (*Noturus placidus*). Kansas. pp. 4

# Integration and Synthesis Summary: Boulder darter

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Etheostoma wapiti* | Boulder darter | 297 |

## Species Overview

In reviewing the status of the Boulder darter, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience significant mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species. Given that exposure is medium and the level of indirect effects is low, we assess the overall risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Boulder darter in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Boulder darter. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 11/6/2019; Wherever found; *States within the range:* AL, TN. Figure 6 depicts the species' range.

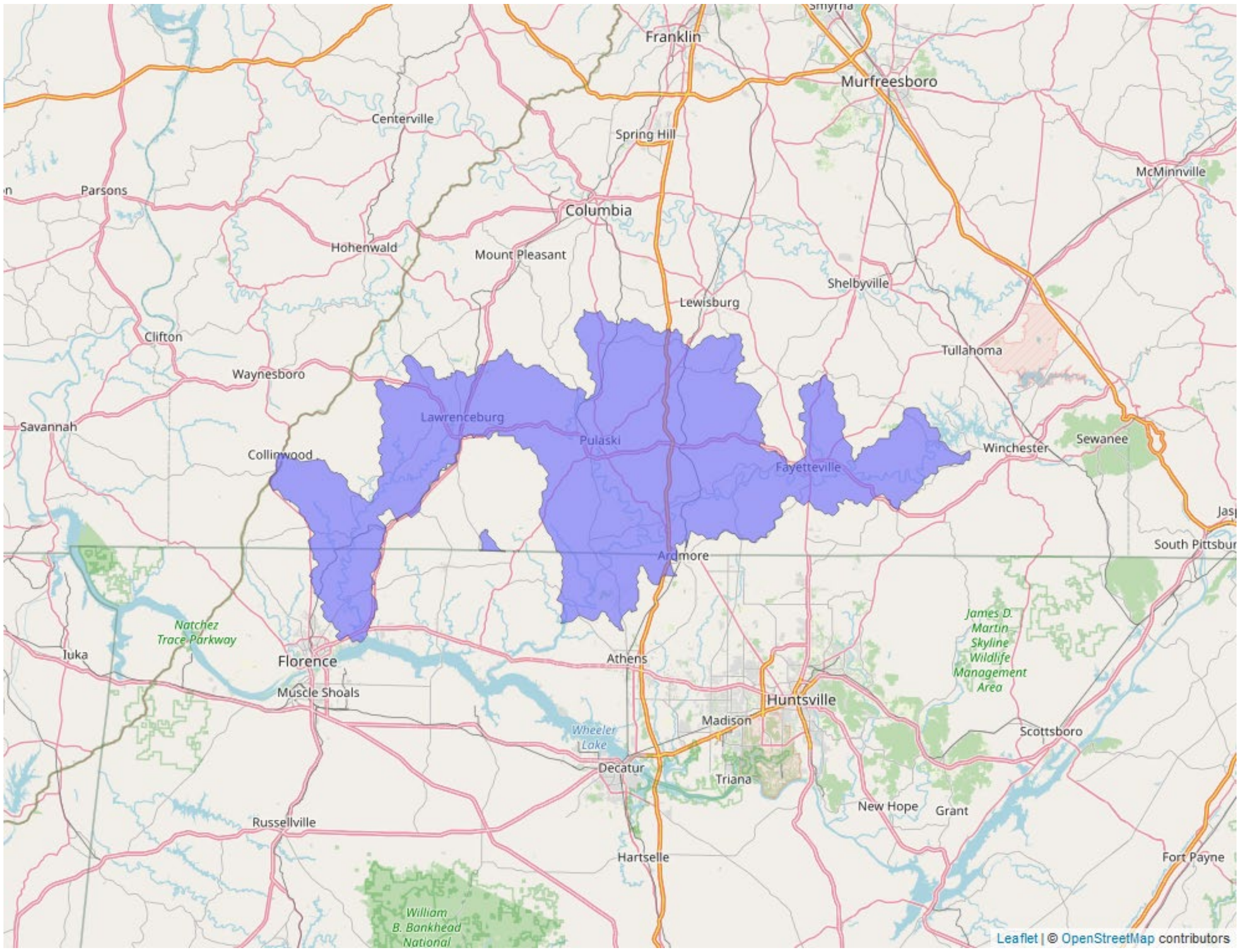


**Figure 6. Range map of boulder darter (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/5398.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 7/21/2023

**Distribution:** Population size/Location(s) unknown

**Number of populations:** Population size/location(s) unknown

**Species trends:** Declining population(s) - one or more populations declining

**Pesticides noted in Service documents as a threat to the species:** yes

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

The boulder darter, listed in 1988, is currently known from approximately 104 river kilometers of the Elk River in Giles and Lincoln counties in Tennessee and Limestone County in Alabama. Since 2005, Conservation Fisheries, Inc. has been actively involved in the controlled propagation and reintroduction of the boulder darter, releasing a total of 14,142 individuals into Shoal Creek (Petty et al. 2023). Despite these efforts, annual monitoring indicates that population numbers remain low, with an average observation rate of 1.7 individuals per person-hour search time.

The species continues to face significant threats from habitat modification, pollution, and other anthropogenic impacts such as siltation from agricultural practices, urban development, and road construction. These activities contribute to sedimentation and water quality degradation, posing ongoing challenges to the boulder darter's habitat (TDEC 2008). Efforts to mitigate these impacts include modifications to dam operations to improve water quality and habitat conditions, particularly below Tims Ford Dam. These modifications have increased temperature and improved conditions for native warm-water species, including the boulder darter. Additionally, the proposed removal of Harms Mill Dam is expected to restore connectivity and enhance habitat conditions along the Elk River, potentially benefiting the boulder darter population (Wisniewski 2022). State and federal water quality laws, such as the Clean Water Act, provide some protection but have not effectively prevented pollution from various sources. The ongoing listing of the Elk River and its tributaries as impaired waters underscores the persistent challenges in safeguarding the boulder darter's habitat (ADEM 2022; TDEC 2022). Given the ongoing threats, limited distribution, and the species' low resiliency, the boulder darter remains at risk of extinction. Continuous efforts in monitoring, habitat restoration, and pollution control are crucial to improving the species' chances of recovery. The status of the boulder darter as endangered is appropriate, reflecting the high degree of threat and the low potential for recovery without significant conservation actions.

Additionally, a portion of Shoal Creek, from mile 41.7 at the mouth of Long Branch in Lawrence County, TN, downstream to the backwaters of Wilson Reservoir at Goose Shoals in Lauderdale County, AL, including the lower 5 miles of all tributaries that enter this reach, has been designated as a Nonessential Experimental Population area. This designation, made in 2005, allows for the reintroduction of the boulder darter into this portion of its historical range. A propagation and reintroduction program has been ongoing in the Shoal Creek Nonessential Experimental Population since 2005, contributing to the conservation efforts for the species (Petty 2020). (Note: This species has a non-essential experimental population: Entity ID 8921).

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 14.6% of the species range will contain use sites (Table 17).

### Usage

Past usage data indicate that up to 0.9 % of the species' range has been treated with methomyl annually (Table 17).

**Table 17. Overlap and annual usage data (% Range Treated) for the boulder darter. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable)**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 10 | 0.5 |
| Cotton | 2.2 | 0.1 |
| Other Grains | 0.3 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | <0.1 | <0.1 |
| **Soybeans**[7] | 11.9 | 0.6 |
| Vegetables and Ground Fruit | 0.2 | 0.2 |
| Wheat | NA | NA |
| **Total** | **14.6** | **0.9** |

[7] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 18 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

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## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations within the Boulder darter's habitat can reach up to 23.4 µg/L (Table 18). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish species, we do not anticipate any mortality or sublethal adverse effects (e.g., reduced growth or reproduction) will occur to exposed individuals.

**Table 18. Predicted environmental concentrations of methomyl within the boulder darter's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---|---|
| High flow waterbodies | HUC 6 | 23.4 | 0 |

**Indirect Effects:**

The feeding preferences of the boulder darter are unknown but based on available life history information from closely related species, we assume the species can consume invertebrate species as a food resources. While available toxicity data indicate that invertebrate species are generally sensitive to methomyl, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. We anticipate individual darters are likely more robust to temporary losses of certain invertebrate prey species as they can likely switch to use other species whose abundance is not as greatly reduced by methomyl exposure. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of adverse indirect effect to the boulder darter.

**Toxicity Summary**

We do not anticipate any direct adverse effects are likely to occur at predicted environmental concentrations of methomyl. We anticipate there will likely be a reduction in the availability of some invertebrate prey that the boulder darter likely consumes, but we anticipate other prey species that the darter can use will not experience such decreases in abundance, suggesting a low level of indirect effects is likely to occur. As such, we determine the species has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The boulder darter has a medium exposure ranking. While there is a low level of past methomyl usage within the species' range (up to 0.9% of the range treated annually), there is a high extent of overlap between the species' range and the action area (14.6% total overlap), indicating that a moderate portion of the species' range is likely to be treated with methomyl over the duration of the proposed action. As such, we expect a moderate number of individuals are likely to be exposed to methomyl.

The boulder darter has a low toxicity ranking. We do not anticipate any direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) are likely to occur at predicted environmental concentrations of methomyl. While we anticipate temporary losses of some prey species will occur with methomyl exposure, we anticipate only low levels of indirect effects are likely to occur.

We expect a moderate number of individuals are likely to experience exposure. However, we anticipate most of these exposed individuals are not likely to experience any direct adverse effects and only low levels of indirect adverse effects to prey resources. Therefore, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The endangered Boulder darter is endemic to the Elk River system, where it inhabits fast-flowing, clean, and well-oxygenated waters. Despite ongoing efforts to reintroduce individuals into its historical range, including controlled propagation programs, the species remains vulnerable due to its limited range, low population size, and persistent threats from habitat degradation, siltation, and water quality issues. Although there is a significant overlap (14.6%) between the action area and the species' range, methomyl usage within its range is low (up to 0.9% annually treated). Predicted environmental concentrations of methomyl are not expected to result in direct mortality or adverse sublethal effects on growth and reproduction. Indirect effects, such as temporary reductions in prey availability, are anticipated to be minimal due to the Boulder darter's assumed generalist feeding habits, which allow it to adapt to fluctuations in prey abundance. Considering these factors, we anticipate only localized and minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Boulder darter in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Boulder darter.

## References

Petty, M. 2020. Boulder darter (*Etheostoma wapiti*): Plan for controlled propagation for reintroduction in the Elk River drainage, Tennessee. Conservation Fisheries, Inc. Unpublished report. Submitted to the U.S. Fish and Wildlife Service, Tennessee Field Office, Cookeville, TN. 18pp.

U.S. Fish and Wildlife Service. 2017. Boulder Darter (*Etheostoma wapiti*) 5-Year Review: Summary and Evaluation. Cookeville, Tennessee.

U.S. Fish and Wildlife Service. 2009. Boulder Darter (*Etheostoma wapiti*) 5-Year Review: Summary and Evaluation. Cookeville, Tennessee.

# Integration and Synthesis Summary: Arkansas River shiner

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Notropis girardi* | Arkansas River shiner | 299 |

## Species Overview

In reviewing the status of the Arkansas River shiner, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience significant mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species. Given that exposure is medium and the level of indirect effects is low, we assess the overall risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Arkansas River shiner in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Arkansas River shiner. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 9/9/2022; Arkansas River Basin (AR, KS, NM, OK, TX); *States within the range:* KS, NM, OK, TX. Figure 7 depicts the species' range.

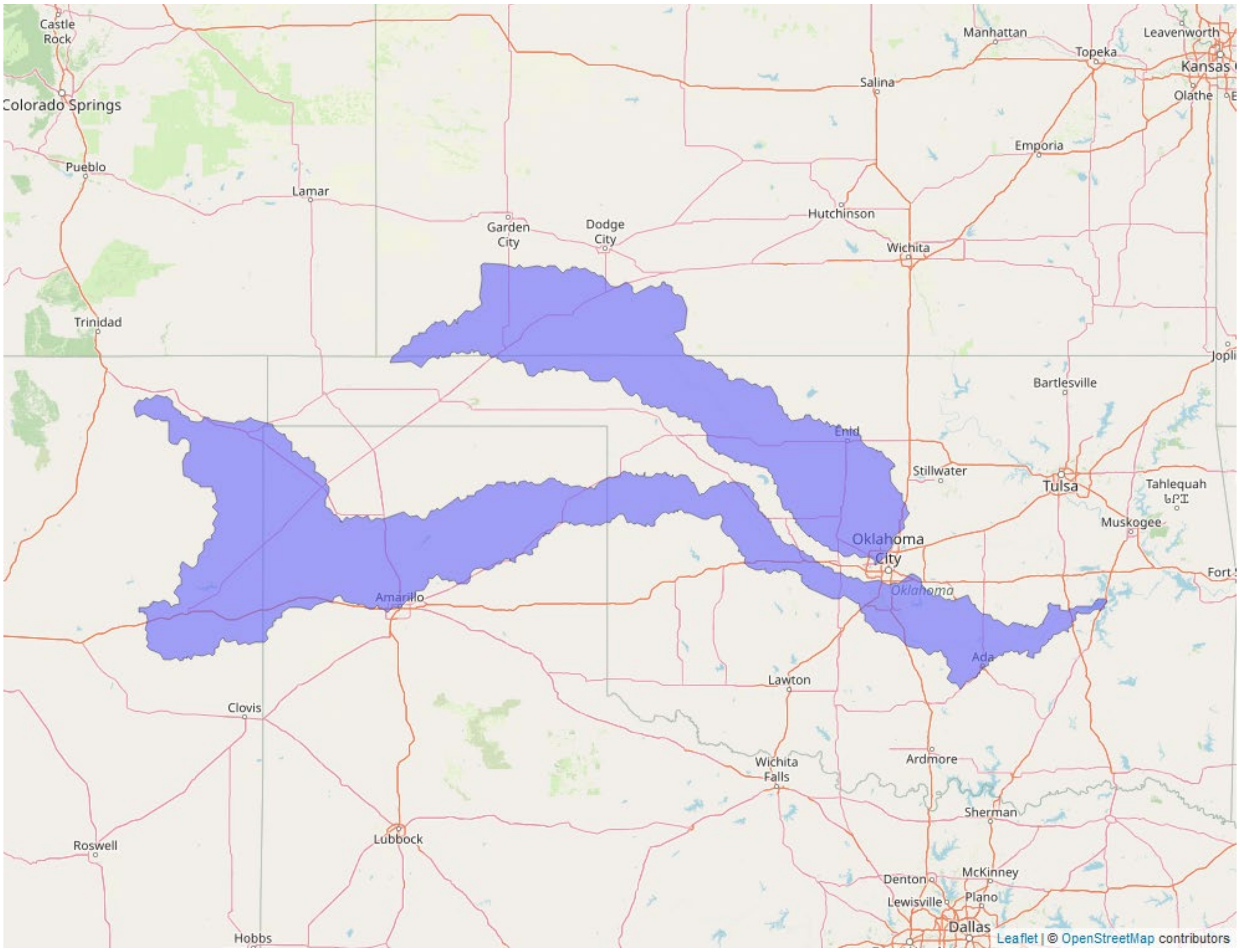


**Figure 7. Range map of Arkansas River shiner (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/4364.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Threatened

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 9/29/2020

**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 in Service documents as a threat to the species:** yes

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

The Arkansas River shiner is a minnow (family Cyprinidae) once widespread and common in the western portion of the Arkansas River basin in Kansas, New Mexico, Oklahoma, Arkansas, and Texas. This species is no longer found in over 83 percent of its historical range (3,896 river miles) and now appears to be entirely restricted to portions of the South Canadian River (or identified as Canadian River on USGS topographic maps) in eastern New Mexico, the Texas panhandle, and Oklahoma (673 river miles) (63 FR 64772). A non-native introduced population of the Arkansas River shiner occurs in the Pecos River in New Mexico, just outside of the species' historical native range (Bestgen et al. 1989, p. 228).

After evaluating threats to the species and assessing the cumulative effects of the threats, we find that the species' resiliency, representation, and redundancy are at levels that currently allow the Arkansas River shiner to persist in the Arkansas River basin as two self-sustaining populations: one in the upper South Canadian River and one in the lower South Canadian River. The resiliency of each population is currently considered to be at moderate level, making it less vulnerable to a catastrophic event as compared to a population with low resiliency. However, given current downward trends of the species and its habitat we expect that population resiliency for Arkansas River basin populations of the Arkansas River shiner will be further reduced from current condition. This reduction could lead to low resiliency of both remaining populations within 20 years, with potential extirpation of one of those two populations within 50 years. Future species and water conservation efforts could provide more population resiliency and add redundancy through the successful re-introduction and management of new populations, but those efforts are only in their planning stages. Given that redundancy is currently limited (only two remaining populations) and with future anticipated declines in population resiliency, the remaining populations of Arkansas River shiner will be more vulnerable to extirpations as compared to current condition.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where

individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 23.4% of the species range will contain use sites (Table 19).

**Usage**

Past usage data indicate that up to 1.7 % of the species' range has been treated with methomyl annually (Table 19).

**Table 19. Overlap and annual usage data (% Range Treated) for the Arkansas River shiner. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Alfalfa | 1.3 | 0.2 |
| Citrus | NA | NA |
| **Corn**[8] | 7.2 | 0.4 |
| Cotton | 1.5 | 0.1 |
| Other Grains | 13 | 0.7 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.2 | 0.1 |
| Soybeans | 1.2 | 0.1 |
| Vegetables and Ground Fruit | 0.2 | 0.2 |
| Wheat | NA | NA |
| **Total** | **23.4** | **1.7** |

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

[8] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 20 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations or methomyl within the Arkansas River shiner's habitat can reach up to 309.6 µg/L (Table 20). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies . Based on available toxicity data in fish species, we anticipate this range of exposure concentrations will cause mortality in up to 4% of exposed individuals. However, this level of mortality is only associated with low flow or low water volume habitats within one particular region of the species' range (i.e., HUC 11a). Available life history data indicate that the species typically inhabits the main channels of wide, shallow, sandy bottom rivers and larger streams and generally avoid calm waters. As such, we expect individuals will more typically inhabit areas that will only accumulate low levels of methomyl, where only 0.49% of exposed individuals will likely experience mortality. We do not anticipate any sublethal adverse effects (e.g., reduced growth or reproduction) will occur.

**Table 20. Predicted environmental concentrations of methomyl within the Arkansas River shiner's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 11a | 18.86 | 0.00 |
| High flow waterbodies | HUC 11b | 22.68 | 0.00 |
| High flow waterbodies | HUC 12b | 17.57 | 0.00 |
| High flow waterbodies | HUC 13 | 11.67 | 0.00 |

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---|---|
| Low flow/Low volume waterbodies | HUC 11a | 309.60 | 0.49 |
| Low flow/Low volume waterbodies | HUC 11b | 475.20 | 4.06 |
| Low flow/Low volume waterbodies | HUC 12b | 148.50 | 0.00 |
| Low flow/Low volume waterbodies | HUC 13 | 257.40 | 0.16 |

**Indirect Effects:**

Available life history information for the Arkansas River shiner indicates that it only requires plant-based food resources and does not rely on invertebrate species for food. Available data for methomyl show no toxicity to plant species, suggesting that there will likely not be any reductions in the abundance of plant-based food resources for the shiner. As such, we do not expect any adverse indirect effects are likely to occur with methomyl use.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats that the Arkansas River shiner is found in (e.g., areas of high flow), we expect there will be a low level of mortality to exposed individuals. r. We do not anticipate any indirect effects are likely to occur as the species only requires plant-based food resources, which we do not anticipate will have any reduced availability as a result of methomyl use. As such, we anticipate the species will has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Arkansas River shiner has a medium exposure ranking. While there is a low level of past usage within the species' range (up to 1.7% range treated annually), there is a high level of overlap between the species' range and the action area (23.4% total overlap), indicating that a moderate portion of the species' range is likely to be treated over the duration of the proposed action. As such, we anticipate a moderate number of individuals are likely to experience exposure.

The Arkansas River shiner has a low toxicity ranking. We anticipate the species' preferred habitat (e.g., areas of high flow rate) will not accumulate high levels of methomyl, resulting in low mortality or sublethal effects to growth or reproduction in exposed individuals. The species is also not likely to experience any indirect adverse effects as methomyl is not likely to cause any adverse effects to the vegetative food resources the species relies on.

While we anticipate a moderate number of individuals are likely to experience exposure, we only expect a low level of mortality in exposed individuals. As such, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The threatened Arkansas River shiner is a small, pelagic fish endemic to the Arkansas River basin, where it inhabits wide, shallow, sandy-bottomed streams with moderate to high flow rates. The species has experienced significant declines in distribution and abundance, with its range reduced by over 80% due to habitat fragmentation, altered flow regimes, and water quality degradation. Despite its restricted range and ongoing threats, the Arkansas River shiner exhibits some resiliency, with two self-sustaining populations persisting in the South Canadian River system. Although there is a significant overlap (23.4%) between the action area and the species' range, methomyl usage within its range is relatively low (up to 1.7% annually treated). Predicted environmental concentrations of methomyl in the species' preferred high-flow habitats are not expected to result in substantial mortality or sublethal effects on growth and reproduction. The Arkansas River shiner's reliance on plant-based food resources, which are not anticipated to be affected by methomyl exposure, further reduces the potential for indirect adverse effects. Considering these factors, we anticipate only localized and minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Arkansas River shiner in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Arkansas River shiner.

## References

U.S. Fish and Wildlife Service. 2020. Arkansas River Shiner (*Notropis girardi*) 5-Year Review: Summary and Evaluation. Tulsa, Oklahoma. 20 pp.

# Integration and Synthesis Summary: Pallid sturgeon

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Scaphirhynchus albus* | Pallid sturgeon | 303 |

## Species Overview

In reviewing the status of the Pallid sturgeon, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is medium. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a low extent of exposure. Exposed individuals are expected to experience low levels of direct adverse effects, including mortality and sublethal impacts such as impaired growth and reproduction. However, given the species' preference for high-flow habitats, which offer significant dilution potential for methomyl residues, we expect these effects to be minimal. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Pallid sturgeon in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Pallid sturgeon. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 8/16/2022; Wherever found; *States within the range:* AR, IA, IL, KS, KY, LA, MO, MS, MT, ND, NE, SD, TN. Figure 8 depicts the species' range.

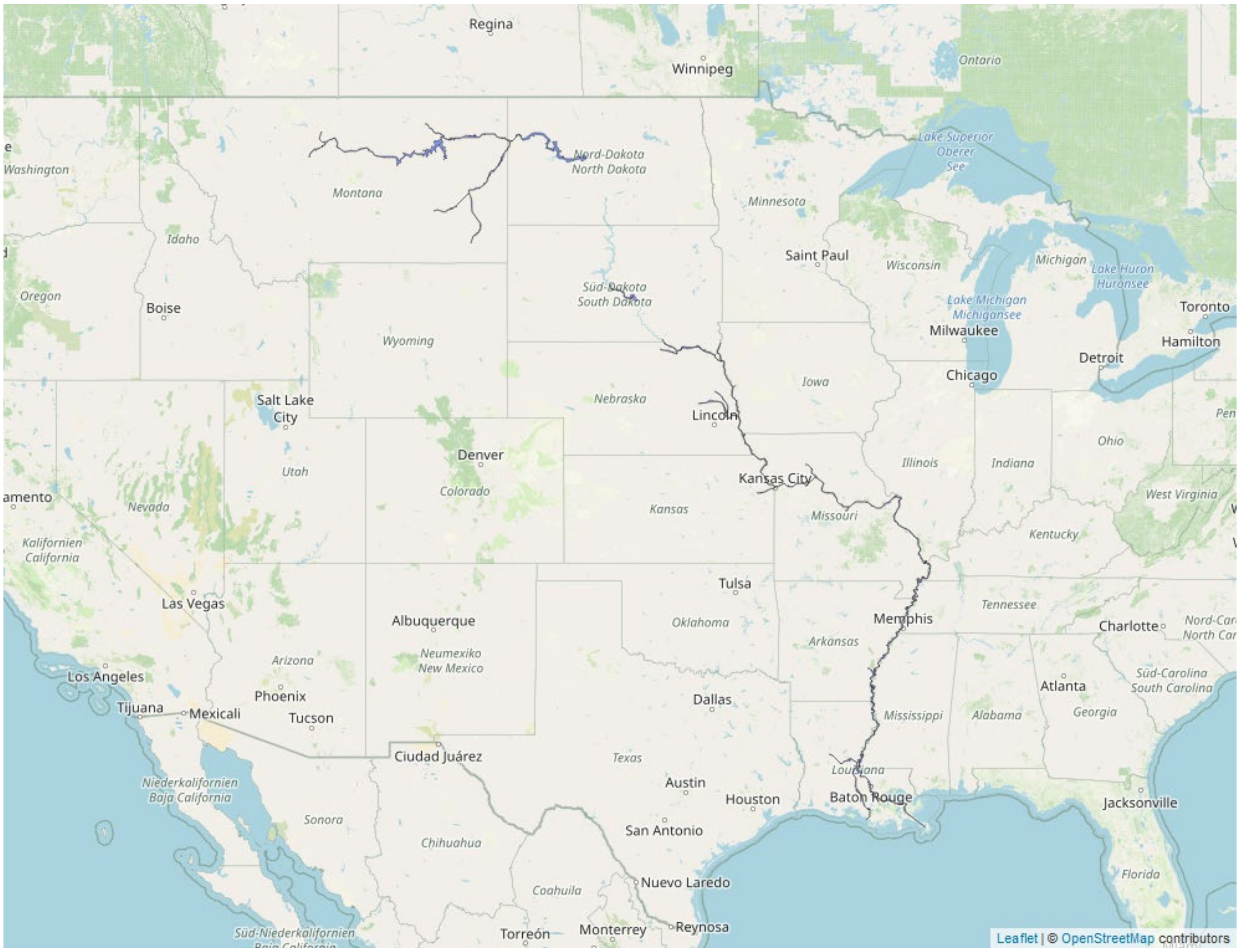


**Figure 8. Range map of pallid sturgeon (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/7162.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 8/23/2021

**Distribution:** Species/Populations widespread or wide-ranging

**Number of populations:** Multiple populations (few)

**Species trends:** All populations stable, with none known to be increasing or decreasing

**Pesticides noted in Service documents as a threat to the species:** no

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

The pallid sturgeon, a long-lived species found in portions of the Missouri and Mississippi rivers, faces ongoing threats despite conservation efforts. This species is primarily located in the Missouri River from Montana to Missouri and in the Mississippi River from Missouri to Louisiana, including major tributaries like the Yellowstone and Platte Rivers. Known occurrences also extend to mainstem Missouri River reservoirs such as Fort Peck Reservoir, Lake Sakakawea, and Lake Sharpe.

As of the most recent data, the wild pallid sturgeon population remains low, estimated at about 125 individuals downstream of Fort Peck Dam to Lake Sakakawea and fewer than 45 in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996; Tews in litt., 2013; Jaeger et al., 2009). Habitat degradation, altered hydrology, and water quality issues continue to pose significant threats. Key factors contributing to their decline include river channelization, impoundment, altered flow regimes, and water quality deterioration due to agricultural runoff and industrial discharges (Keenlyne and Jenkins 1993; Kallemeyn 1983).

The species is further impacted by habitat fragmentation due to dams, which disrupt spawning migrations and genetic exchange between populations. The construction and operation of dams have led to significant habitat modifications across the species' range, affecting water temperatures, flow patterns, and sediment transport, all critical to the sturgeon's life cycle (USFWS 2000a; Bowen et al., 2003). In addition, contaminants like organochlorines, metals, and PCBs detected in water bodies inhabited by pallid sturgeon pose risks to their health and reproductive capabilities (Ruelle and Keenlyne 1993; Ruelle and Henry 1994).

Efforts to mitigate these impacts include habitat restoration projects, such as the construction of a bypass channel at the Intake Diversion Dam on the Yellowstone River and flow management adjustments below Fort Peck Dam. Despite these efforts, the population has not met recovery criteria, and the species remains classified as endangered (U.S. Army Corps of Engineers 2020).

Conservation measures and regulatory protections under the Endangered Species Act include ongoing habitat restoration, monitoring of water quality, and adherence to regulations that prevent overharvesting and manage water use. However, challenges such as inadequate regulatory mechanisms, the presence of invasive species, and climate change effects continue to complicate recovery efforts (U.S. Global Change Research Program 2009).

**Overall Vulnerability:** Medium

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 28% of the species range will contain use sites (Table 21).

### Usage

Past usage data indicate that up to 4 % of the species' range has been treated with methomyl annually (Table 21).

**Table 21. Overlap and annual usage data (% Range Treated) for the pallid sturgeon. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Alfalfa | 2.3 | 0.3 |
| Citrus | NA | NA |
| Corn | 16.9 | 0.8 |
| Cotton | 0.5 | <0.1 |
| Other Grains | 3.1 | 0.2 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.9 | 0.4 |
| **Soybeans**[9] | 18.9 | 0.9 |
| Vegetables and Ground Fruit | 2.2 | 2.2 |
| Wheat | NA | NA |
| **Total** | **28** | **4** |

[9] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Additional Exposure Considerations**

Pallid sturgeon are primarily benthic fish and spend the majority of their time at or near river bottoms. The species is a large river obligate and typically occupy deep waters that generally have consistent flow (on average 1.9-2.9 ft/s), which we expect will result in high levels of dilution of methomyl residues. As such, we do not expect more than low levels of exposure are likely to occur.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. However, based on past usage data, we expect a low level of usage within the species' range. Additionally, we anticipate there will be high levels of dilution of methomyl residues within the large waterbodies that the species' uses for habitat, resulting in only low levels of exposure to individuals. Thus, we anticipate only small numbers of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Low

**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 22 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

maximum predicted environmental concentrations of methomyl within the pallid sturgeon's habitat can reach up to 387.9 µg/L (Table 22). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies (. Based on available toxicity data in fish, we anticipate this range of exposure concentrations can cause low levels of mortality (up to 1.61% of exposed individuals will likely die) as well as adverse effects to growth or reproduction.

**Table 22. Predicted environmental concentrations of methomyl within the pallid sturgeon's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 10a | 23.26 | 0.00 |
| High flow waterbodies | HUC 10b | 12.33 | 0.00 |
| High flow waterbodies | HUC 11a | 48.83 | 0.00 |
| High flow waterbodies | HUC 12a | 43.24 | 0.00 |
| High flow waterbodies | HUC 3 | 34.82 | 0.00 |
| High flow waterbodies | HUC 5 | 23.72 | 0.00 |
| High flow waterbodies | HUC 6 | 23.40 | 0.00 |
| High flow waterbodies | HUC 7 | 23.72 | 0.00 |
| High flow waterbodies | HUC 8 | 45.74 | 0.00 |
| High flow waterbodies | HUC 9 | 18.85 | 0.00 |
| Low flow/Low volume waterbodies | HUC 10a | 248.40 | 0.13 |
| Low flow/Low volume waterbodies | HUC 10b | 274.50 | 0.24 |
| Low flow/Low volume waterbodies | HUC 11a | 321.30 | 0.61 |
| Low flow/Low volume waterbodies | HUC 12a | 387.90 | 1.61 |
| Low flow/Low volume waterbodies | HUC 3 | 171.00 | 0.01 |

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---|---|
| Low flow/Low volume waterbodies | HUC 5 | 229.50 | 0.08 |
| Low flow/Low volume waterbodies | HUC 6 | 164.70 | 0.01 |
| Low flow/Low volume waterbodies | HUC 7 | 209.70 | 0.04 |
| Low flow/Low volume waterbodies | HUC 8 | 225.90 | 0.07 |
| Low flow/Low volume waterbodies | HUC 9 | 161.10 | 0.01 |

**Indirect Effects:**

The pallid sturgeon can consume a wide variety of food resources, including aquatic insects, mollusks, and other fish species. We anticipate reductions in the availability of certain prey species, such as aquatic insects, are likely as we anticipate these species are particularly sensitive to methomyl exposure. However, given that the pallid sturgeon can use a wide variety of prey species, including species that are not likely to be as sensitive to methomyl exposure, indicating that there will likely be sufficient food resources available for individuals. As such, we expect only low levels of indirect effects to individuals as a result of methomyl use.

**Toxicity Summary**

We expect only low levels of direct adverse effects, including mortality as well as sublethal effects to growth and reproduction, are likely to occur at predicted environmental concentrations of methomyl. We anticipate indirect effects are likely as there will likely be reductions in the availability of sensitive prey items like aquatic insects. However, we anticipate there will still be sufficient food resources available for individuals as pallid sturgeon can use a wide variety of prey species, some of which we expect will not experience any substantial reductions in abundance as they are less sensitive to methomyl. Thus, we anticipate the species will only experience low levels of indirect adverse effects. As such, we anticipate the species has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The pallid sturgeon has a low exposure ranking. While there is a high extent of overlap between the species' range and the action area (28% total overlap), there is a low level of past methomyl usage (up to 4% range treated annually), indicating that a moderate portion of the species' range is likely to be treated over the duration of the proposed action. However, given that the species' is a large river obligate and rarely occurs in areas lacking flowing water, we anticipate there will be a high level of dilution of methomyl residues, resulting in only low levels of exposure. As such, we expect a small number of individuals are likely to experience exposure.

The pallid sturgeon has a low toxicity ranking. Based on predicted environmental concentrations of methomyl within the species' habitat, we expect up to 1.61% of exposed individuals will die. Similarly, we anticipate exposed individuals that do not die will experience only low levels of sublethal adverse effects to growth or reproduction given the low level of predicted environmental concentrations of methomyl. We expect a small level of indirect effects are likely as we anticipate some reductions in the availability of prey species, such as aquatic insects. However, given that the pallid sturgeon can use a wide variety of prey species, some of which we expect will not experience any reductions in abundance, we anticipate there will still be sufficient food resources available for individuals, suggesting only low levels of indirect effects are likely.

Given that there is a small number of individuals that are likely to be exposed and that there will likely only be a low level of mortality, sublethal effects, and indirect adverse effects, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The endangered Pallid sturgeon, a large, benthic fish species endemic to the Missouri and Mississippi Rivers and their major tributaries, remains highly vulnerable due to habitat degradation, altered flow regimes, and low population numbers. Despite its wide-ranging distribution across 14 states, habitat fragmentation and pollution have severely impacted its population, with fewer than 200 individuals estimated in key portions of its range. Conservation efforts, including habitat restoration and regulatory measures, are ongoing but have yet to reverse the species' decline. Methomyl usage within its range is low, with up to 4% of the area treated annually, and the Pallid sturgeon's preference for high-flow, large river habitats further reduce its exposure risk, as these conditions provide high levels of dilution for methomyl residues. We anticipate only low levels of mortality or sublethal effects on growth and reproduction at predicted environmental concentrations of methomyl. Indirect effects, such as reductions in sensitive prey species like aquatic insects, are expected to be minimal, as the Pallid sturgeon can adapt its diet to include less-sensitive prey. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Pallid sturgeon in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Pallid sturgeon.

## References

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

## Integration and Synthesis Summary: Topeka shiner

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Notropis topeka (=tristis)* | Topeka shiner | 311 |

### Species Overview

In reviewing the status of the Topeka shiner, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is medium. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience more than low levels of mortality or sublethal effects, but may face low levels of indirect effects, primarily through reductions in the availability of prey species and changes in habitat quality. Given that both exposure and direct effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Topeka shiner in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Topeka shiner. We discuss our rationale for this conclusion for the species in the sections below.

### Species range

Based on range map dated: 3/28/2023; Wherever found, except where listed as an experimental population; *States within the range:* IA, KS, MN, MO, NE, SD. Figure 9 depicts the species' range.

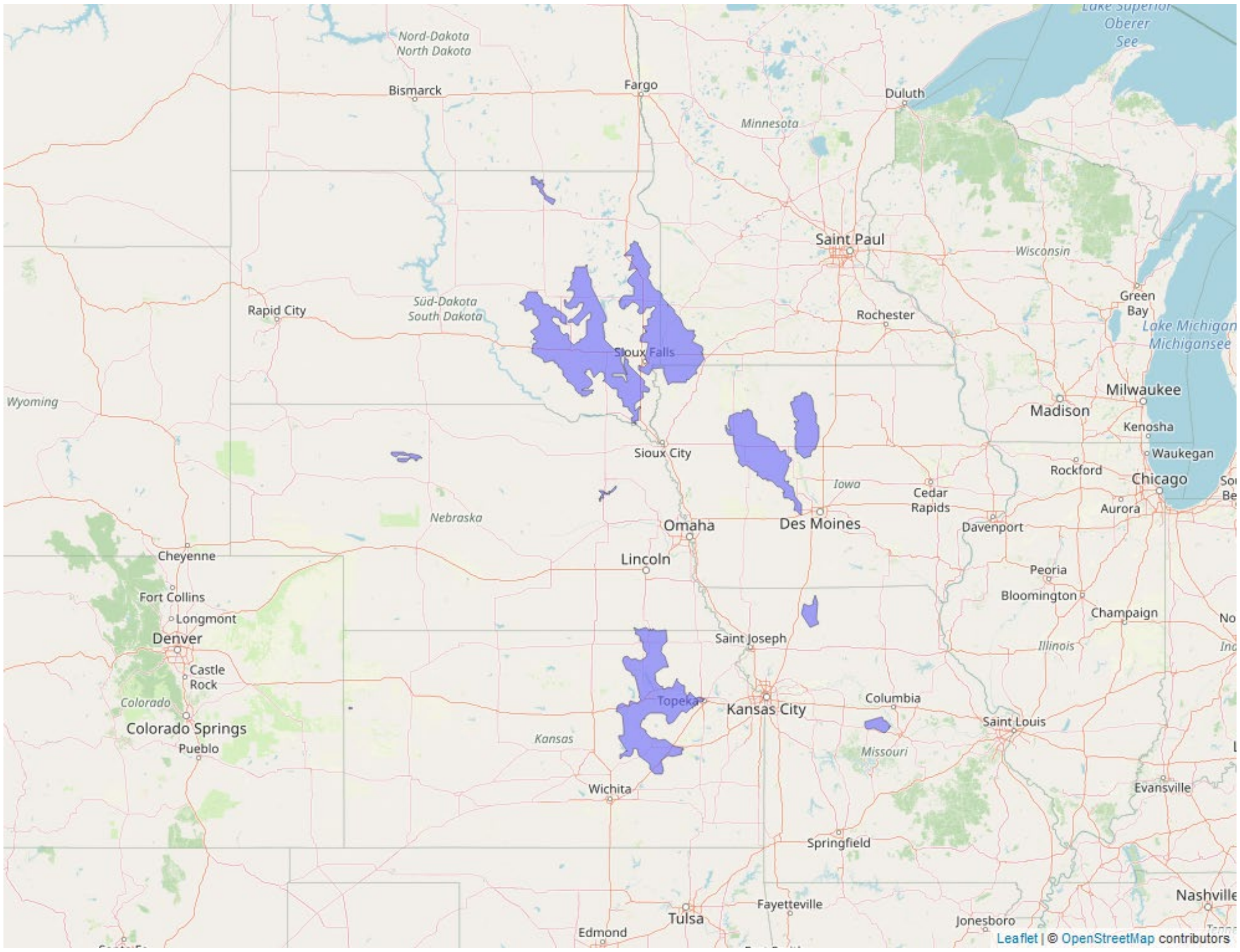


**Figure 9. Range map of Topeka shiner (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/4122.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** Downlist to Threatened

**Most recently completed 5-Year Review:** 7/21/2021

**Distribution:** Species/Populations widespread or wide-ranging

**Number of populations:** Multiple populations (numerous)

**Species trends:** All populations stable, with none known to be increasing or decreasing

**Pesticides noted in Service documents as a threat to the species:** yes

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

The Topeka shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska. At the time of listing, we concluded that the species was endangered due to the species' recent significant reduction in range and the extirpation of the species throughout most of its historic range, within the context of the expected impacts from present and planned projects and activities. This conclusion has proven accurate in southern portions of the range (i.e., Kansas, Missouri, Nebraska, and most of Iowa) where historic changes in land-use, land-cover, and hydrology have largely reduced the species to small, isolated populations susceptible to ongoing and projected threats (Menzel pers. comm. 2002; 69 FR 44736, July 27, 2004; Howell pers. comm. 2006; Kansas Department of Wildlife and Parks 2006; Kansas Department of Wildlife and Parks 2007; McPeek pers. comm. 2007; Stark 2007; Davis 2008). Even with federal protection, it is likely that additional sites in this portion of the range will be lost within the foreseeable future, consistent with extirpations in the recent past (Missouri Department of Conservation 1999; Stark et al. 1999; Kerns pers. comm. 2007; Tabor pers. comm. 2009). However, new distribution data and a better understanding of threats in the northern portion of the species' range has altered our perception of the species' status as a whole.

At the time of listing, the Topeka shiner was known from 20 stream sites in Minnesota, South Dakota, and Iowa's Rock River watershed. This apparently limited distribution and the assumption that the species had been lost from so many areas supported our assertion that the species was highly susceptible to documented threats across its range and trending toward extinction. Since listing, additional survey work has resulted in a 7-fold increase in the number of occupied stream sites across this portion of the species' range. Topeka shiner populations in Minnesota and South Dakota now appear to be closely representative of the species' known historic range (Ceas and Anderson 2004; Wall et al. 2004; Wall and Thompson 2007; Ceas and Larson 2008). Such data indicates the species continues to be widespread despite impacts to stream habitat (Ceas and Monstad 2005; Wall and Thompson 2007; Ceas and Larson 2008). While the reason for this apparent resiliency is not certain, it may be related to ecological differences caused by the area's geologic morainal features (Clark 2000; Wall et al. 2004). These features appear to have positively influenced groundwater inputs to streams and perennial pools in intermittent streams, benefiting the species' ability to persist (Berg et al. 2004; Wall et al. 2004). We now know that the extent of the species' population decline is not as severe as originally presumed and that vulnerability of many of the remaining populations is substantially lower than presumed at the time of listing. 2021 5-Year Review Given the high number of currently occupied streams (223) compared to when the species was listed (approximately 57), the current levels of resiliency found within populations, the spread of populations and population complexes around the six-state range, the genetic and ecological diversity observed, and the lack of significant, imminent stressors, we believe that the Topeka shiner currently has sufficient ability to withstand stochastic and catastrophic events and to adapt to environmental changes. Therefore, we conclude that the current risk of extinction is low, such that the Topeka shiner is not currently in danger of extinction throughout all its range.

Additionally, a nonessential experimental population (Entity ID 10910) of the Topeka shiner has been established within portions of its historical range in Adair, Gentry, Harrison, Putnam, Sullivan, and Worth Counties, Missouri. This nonessential experimental population designation, made under section 10(j) of the Endangered Species Act, allows for the reintroduction of the Topeka shiner into suitable habitats outside its current natural range. The nonessential experimental population is considered nonessential to the continued existence of the species in the wild, meaning its loss will not likely appreciably reduce the species' likelihood of survival. This designation provides management flexibility and allows for conservation actions tailored to promote the species' recovery without imposing the full range of restrictions typically associated with an endangered designation.

**Overall Vulnerability:** Medium

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 46% of the species range will contain use sites (Table 23).

### Usage

Past usage data indicate that up to 2.7 % of the species' range has been treated with methomyl annually (Table 23).

**Table 23. Overlap and annual usage data (% Range Treated) for the Topeka shiner. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | 2.2 | 0.3 |
| Citrus | NA | NA |

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| **Corn**[10] | 40.8 | 2 |
| Cotton | <0.1 | <0.1 |
| Other Grains | 2.6 | 0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.2 | 0.1 |
| Soybeans | 40.2 | 2 |
| Vegetables and Ground Fruit | 0.2 | 0.2 |
| Wheat | NA | NA |
| **Total** | **46** | **2.7** |

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

**Conservation Measures:**

**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 24 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

[10] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the Topeka shiner's habitat can reach up to 321.3 µg/L (Table 24). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish species, we anticipate only low levels of mortality are likely to occur at these exposure levels (i.e., up to 0.61% of exposed individuals are likely to die). Similarly, while high end estimates of aquatic methomyl concentrations are likely to cause some level of reduced growth or reproduction, we anticipate only low levels of sublethal adverse effects are likely to occur given that typical exposures levels are likely well below the level where sublethal adverse effects have been observed in toxicity studies. Furthermore, we anticipate adverse effects will only occur in low flow or low water volume habitats as estimated environmental concentrations of methomyl in high flow habitats are not likely to cause any mortality or sublethal adverse effects.

**Table 24. Predicted environmental concentrations of methomyl within the Topeka shiner's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 10a | 23.26 | 0.00 |
| High flow waterbodies | HUC 10b | 12.33 | 0.00 |
| High flow waterbodies | HUC 11a | 48.83 | 0.00 |
| High flow waterbodies | HUC 7 | 23.72 | 0.00 |
| Low flow/Low volume waterbodies | HUC 10a | 248.40 | 0.13 |
| Low flow/Low volume waterbodies | HUC 10b | 274.50 | 0.24 |
| Low flow/Low volume waterbodies | HUC 11a | 321.30 | 0.61 |
| Low flow/Low volume waterbodies | HUC 7 | 209.70 | 0.04 |

**Indirect Effects:**

Available life history information available on the Topeka shiner indicates that it is an opportunistic omnivore that feeds on aquatic insects, microcrustaceans, larval fish, algae, and detritus. We anticipate methomyl exposure will reduce the abundance of certain food resources, such as aquatic insects and microcrustaceans. However, we do not expect all insect and crustacean species are equally sensitive to methomyl, indicating that while some species of insects and microcrustaceans may experience significant reductions in abundance, other species are not likely to have their abundance reduced in response to methomyl exposure. Additionally, available toxicity data indicate no effects to plants, including nonvascular species like algae, are not affected by methomyl. As such, while we anticipate the Topeka shiner may experience reduced availability of some prey species, we expect sufficient levels of other dietary items will remain such that there will be no more than low levels of indirect effects to individuals resulting from methomyl use.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the Topeka shiner's habitat, we anticipate, at most, only low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) is likely to occur. Furthermore, we anticipate these adverse effects will only occur in some of the species' habitats (e.g., low flow or low water volume habitats). As an opportunistic omnivore, we anticipate only low levels of indirect effects to individuals are likely as individuals can use alternative food resources (such as algae and detritus) in response to reductions in the availability of prey species that are highly sensitive to methomyl exposure such as aquatic insects and microcrustaceans. As such, we determine the Topeka shiner has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Topeka shiner has a medium exposure ranking. While there is a low level of past methomyl usage within the species' range (up to 2.7% range treated annually), there is a large extent of overlap between the species' range and the action area (46% total overlap), indicating a moderate portion of the species' range is likely to be treated over the duration of the proposed action. As such, we expect a moderate number of individuals are likely to experience exposure to methomyl.

The Topeka shiner has a low toxicity ranking. We anticipate, at most, only low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) will occur at predicted environmental concentrations of methomyl that are likely to occur within the species' habitat. In general, we do not expect more than low levels of indirect effects to individuals are likely to occur as the Topeka shiner is an opportunistic omnivore and can use a number of food resources that are not likely to experience any reductions in abundance with methomyl exposure.

Given that we expect a moderate number of individuals are likely to experience methomyl exposure but that we only anticipate low levels of adverse effects to exposed individuals, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The endangered Topeka shiner occupies small streams across portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska. Despite its wide-ranging distribution, the species has experienced significant declines in its southern range due to habitat degradation and hydrological alterations. Surveys in the northern range indicate higher resiliency, with populations persisting across an expanded number of sites compared to those known at the time of listing. Methomyl usage within the Topeka shiner's range is low, with only up to 2.7% of the area treated annually, and exposure is expected to result in, at most, low levels of mortality or sublethal effects on growth and reproduction. The species' opportunistic omnivorous diet, including aquatic insects, algae, and detritus, provides resilience against fluctuations in prey availability, further reducing the likelihood of indirect adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Topeka shiner in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Topeka shiner.

## References

U.S. Fish and Wildlife Service. 2021. Topeka shiner (*Notropis Topeka*) 5-Year Review: Evaluation and Summary. Denver, Colorado. 20 pp.

U.S. Fish and Wildlife Service. 2010. Topeka shiner (*Notropis Topeka*) 5-Year Review: Evaluation and Summary. Manhattan, Kansas.

U.S. Fish and Wildlife Service. 1998. Endangered and Threatened Wildlife and Plants; Final Rule to List the Topeka Shiner as Endangered. Federal Register 63(240):69008-69021.

## Integration and Synthesis Summary: Relict darter

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Etheostoma chienense* | Relict darter | 313 |

### Species Overview

In reviewing the status of the Relict darter, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is medium. In addition, although there is a high overlap of the action area with the species’ range, there is low past usage of methomyl within the species’ range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience more than low levels of mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species and changes in habitat quality. Given that both exposure and direct effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Relict darter in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Relict darter. We discuss our rationale for this conclusion for the species in the sections below.

### Species range

Based on range map dated: 4/21/2016; Wherever found; *States within the range:* KY. Figure 10 depicts the species’ range.

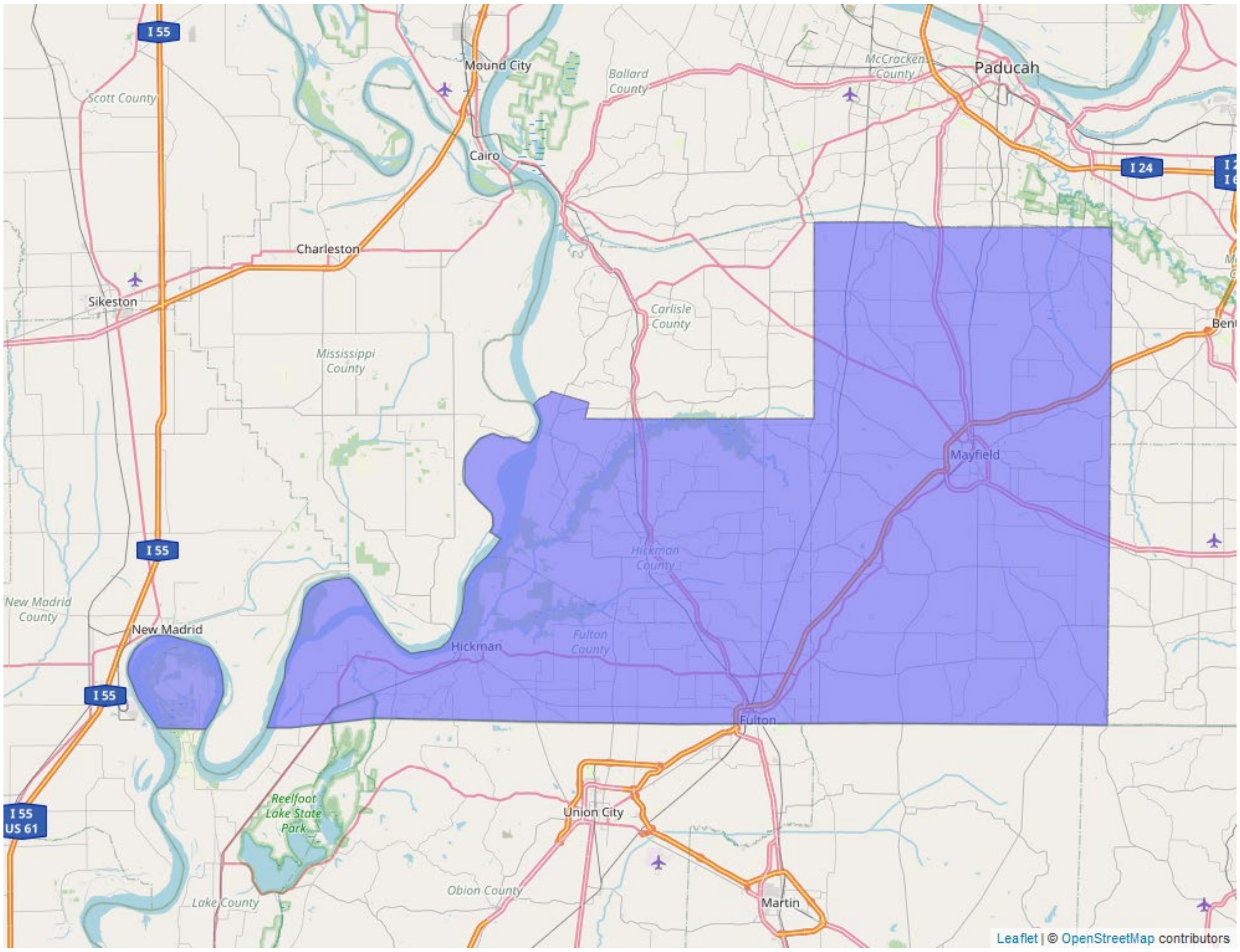


**Figure 10. Range map of relict darter (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/1979.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Threatened

**Most recent 5-Year Review recommendation:** Downlist to Threatened

**Most recently completed 5-Year Review:** 8/30/2019

**Distribution:** Species/Populations neither constrained nor widespread

**Number of populations:** Multiple populations (few)

**Species trends:** Unknown population trends

**Pesticides noted in Service documents as a threat to the species:** no

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

The relict darter (*Etheostoma chienense*) is a small, narrowly endemic, benthic fish that occupies the Bayou de Chien stream system in western Kentucky, specifically in Fulton, Graves, and Hickman counties (Webb and Sisk 1975; Burr and Warren 1986; Warren et al. 1994; Piller and Burr 1998; Service 2020). It can be distinguished from other darters by the number of dorsal fin rays, its breeding behavior (egg-clustering with parental care), and the color and morphology of the dorsal fins of breeding males. Females and nonbreeding males have light-tan-colored backs and sides with brown mottling, and six to eight dark brown saddles, while breeding males have gray to dark brown sides and backs and light tan undersides (Page et al. 1992).

At the time of listing in 1993, the species was known only from the Bayou de Chien mainstem and Jackson Creek. The species was considered to be most abundant in Jackson Creek and a limited reach of the headwaters of Bayou de Chien near the town of Water Valley in Graves County (Webb and Sisk 1975; Warren and Burr 1991; Warren et al. 1994). Piller and Burr (1998) documented the species' presence at 16 of 28 sites surveyed, including 6 new sites in Graves and Hickman counties. The species was most commonly collected in the middle and headwater reaches of the system, where it was described as "abundant" in Jackson Creek and "common" at four Bayou de Chien sites. Relict Darters or nests were also observed at sites on South Fork Bayou de Chien, Cane Creek, Sand Creek, and two unnamed tributaries; however, the species' summer and fall distribution was limited to the Bayou de Chien mainstem, Jackson Creek, and South Fork Bayou de Chien.

In July 2017, a second population of the species was discovered in Little Bayou de Chien in Fulton County (USFWS 2019, 2020). The relict darter continues to be threatened by three of the Service's five listing factors: the present or threatened destruction, modification, or curtailment of its habitat or range (Factor A), the inadequacy of existing regulatory mechanisms in protecting against habitat alteration or destruction (Factor D), and other natural or manmade factors affecting its continued existence (Factor E). While habitat threats remain and current regulatory mechanisms have been inadequate to prevent all these impacts, we conclude that habitat threats in Jackson Creek and Bayou de Chien have decreased from a high level to a moderate level. This conclusion is based on observed trends of abundance and mean density in Jackson Creek and Bayou de Chien, estimates of the species' population size in both streams, ample evidence of reproduction and recruitment in both streams, and repeated observations of these conditions during major survey efforts in 2011-2012 and 2017-2018. Recent field surveys (2010–2019) suggest that relict darters in Little Bayou de Chien are isolated from the rest of the system; however, genetic analyses indicate a single panmictic population, where random mating occurs among all individuals in the Bayou de Chien system (Kattawar and Piller 2020). In addition to these factors, threats to the species’ habitat have been reduced, and in some cases eliminated, by multiple habitat protection projects (e.g., cattle exclusion, riparian plantings) in Jackson Creek and Bayou de Chien. The Service continues to work with its partners to implement additional projects in these watersheds.

With respect to other natural or manmade factors affecting its survival, the species’ linear distribution and limited range within the Bayou de Chien watershed continue to make it vulnerable to stochastic events (e.g., drought or toxic chemical spills) that could cause the extirpation of the species from portions of Bayou de Chien, Jackson Creek, or Little Bayou de Chien. The species’ discovery in Little Bayou de Chien offers some protection against catastrophic events that could lead to the species’ extinction (e.g., improved redundancy); however, the Little Bayou de Chien population appears to be small relative to Bayou de Chien and Jackson Creek (i.e., lower resiliency), and habitat conditions are not as favorable for the species. In addition to the species’ limited range, genetic analyses indicate low genetic diversity for the species, suggesting a reduced ability to adapt to changing environmental conditions and greater vulnerability to local extirpations. Recent conservation efforts, including habitat protection and restoration projects, have contributed to an improvement in the species’ overall condition, but ongoing threats related to habitat loss, pollution, and climate change remain. The Service continues to monitor and implement measures to improve the species' habitat and mitigate threats.

As of September 27, 2023, the Service reclassified the relict darter from endangered to threatened, acknowledging the improvements in the species' condition and the reduced magnitude of some threats. This reclassification reflects the species' current status and the ongoing conservation efforts that have helped improve its habitat and population size.

**Overall Vulnerability:** Medium

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 50.6% of the species range will contain use sites (Table 25).

**Usage**

Past usage data indicate that up to 2.9 % of the species' range has been treated with methomyl annually (Table 25).

**Table 25. Overlap and annual usage data (% Range Treated) for the relict darter. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 43 | 2.2 |
| Cotton | 0.2 | <0.1 |
| Other Grains | 0.6 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.4 | 0.2 |
| **Soybeans**[11] | 49.1 | 2.5 |
| Vegetables and Ground Fruit | 0.2 | 0.2 |
| Wheat | NA | NA |
| **Total** | **50.6** | **2.9** |

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1

[11] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 26. the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the relict darter's habitat can reach up to 229.50 µg/L (Table 26). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish species, we anticipate very few individuals are likely to die (up to 0.08% of exposed individuals). Similarly, we only expect low levels of sublethal adverse effects (e.g., reduced growth, reduced reproduction) are likely to occur. In both cases, we expect direct adverse effects will be limited to only individuals exposed in certain areas of the range (i.e., low flow or low water volume habitats).

**Table 26. Predicted environmental concentrations of methomyl within the relict darter's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 5 | 23.72 | 0.00 |
| High flow waterbodies | HUC 6 | 23.40 | 0.00 |
| High flow waterbodies | HUC 8 | 45.74 | 0.00 |
| Low flow/Low volume waterbodies | HUC 5 | 229.50 | 0.08 |

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---|---|
| Low flow/Low volume waterbodies | HUC 6 | 164.70 | 0.01 |
| Low flow/Low volume waterbodies | HUC 8 | 225.90 | 0.07 |

**Indirect Effects:**

The relict darter can consume a variety of invertebrate species as food resources, including aquatic insects, small crustaceans (copepods, cladocerans, ostracods), chironomids (midges), amphipods, isopods, and caddisflies. While available toxicity data indicate that invertebrate species are generally sensitive to methomyl, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. As such, we anticipate there will be sufficient food resources available to individuals even if there is a reduction in the availability of sensitive prey species.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the relict darter's habitat, we expect only low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) are likely. Similarly, we expect only low levels of indirect adverse effects to individuals as relict darters are presumed to be generalist invertivores and will likely have sufficient alternative food resources in the form of less sensitive invertebrate species. As such, the relict darter has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The relict darter has a medium exposure ranking. While there is a low level of past methomyl usage (up to 2.9% range treated annually), there is a high extent of overlap between the species' range and the action area (50.6% total overlap), indicating that a moderate portion of the species' range is likely to be treated with methomyl over the duration of the proposed action. As such, we expect a moderate number of individuals are likely to be exposed to methomyl.

The relict darter has a low toxicity ranking. Based on predicted environmental concentrations of methomyl within the species' habitat, we expect only low levels of direct adverse effects (i.e., up to 0.81% of exposed individuals will die) are likely to occur. We do not anticipate more than low levels of adverse indirect effect to individuals as the relict darter is a generalist invertivore, indicating that while some prey species may experience large reductions in abundance, there will likely be sufficient food resources available as other prey species are not likely as sensitive to methomyl exposure.

While we anticipate a moderate number of individuals are likely to experience exposure, given that individuals will only experience low levels of direct and indirect adverse effects, the overall risk of adverse effects to the species is low.

## Conclusion

The threatened Relict darter is a small, benthic fish restricted to the Bayou de Chien stream system in western Kentucky, where it occupies a highly localized and specialized habitat. Despite its limited range, surveys indicate the presence of stable populations in Jackson Creek, Bayou de Chien, and Little Bayou de Chien, supported by recent habitat restoration efforts. Methomyl usage within the Relict darter's range is low, with only up to 2.9% of the area treated annually, and predicted environmental concentrations are unlikely to result in significant mortality. While up to 0.08% of exposed individuals may die, direct adverse effects are expected to be minimal and localized, primarily occurring in low-flow or low-water-volume areas within the species' habitat. Indirect effects, such as reduced availability of sensitive prey species, are also anticipated to be low. As a generalist invertivore, the Relict darter can adapt to fluctuations in prey abundance by utilizing alternative prey species that are less sensitive to methomyl exposure, ensuring sufficient food resources for survival and reproduction. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Relict darter in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Relict darter.

## References

U.S. Fish and Wildlife Service. 2019. Relict Darter (*Etheostoma chienense*) 5 Year Review: Summary and Evaluation. Frankfurt, Kentucky. pp. 37.

# Integration and Synthesis Summary: Grotto sculpin

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Cottus specus* | Grotto sculpin | 4248 |

## Species Overview

In reviewing the status of the Grotto sculpin, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species’ range, there is low past usage of methomyl within the species’ range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience more than low levels of mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species and changes in habitat quality. Unlike other listed species that occupy cave habitats, the Grotto sculpin also occupies surface habitats, where exposure to methomyl is more likely to occur. Given that both exposure and direct effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Grotto sculpin in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Grotto sculpin. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 3/10/2022; Wherever found; *States within the range:* MO. Figure 11 depicts the species’ range.

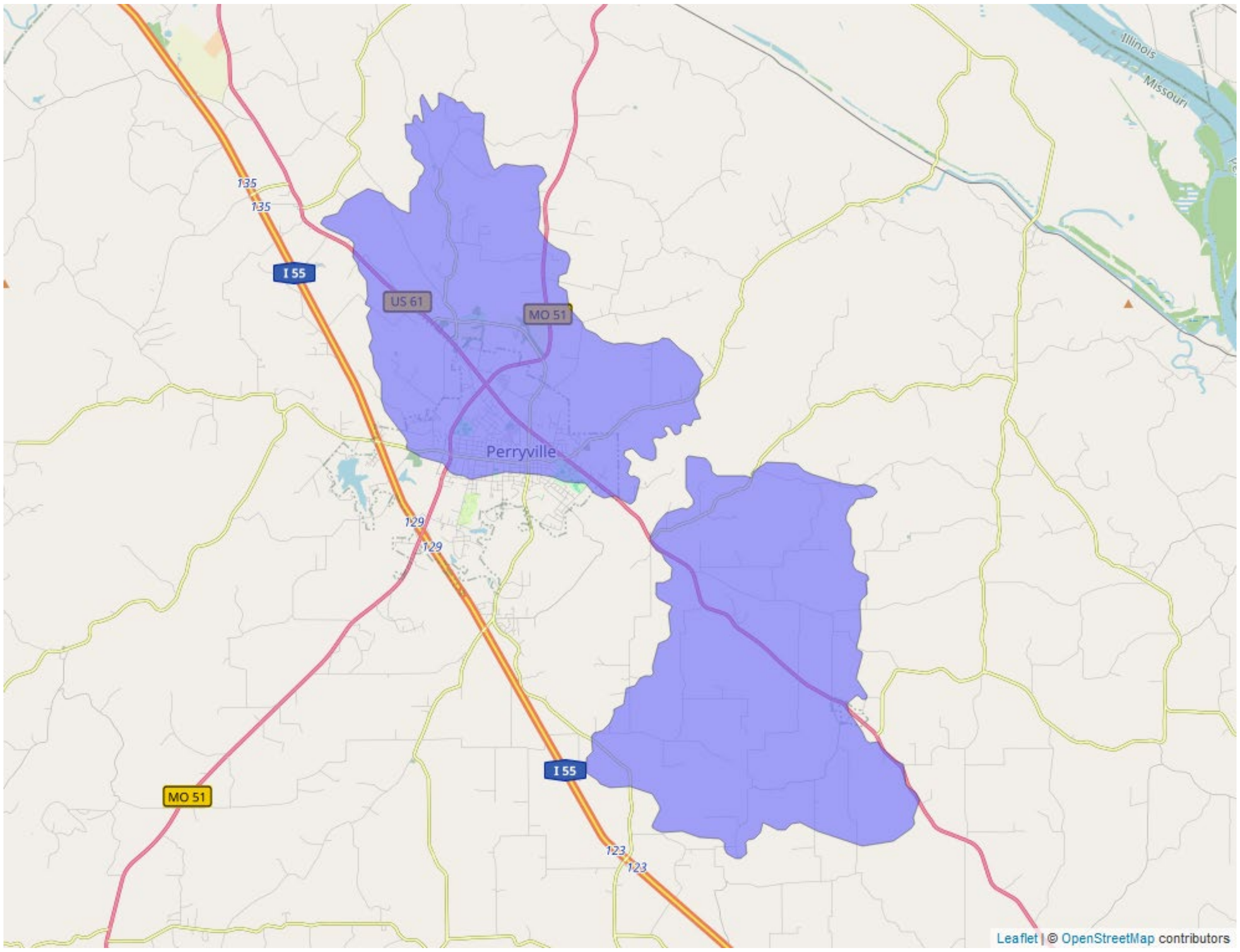


**Figure 11. Range map of Grotto sculpin (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/1009.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 9/17/2021

**Distribution:** Small, endemic, constrained, and/or isolated population(s)

**Number of populations:** Multiple populations (few)

**Species trends:** Unknown population trends

**Pesticides noted in Service documents as a threat to the species:** yes

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

The most substantial threats to the grotto sculpin come from the present or threatened destruction, modification, or curtailment of its habitat. This species, listed as endangered on October 25, 2013 (78 FR 58938), is restricted to just five cave systems in two karst areas in Perry County, Missouri. Although no clear estimates of historical population numbers exist to determine whether dramatic declines have occurred, two mass mortalities have been documented since the early 2000s, likely due to point-source pollution of surface waters that recharge cave streams occupied by the grotto sculpin (USFWS 2013). All recharge areas for known grotto sculpin habitat are considered vulnerable. The primary threats are habitat destruction and modification from water quality degradation and siltation (USFWS 2012, USFWS 2013). Notably, a suite of chemicals and contaminants continuously entering the groundwater above harmful levels is especially concerning (USFWS 2013).

Potential pollution sources include industrialization, contaminated agricultural runoff, sinkhole dumps, and improperly installed vertical drains. Various current and legacy-use pesticides from agricultural runoff and sinkhole leaching, human waste from ineffective septic systems, and animal waste from livestock operations have been detected in grotto sculpin streams (USFWS 2013). These pollutants not only directly affect the grotto sculpin but also harm the aquatic ecosystems and aquifer underlying the Perry County sinkhole plain. Additional factors include siltation beyond historical levels, predation from non-native fish, and stochastic events. These threats impact individual populations, decrease the viability of source populations, and increase the likelihood of extirpation (USFWS 2013). Existing regulatory mechanisms provide limited direct protection of water quality in grotto sculpin habitat, which is the most significant threat to the species (USFWS 2013).

Since its listing, new information indicates the species has a preference for clean gravel and bedrock substrate, and a lack of vital refuge habitat in three of the five inhabited caves has been identified (Fernholz et al. 2019). This absence of habitat may be due to landscape alterations from agriculture and construction of impervious surfaces, leading to agricultural runoff, soil erosion, and sediment pollution (USFWS 2013). Water quality degradation may also increase susceptibility to parasitic infections, compounded by a lack of prey in highly polluted areas and increased cannibalism (Day et al. 2014). Predation by invasive surface fish from farm ponds, entering caves through sinkholes or during flooding, remains a threat (Fernholz et al. 2019). Acanthocephalan parasitism has been found with high prevalence in caves, adding to the species' challenges (Day et al. 2014). Despite regulatory mechanisms, waterbodies with known grotto sculpin presence were listed as impaired in Missouri's 2020 303(d) List, and current regulatory measures appear insufficient to prevent water quality degradation, putting the species at risk (Missouri DNR 2020).

Water quality deterioration and habitat siltation are the main threats to the grotto sculpin and occur because of contaminated agricultural runoff, sinkhole dumps, industrialization, and vertical drains installed without appropriate best management practices (USFWS 2012, USFWS 2013). Cave systems in Perry County, Missouri are affected by the influx of surface waters, impacting water quality factors such as dissolved oxygen, turbidity, nutrients, and pH, which are crucial for the survivability of fish (Pobst and Taylor 2007; Water Quality Extension 2020). Sedimentation from agricultural practices, construction, mining, and other land disturbances impacts grotto sculpin by transporting contaminants and depositing excessive amounts of sediment in cave streams, reducing habitat availability, impacting reproduction, and increasing predator risks (USFWS 2013).

Agricultural practices in Perry County, which contribute significantly to land erosion and water quality issues, include row crops and livestock farming, leading to increased sediment and nutrient leaching (USDA NASS 2017; Perry County Community Economic and Environment Committee 2013). Loss of surface vegetation, road and bridge construction, mining, and dam activities further exacerbate sedimentation issues (U.S. Army Corps of Engineers 2019; Wellman et al. 2000; Milanovic 2002). Vertical drains and improper urbanization also pose threats by allowing contaminants to bypass natural filtration and directly enter groundwater systems (USDA NRCS 2008; Moss and Pobst 2010).

Persistent organic pollutants from pesticides, herbicides, and fungicides accumulate in cave ecosystems, leading to severe health effects on aquatic species (Kelly et al. 2007; Fox et al. 2010). Fertilizers from agricultural runoff contribute to eutrophication, lowering dissolved oxygen levels in water (Hernández et al. 2016). Accidental spills from transportation systems introduce hazardous materials into the ecosystem, further degrading water quality (Schipper et al. 2007). The extensive presence of sinkholes facilitates the direct entry of contaminants into the aquifers, exacerbating the vulnerability of grotto sculpin habitats (Pobst and Taylor 2007).

Climate change adds another layer of complexity, potentially increasing temperatures and altering precipitation patterns, which could affect cave temperatures and water levels, impacting the grotto sculpin and its prey (Settele et al. 2014; Vose et al. 2017; USGCRP 2017). The health status of the grotto sculpin is further compromised by parasitic infections, with a high prevalence of Acanthocephalan parasitism reported in adult cave fish (Day et al. 2014). Despite these threats, conservation measures and local protections under the Perry County Community Conservation Plan offer some hope for mitigating these impacts through best management practices and educational campaigns (Crites et al. 2019). The grotto sculpin's restricted range and population isolation, along with continued threats, affirm its classification as an endangered species. Future conservation actions should focus on understanding demographic and ecological features, developing a recovery plan with measurable criteria, implementing land acquisition and pollution mitigation efforts, and engaging various partners in recovery initiatives (Fernholz and Phelps 2016).

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 29% of the species range will contain use sites (Table 27).

### Usage

Past usage data indicate that up to 1.5 % of the species' range has been treated with methomyl annually (Table 27).

**Table 27. Overlap and annual usage data (% Range Treated) for the grotto sculpin. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | 0.5 | 0.1 |
| Citrus | NA | NA |
| Corn | 21.9 | 1.1 |
| Cotton | <0.1 | <0.1 |
| Other Grains | 0.4 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | <0.1 | <0.1 |
| **Soybeans**[12] | 28 | 1.4 |

[12] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Vegetables and Ground Fruit | <0.1 | <0.1 |
| Wheat | NA | NA |
| **Total** | **29** | **1.5** |

**Additional Exposure Considerations**

The grotto sculpin is a unique fish species that can use subterranean as well as surface ecosystems. While the cave system habitats occupied by this species are susceptible to groundwater contamination, we do not expect methomyl will be present in groundwater as we anticipate methomyl in surface water will degrade within the time required for surface water to percolate into groundwater reservoirs. As such, we anticipate exposure will be low for individuals occupying cave system habitats. However, individuals can also use shallow, surface water pools where exposure to methomyl is likely to occur.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. While we do not anticipate exposure is likely to occur in cave habitats given that methomyl is not likely found in groundwater, individuals occupying surface habitats are likely to be exposed to methomyl. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 28 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states “Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds”.

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the grotto sculpin’s habitat can reach up to 225.9 µg/L (Table 28). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish, we anticipate only low levels of mortality are likely to occur (i.e., up to 0.07% of exposed individuals are likely to die). Similarly, we only anticipate low levels of sublethal adverse effects (e.g., reduced growth or reproduction), which are only likely to occur to individuals occupying low flow or low water volume habitats.

**Table 28. Predicted environmental concentrations of methomyl within the grotto sculpin’s habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 7 | 23.72 | 0.00 |
| High flow waterbodies | HUC 8 | 45.74 | 0.00 |
| Low flow/Low volume waterbodies | HUC 7 | 209.70 | 0.04 |
| Low flow/Low volume waterbodies | HUC 8 | 225.90 | 0.07 |

**Indirect Effects:**

Grotto sculpin primarily prey on invertebrates, including amphipods, isopods, snails, and flatworms, and small vertebrates such as other fish (even other grotto sculpin). We expect there will be reduced abundance of some prey species in response to methomyl exposure, particularly in sensitive taxa such as insects and crustaceans. However, we do not expect other invertebrate taxa, such as mollusks and worms, will experience any levels of mortality as available toxicity data in these phyla show no adverse effects in response to methomyl exposure. Thus, while we anticipate grotto sculpin may experience some reductions in the availability of certain prey species, we anticipate there will be sufficient food resources for individuals as other prey items are not likely to experience any reductions in abundance with methomyl exposure. Therefore, we expect only low levels of indirect effect are likely to occur.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats where the grotto sculpin is found, we expect there only be low levels of mortality (up to 0.07% of exposed individuals are likely to die) and low levels of sublethal adverse effects to growth and reproduction. While we expect some prey resources of the grotto sculpin will be reduced in abundance with methomyl exposure, we anticipate many prey species will not have any reductions in abundance as we do not expect them to be sensitive to methomyl, indicating there will still be sufficient food resources for individuals. As such, the grotto sculpin has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The grotto sculpin has a medium exposure ranking. While there is a low level of past methomyl usage within the species' range (up to 1.5% range treated annually), a large portion of the range overlaps with the action area (29% total overlap), indicating that a moderate portion of the species' range is likely to be treated over the duration of the proposed action. Unlike other listed species that occupy cave habitats, the grotto sculpin also occupies surface habitats where exposure to methomyl is likely to occur. As such, we expect a moderate number of individuals are likely to be exposed to methomyl.

The grotto sculpin has a low toxicity ranking. Based on predicted environmental concentrations of methomyl within the species' habitat, we expect there will be no more than low levels of direct adverse effects (e.g., only 0.07% of exposed individuals will die). We expect only low levels of indirect adverse effects will occur as the grotto sculpin can rely on a number of prey taxa that are not likely to experience any adverse effects from methomyl exposure, suggesting that sufficient food resources will be available for individuals.

Given that we anticipate a moderate number of individuals are likely to experience exposure, but we only expect low levels of direct and indirect adverse effects, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The endangered Grotto sculpin is confined to five cave systems in Perry County, Missouri, and relies on clean water in karst regions to survive. Despite its unique adaptations, the species faces significant threats from habitat degradation and groundwater contamination due to agricultural runoff, sinkhole dumping, and industrialization. Methomyl usage within the Grotto sculpin's range is low, with only up to 1.5% of the area treated annually. Predicted environmental concentrations of methomyl are unlikely to result in significant mortality, with only 0.07% of exposed individuals expected to die. Direct adverse effects are minimal and limited to specific surface habitats where exposure is more likely to occur. Indirect effects, such as reduced availability of sensitive prey species, are also anticipated to be low. As a generalist invertivore, the Grotto sculpin can adapt to changes in prey availability by utilizing alternative prey species that are less sensitive to methomyl exposure, ensuring sufficient food resources for survival and reproduction. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Grotto sculpin in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Grotto sculpin.

## References

U.S. Fish and Wildlife Service. 2021. Grotto Sculpin (*Cottus specus*) 5-Year Review: Summary and Evaluation. Columbia, Missouri. 18 pp.

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Grotto Sculpin (*Cottus specus*) Throughout Its Range. Federal Register 78(186):58938-58955.

# Integration and Synthesis Summary: Barrens topminnow

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Fundulus julisia* | Barrens topminnow | 4318 |

## Species Overview

In reviewing the status of the Barrens topminnow, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the species' range, indicating a medium extent of exposure. Exposed individuals are unlikely to experience more than low levels of mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species and changes in habitat quality. Given that both exposure and direct effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Barrens topminnow in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Barrens topminnow. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 5/26/2023; Wherever found; *States within the range:* TN. Figure 12 depicts the species' range.

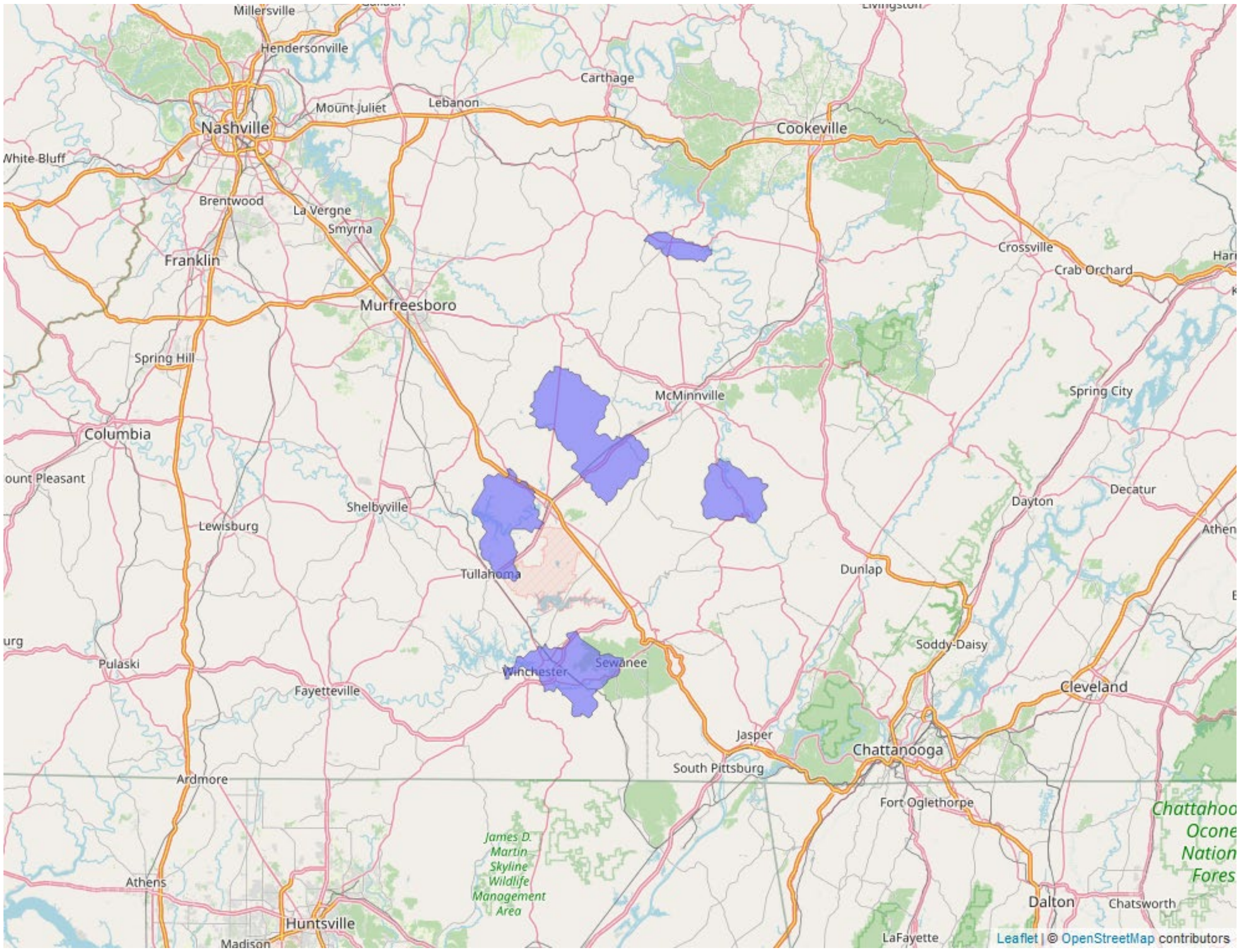


**Figure 12. Range map of barrens topminnow (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/5045.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** N/A

**Most recently completed 5-Year Review:** N/A

**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 in Service documents as a threat to the species:** no

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

The Barrens topminnow is a small fish endemic to streams on the Barrens Plateau in middle Tennessee. This species is a spring specialist that is found in springhead pools and the slower areas of spring runs. Typical of members of the genus Fundulus, Barrens topminnows prefer areas of slower current. Barrens topminnows have only been found in areas with a large proportion of groundwater influence in the streams. Due to the groundwater influence of these habitats, the temperatures are relatively stable, ranging from 15°C-25°C (59-77°F). The karst topography of the Barrens Plateau area allows for a number of spring systems to be present, though not all of these have been inhabited by the topminnow. In times of drought, if the discharge of the springs is severely reduced, Barrens topminnows likely move downstream into more permanent water if suitable habitat is available. The Barrens topminnow is a protracted, fractional spawner (a few eggs at a time over a long period) that spawns over the course of the warm months (April to August), peaking from May to June. Most fish mature and are ready to spawn within the first year, though some of the later spawned fish are in year 2 before they spawn (Rakes 1989, entire). The Barrens topminnow is currently found in Warren, Coffee, Franklin, Cannon, and Dekalb Counties in Tennessee. The native populations from the Duck River drainage were extirpated soon after discovery, before fish could be kept in an ark population or genetic samples taken. Sites within the drainage are currently stocked with fish from Witty Creek Management Unit and/or the Hickory Creek Management Unit. In an effort to maintain the species, Barrens topminnows have been stocked into sites where the population had been extirpated and into springs within the native watersheds where they were not known historically but appeared to have appropriate habitats. The Western Mosquitofish (*Gambusia affinis*) poses the largest and most direct threat to the continued existence of the Barrens topminnow. This small, live-bearing fish is native to Tennessee, but not naturally found on the Barrens Plateau. These fish were likely first introduced to the plateau in the 1960s in an effort to control mosquitos. Native predatory centrarchid (sunfish) species, cattle/livestock operations, habitat alteration, drought, and impoundments are also believed to negatively affect the species. Currently, the Barrens topminnow is known from the headwaters of three river basins, though genetically represented by Evolutionarily Significant Units of two of those watersheds and only one of those is subdivided into separate MUs. The populations in the Duck River basin were historically extirpated. The Elk River ESU is likely currently extirpated, only being represented by an ark population. The remaining Management Units both exhibit low resilience due to low abundance, small number of occupied sites, and stressors affecting the viability of the populations at those sites. Representation and redundancy are also low for this species because of the loss of two watersheds and the low resilience of the remaining Management Units. The main threats to the Barrens topminnow are competition from introduced Western Mosquitofish, and the drying of springs during droughts.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 14.6% of the species range will contain use sites (Table 29).

### Usage

Past usage data indicate that up to 0.9 % of the species' range has been treated with methomyl annually (Table 29).

**Table 29. Overlap and annual usage data (% Range Treated) for the Barrens topminnow. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---|---|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 8.2 | 0.4 |
| Cotton | 1.9 | 0.1 |
| Other Grains | 0.6 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.1 | 0.1 |
| **Soybeans**[13] | 11.8 | 0.6 |
| Vegetables and Ground Fruit | <0.1 | 0.1 |
| Wheat | NA | NA |
| **Total** | **14.6** | **0.9** |

[13] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. Given that the extent of overlap is high, and that expected usage is low, we expect a moderate number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Medium

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 30 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

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## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the Barrens topminnow's habitat can reach up to 229.5 µg/L(Table 30). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies . Based on available toxicity data in fish, we expect only low levels of mortality are likely to occur at these exposure concentrations (e.g., up to 0.08% of exposed individuals are likely to die). Similarly, we anticipate exposed individuals will experience no more than low levels of sublethal adverse effects (e.g., reduced growth or reproduction) at these exposure concentrations.

**Table 30. Predicted environmental concentrations of methomyl within the Barren's topminnow's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| Low flow/Low volume waterbodies | HUC 3 | 171.0 | 0.01 |
| Low flow/Low volume waterbodies | HUC 5 | 229.5 | 0.08 |
| Low flow/Low volume waterbodies | HUC 6 | 164.7 | 0.01 |
| Low flow/Low volume waterbodies | HUC 8 | 225.9 | 0.07 |

**Indirect Effects:**

Based on the known life history of other similar species, we presume the Barrens topminnow can consume a wide variety of invertebrate species as a food resources, including aquatic insects, crustacean zooplankton, and snails. We anticipate methomyl exposure is likely to reduce the abundance of sensitive prey species, such as arthropod species. However, available toxicity data in other invertebrate taxa indicate that mollusk species are not sensitive to methomyl and are not likely to experience any mortality at concentrations predicted to occur in the Barrens topminnow's habitat. As such, we expect only low levels of indirect adverse effects are likely to occur as sufficient prey resources in the form of less sensitive invertebrate taxa (like snails) will be available for individuals to consume.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the Barrens topminnow's habitat, we expect there will only be low levels of mortality (up to 0.08% of exposed individuals are likely to die) and low levels of sublethal adverse effects. We do not expect more than low levels of indirect effects are likely as the Barrens topminnow can use prey species that are not likely to experience any reductions in abundance with methomyl exposure, such as snails. Given the low level of direct adverse effects to exposed individuals, the Barrens topminnow has a low toxicity ranking.

**Overall Toxicity:** Low

## Effects of the Action Summary

The Barrens topminnow has a medium exposure ranking. While there is a low level of past methomyl usage within the species' range (up to 0.9% range treated annually), there is a high extent of overlap between the range and the action area, indicating that a moderate portion of the species' range is likely to be treated over the duration of the proposed action. As such, we expect a moderate number of individuals are likely to be exposed.

The Barrens topminnow has a low toxicity ranking. We expect no more than low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction) at estimated exposure concentrations. Similarly, we do not anticipate more than low levels of adverse indirect effects, as individuals can likely rely on food resources that will not experience any reductions in abundance (i.e., snail prey).

Given that we expect a moderate number of individuals are likely to be exposed but that we expect exposed individuals will experience no more than low levels of direct adverse effects, we anticipate the overall risk of adverse effects to the species is low.

## Conclusion

After The endangered Barrens topminnow inhabits spring-fed systems on the Barrens Plateau in middle Tennessee, where its survival is tied to stable groundwater-influenced habitats. Despite its ecological specialization and high vulnerability due to habitat alterations, competition with invasive Western Mosquitofish, and susceptibility to drought, the species has persisted with assistance from conservation efforts, including reintroductions and habitat restoration. Methomyl usage within the species' range is low, with only 0.9% of the range treated annually. While a significant overlap (14.6%) between the action area and the species' habitat exists, predicted environmental concentrations of methomyl are unlikely to cause more than low levels of mortality (up to 0.08% of exposed individuals) or sublethal adverse effects. Indirect effects, such as reductions in sensitive prey species like arthropods, are anticipated to be minimal due to the topminnow's ability to utilize alternative food resources, such as mollusks and snails, which are not sensitive to methomyl exposure. This dietary flexibility ensures that individuals can maintain sufficient nutrition, mitigating the severity of indirect effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Barrens topminnow in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Barrens topminnow.

## References

U.S. Fish and Wildlife Service. 2017. Species Status Assessment for the Barrens Topminnow (*Fundulus julisia*). Version 1.1.

# Integration and Synthesis Summary: Carolina madtom

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Noturus furiosus* | Carolina madtom | 5288 |

## Species Overview

In reviewing the status of the Carolina madtom, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. In addition, although there is a high overlap of the action area with the species' range, there is medium past usage of methomyl within the species' range, indicating a high extent of exposure. Exposed individuals are unlikely to experience more than low levels of mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of prey species and changes in habitat quality. Given that exposure is high, and the level of indirect effects is low, we assess the risk of adverse effects to the species as medium. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Carolina madtom in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Carolina madtom. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 10/4/2018; Wherever found; *States within the range:* NC. Figure 13 depicts the species' range.

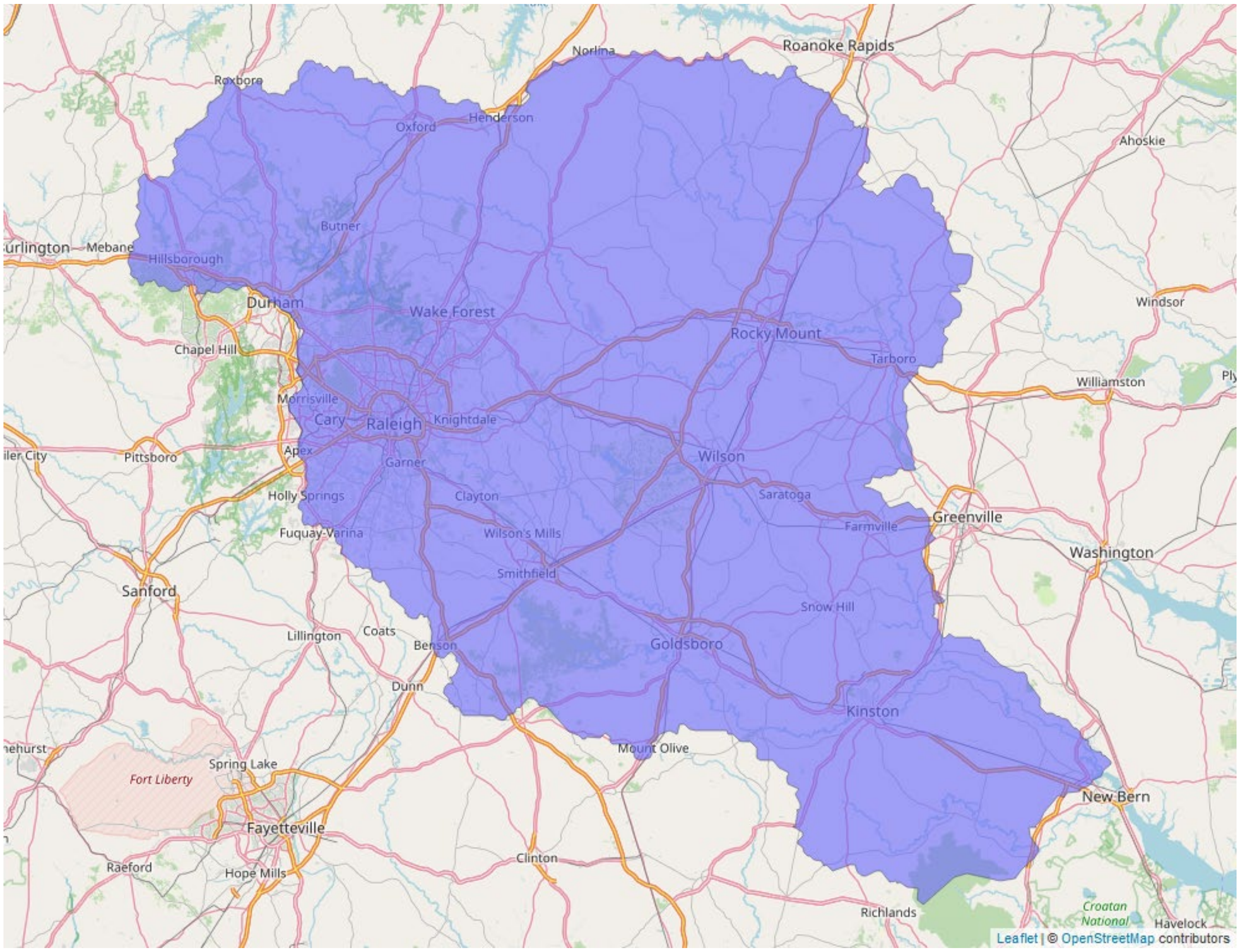


**Figure 13. Range map of Carolina madtom (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/528.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:**

**Most recently completed 5-Year Review:**

**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 in Service documents as a threat to the species:** yes

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

The Carolina madtom is a freshwater fish 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. The historical range of the Carolina madtom included streams and rivers in the Tar, Neuse, and Trent River drainages with the documented historical distribution in 11 management units within three former populations. The Carolina madtom is presumed extirpated from 64% (7) of the historically occupied management units. The analysis of species' current condition revealed that Carolina madtom abundance and distribution has declined considerably, with the species currently occupying approximately 26% of its historical range. The remaining populations are small and fragmented, only occupying a fraction of reaches that were historically occupied. This decrease in abundance and distribution has resulted in largely isolated current populations. Evidence suggests that the range reduction of the species corresponds to habitat degradation resulting from the cumulative impacts of land use change and associated watershed-level effects on water quality, water quantity, habitat connectivity, instream habitat suitability, and predation by the invasive flathead catfish. The effects of climate change have begun to be realized in current Carolina madtom range and may have contributed to habitat degradation. In summary, the Carolina madtom faces a variety of threats from declines in water quality, loss of stream flow, riparian and instream fragmentation, deterioration of instream habitats, and expansion of the invasive predator flathead catfish.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 38.7% of the species range will contain use sites (Table 31).

**Usage**

Past usage data indicate that up to 6.8 % of the species' range has been treated with methomyl annually (Table 31).

**Table 31. Overlap and annual usage data (% Range Treated) for the Carolina madtom. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 9.9 | 0.5 |
| Cotton | 7.7 | 0.4 |
| Other Grains | 1.3 | 0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 5.3 | 2.4 |
| **Soybeans**[14] | 21.6 | 1.1 |
| Vegetables and Ground Fruit | 2.8 | 2.8 |
| Wheat | NA | NA |
| **Total** | **38.7** | **6.8** |

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a medium level of usage within the species' range. Given that the extent of overlap is high and that expected usage is medium, we expect a large number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** High

---

**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1

[14] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 32 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the Carolina madtom's habitat can reach 171 µg/L (Table 32). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish, we expect this range of exposure concentrations will not cause more than low levels of mortality (i.e., up to 0.01% of exposed individuals are likely to die). Similarly, we anticipate these exposures will only result in low levels of sublethal adverse effects to growth or reproduction, which will only be limited to individuals that are exposed in low flow or low water volume habitats.

**Table 32. Predicted environmental concentrations of methomyl within the Carolina madtom's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 3 | 34.82 | 0.00 |
| Low flow/Low volume waterbodies | HUC 3 | 171.00 | 0.01 |

**Indirect Effects:**

The Carolina madtom consumes a wide range of aquatic insects as a food resources. While available toxicity data generally indicates that insect species are sensitive to methomyl, we realistically do not expect all insect species are equally sensitive. As such, we anticipate some insect prey species will experience large reductions in abundance as a response to methomyl exposure while other insect prey species will not experience such reductions in abundance. Given that the Carolina madtom can feed on a wide variety of aquatic insects, including midges, mayflies, caddisflies, dragonfly, and beetle larvae, we anticipate at least some portion of the aquatic insect prey pool will not experience large reductions in abundance, suggesting that there will likely be sufficient prey resources remaining to support individuals. As such, we expect only low levels of indirect effects are likely to occur.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats where the Carolina madtom is found, we expect exposed individuals are not likely to experience more than low levels of direct adverse effects (including mortality, reduced growth, and reduced reproduction), which will only be limited to individuals exposed in low flow or low volume water bodies are likely to experience any adverse effects at all. We expect only low levels of indirect adverse effects are likely to occur as the Carolina madtom can use a wide variety of prey species, indicating that individuals will likely have sufficient food resources available even if there is a reduction in the abundance of sensitive insect prey species. As such, we anticipate the species will has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Carolina madtom has a high exposure ranking. While there is a low level of past methomyl usage within the species' range (up to 6.8% range treated annually), there is a high extent of overlap between the species' range and the action area (38.7% total overlap), indicating that a moderate portion of the species' range is likely to be treated over the duration of the proposed action. As such, we expect a large number of individuals are likely to be exposed.

The Carolina madtom has a low toxicity ranking. We anticipate exposed individuals are not likely to experience more than low levels of mortality and sublethal adverse effects. We expect no more than low levels of indirect adverse effects are likely as the Carolina madtom is a generalist invertivore. While there will likely be large reductions in the abundance of sensitive prey species, we anticipate individuals will be able to rely on prey species that are less sensitive to methomyl exposure. Therefore, we expect the overall risk of adverse effects to the species is low.

## Conclusion

The endangered Carolina madtom is a freshwater fish native to the Tar, Pamlico, and Neuse River drainages in North Carolina. This species, dependent on riffles, runs, and pools in moderate to high-flow environments, is highly vulnerable due to its restricted range, fragmented habitat, and competition with invasive species like the flathead catfish. While methomyl usage within its range is moderately high (up to 6.8% treated annually) and the action area overlaps with 38.7% of its habitat, predicted environmental concentrations of methomyl are not expected to cause significant population-level impacts. The Carolina madtom typically inhabits higher-flow environments, where methomyl concentrations are diluted by water movement. Although low-flow habitats could accumulate higher concentrations of methomyl, these are not the species' primary habitats, reducing the likelihood of adverse effects. Furthermore, the Carolina madtom's dietary flexibility allows it to adapt to potential reductions in sensitive prey species, such as insects, by consuming alternative prey species that are less vulnerable to methomyl toxicity. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Carolina madtom in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Carolina madtom.

## References

U.S. Fish and Wildlife Service. 2018. Species status assessment report for the Carolina Madtom (*Noturus furiosus*). Version 1.1. Atlanta, Georgia.

# Integration and Synthesis Summary: Chucky madtom

| Scientific Name: | Common Name: | Entity ID: |
| --- | --- | --- |
| *Noturus crypticus* | Chucky madtom | 7150 |

## Species Overview

In reviewing the status of the Chucky madtom, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. Additionally, there is a low overlap of the action area with the species' range and low past usage of methomyl within the species' range, indicating a low extent of exposure. Exposed individuals are unlikely to experience significant mortality, and indirect effects are expected to be low to moderate, primarily through reductions in prey availability and potential habitat changes. Given that the exposure is low and the level of indirect effects is low to moderate, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Chucky madtom in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Chucky madtom. We discuss our rationale for this conclusion for the species in the sections below.

## Species range

Based on range map dated: 4/12/2021; Wherever found; *States within the range:* TN. Figure 14 depicts the species' range.

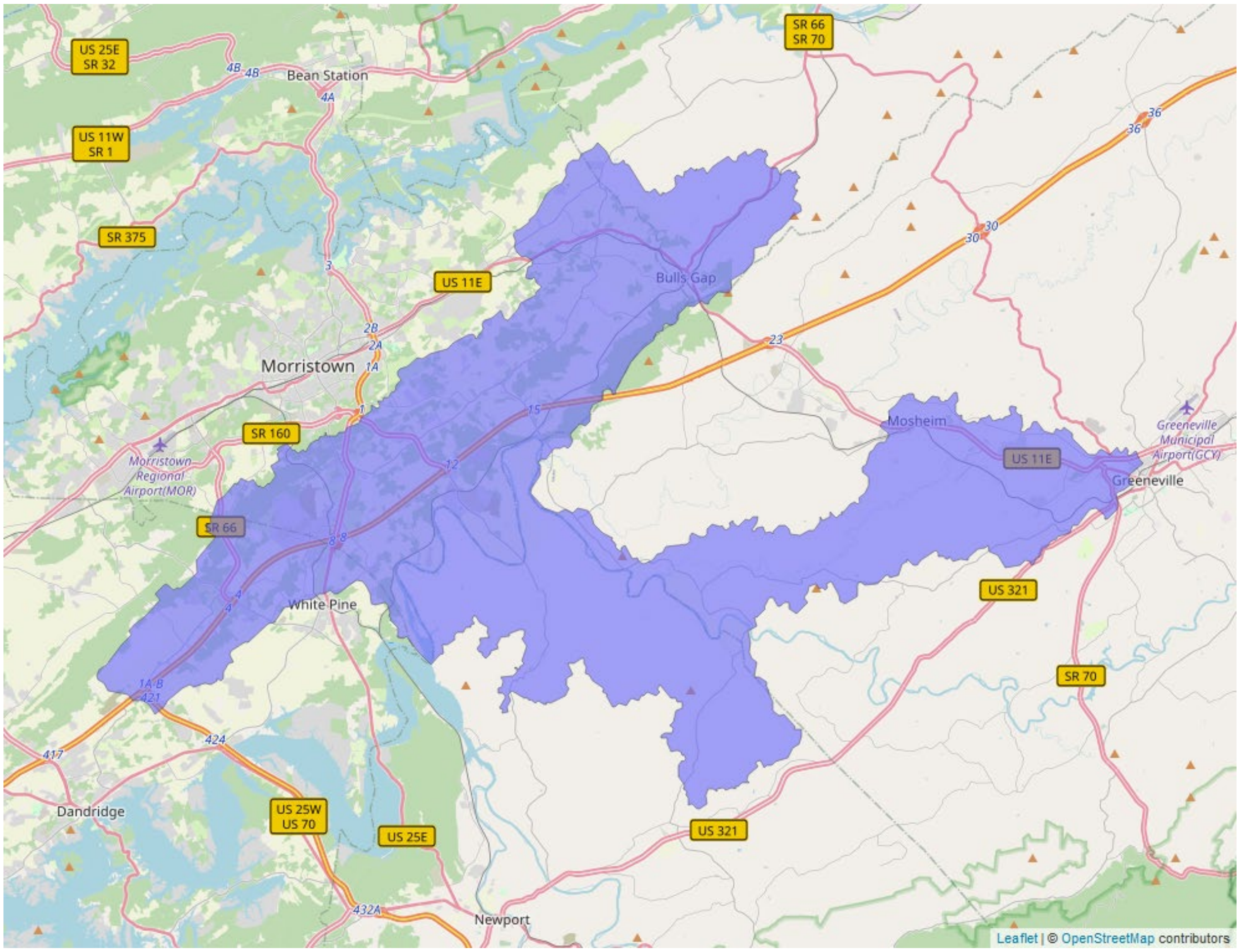


**Figure 14. Range map of chucky madtom (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/7735.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** No change in Status

**Most recently completed 5-Year Review:** 4/10/2024

**Distribution:** Small, endemic, constrained, and/or isolated population(s)

**Number of populations:** Single population

**Species trends:** Declining population(s) - one or more populations declining

**Pesticides noted in Service documents as a threat to the species:** yes

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

The Chucky madtom's range is restricted to a 1.8-mile stretch of Little Chucky Creek in Greene County, Tennessee. This limited range has led to habitat fragmentation, genetic isolation, and increased extinction risk (Burkhead et al., 1997; Hallerman, 2003). Only 14 specimens have been collected since its discovery in 1991, with none found since 2004, suggesting the population may be below the size needed for long-term viability (Franklin and Frankham, 1998; Lande, 1995).

Habitat fragmentation and sedimentation from agricultural activities pose significant threats to the Chucky madtom. The species relies on clean, gravelly substrates, which are sparse in Little Chucky Creek (Burr and Eisenhour, 1994; Burr et al., 2005). Predation by native fish and competition from non-native crayfish also threaten its survival (Emmett and Cochran, 2010; Dinkins, 2014). Additionally, agricultural runoff introduces sediment and agrochemicals into the creek, degrading water quality and habitat (Jones et al., 2000; Middle Nolichucky Watershed Alliance, 2006).

Climate change is expected to increase the frequency and intensity of droughts and storms, further impacting the Chucky madtom's habitat (Cook et al., 2004; Thomas et al., 2004). These events can lead to habitat loss, reduced water quality, and increased stress on the species. Although the species and its habitat are protected under the Clean Water Act and Tennessee Water Quality Control Act, these regulations have not fully mitigated habitat degradation (TDEC, 2012).

Efforts to implement agricultural best management practices in the Little Chucky Creek watershed are ongoing. Partners, including the Greene County Soil Conservation District, NRCS, TVA, and the Service, have worked on projects to improve habitat, such as installing riparian fencing and creating alternate water sources. These efforts aim to reduce sedimentation and improve water quality, ensuring the long-term survival of the Chucky madtom (NRCS; TVA; Service).

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed aquatic species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where

individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 3.1% of the species range will contain use sites (Table 33).

**Usage**

Past usage data indicate that up to 0.4 % of the species' range has been treated with methomyl annually (Table 33).

**Table 33. Overlap and annual usage data (% Range Treated) for the Chucky madtom. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 2.5 | 0.1 |
| Cotton | <0.1 | <0.1 |
| Other Grains | <0.1 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | 0.2 | 0.1 |
| **Soybeans**[15] | 2.6 | 0.1 |
| Vegetables and Ground Fruit | 0.2 | 0.2 |
| Wheat | NA | NA |
| **Total** | **3.1** | **0.4** |

**Additional Exposure Considerations**

The low level of usage reported above is corroborated by data from the USDA Census of Agriculture, which reports low levels of past insecticide usage within the species' range. Only up to 2.3% of the species' range has been treated annually with any insecticides. Given that the Census of Agriculture data aggregates all insecticides into one metric, we expect the reported level of usage is an overestimate of the percent range treated with methomyl. However, the species' is found in a single location with its habitat surrounded by areas of intense agricultural

[15] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

activity, indicating that stressors associated with agricultural runoff (like pesticide exposure) are a major threat to the species.

**Exposure Summary**

There is a low extent of overlap between the action area and the species' range (3.1% total overlap). Based on past usage data, we expect a low level of usage within the species' range, which is corroborated by additional data on insecticide usage from the USDA's Census of Agriculture. Given that the extent of overlap is low, and that expected usage is low, we expect a small number of individuals are likely to experience exposure from the proposed action.

**Overall Exposure:** Low

**Conservation Measures:**

**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 34 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the Chucky madtom's habitat can reach up to 164.7 µg/L (Table 34). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish, we expect this range of exposure concentrations will cause only low levels of mortality (i.e., up to 0.01% of exposed individuals are likely to die). Similarly, we anticipate exposed individuals will only experience low levels of sublethal adverse effects, such as reduced growth or reproduction, which will only be limited to individuals that are exposed in low flow or low water volume habitats.

**Table 34. Predicted environmental concentrations of methomyl within the Chucky madtom's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 6 | 23.4 | 0.00 |
| Low flow/Low volume waterbodies | HUC 6 | 164.7 | 0.01 |

**Indirect Effects:**

The Chucky Madtom's prey items are unknown, but based on information available for other madtom species, we presume the Chucky madtom is a generalist invertivore and primarily consumes small aquatic benthic insects and macroinvertebrates. Available toxicity data indicate that invertebrate species, particularly arthropods, are sensitive to methomyl and are likely to die with exposure to methomyl at predicted environmental concentrations. As such, we anticipate indirect effects to the species through the loss of prey resources is likely. However, we do not expect all invertebrate species will be equally sensitive to methomyl exposure. As such, we anticipate there will be large reductions in abundance of some invertebrate species while other species may experience only small reductions in abundance. Since we presume the Chucky madtom is an invertebrate prey generalist, we anticipate individuals are likely more robust to temporary losses of certain invertebrate prey species as they can likely switch to use other species whose abundance is not as greatly reduced. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of adverse indirect effect to the Chucky madtom.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats where the Chucky madtom is found, we expect exposed individuals will only experience, at most, low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction). We anticipate only low levels of adverse indirect effects are likely to occur as we presume the species is an invertebrate prey generalist and anticipate individuals will be able to capitalize on more abundant prey resources when sensitive prey species are adversely affected by methomyl. Given the range of direct adverse effects that are likely to occur, the Chucky madtom has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The Chucky madtom has a low exposure ranking. There is a small extent of overlap between the species' range and the action area (3.1% total overlap) and a low level of past usage (up to 0.4% range treated annually), which is corroborated by a low level of past insecticide usage as reported by the Census of Agriculture (up to 2.25% range treated annually with any insecticide). As such, we anticipate only a small number of individuals are likely to be exposed.

The Chucky madtom has a low toxicity ranking. Predicted environmental concentrations of methomyl the Chucky madtom's habitat will cause only low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction). Similarly, we anticipate only low levels of adverse indirect effects, in the form of reduced prey availability, are likely to occur as the species is an invertebrate prey generalist and can likely switch resources when there is a large reduction in the abundance of sensitive prey.

Given that we anticipate a small number of individuals are likely to be exposed and that exposed individuals are not likely to experience more than low levels of adverse effects, we anticipate the overall risk of adverse effects to the species is low.

## Conclusion

After The endangered Chucky madtom is restricted to a 1.8-mile stretch of Little Chucky Creek in Greene County, Tennessee. This species is highly vulnerable due to its extremely limited range, habitat fragmentation, and threats from sedimentation and agricultural runoff. Although the Chucky madtom faces ongoing environmental pressures, the proposed action does not significantly increase risks to its survival and recovery. The action area overlaps with only 3.1% of the species' range, and methomyl usage within this range has been historically low (up to 0.4% treated annually). Predicted environmental concentrations of methomyl are expected to result in low levels of direct adverse effects, including minimal mortality (up to 0.01% of exposed individuals) and limited sublethal effects such as reduced growth and reproduction. These effects are anticipated to be restricted to individuals in low-flow or low-water-volume habitats. Indirect effects on the Chucky madtom are also expected to be minimal. As a generalist invertivore, the Chucky madtom can adapt to reductions in sensitive prey species by consuming alternative prey less affected by methomyl. This dietary flexibility mitigates the risk of food resource depletion and supports the species' resilience. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Chucky madtom in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Chucky madtom.

## References

U.S. Fish and Wildlife Service. (undated). Species Biological Report for Chuck Madtom (*Noturus crypticus*). Southeast Regional Office, Atlanta, Georgia. 23 pp. (downloaded February 16, 2017, available at: https://www.fws.gov/cookeville/pdfs/10202016_Chucky%20Madtom_Species_Biological_Report.pdf

## Integration and Synthesis Summary: Spring pygmy sunfish

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

### Species Overview

In reviewing the status of the Spring Pygmy Sunfish, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is medium. Although there is a high overlap of the action area with the species' range, there is low past usage of methomyl within the range, indicating a low extent of exposure due to existing conservation agreements. Exposed individuals are unlikely to experience mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in prey availability and changes in habitat quality. Given that both exposure and indirect effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, accounting for cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the Spring Pygmy Sunfish in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Spring Pygmy Sunfish.

### Species range

Based on range map dated: 3/10/2022; Wherever found; *States within the range:* AL. Figure 15 depicts the species' range.

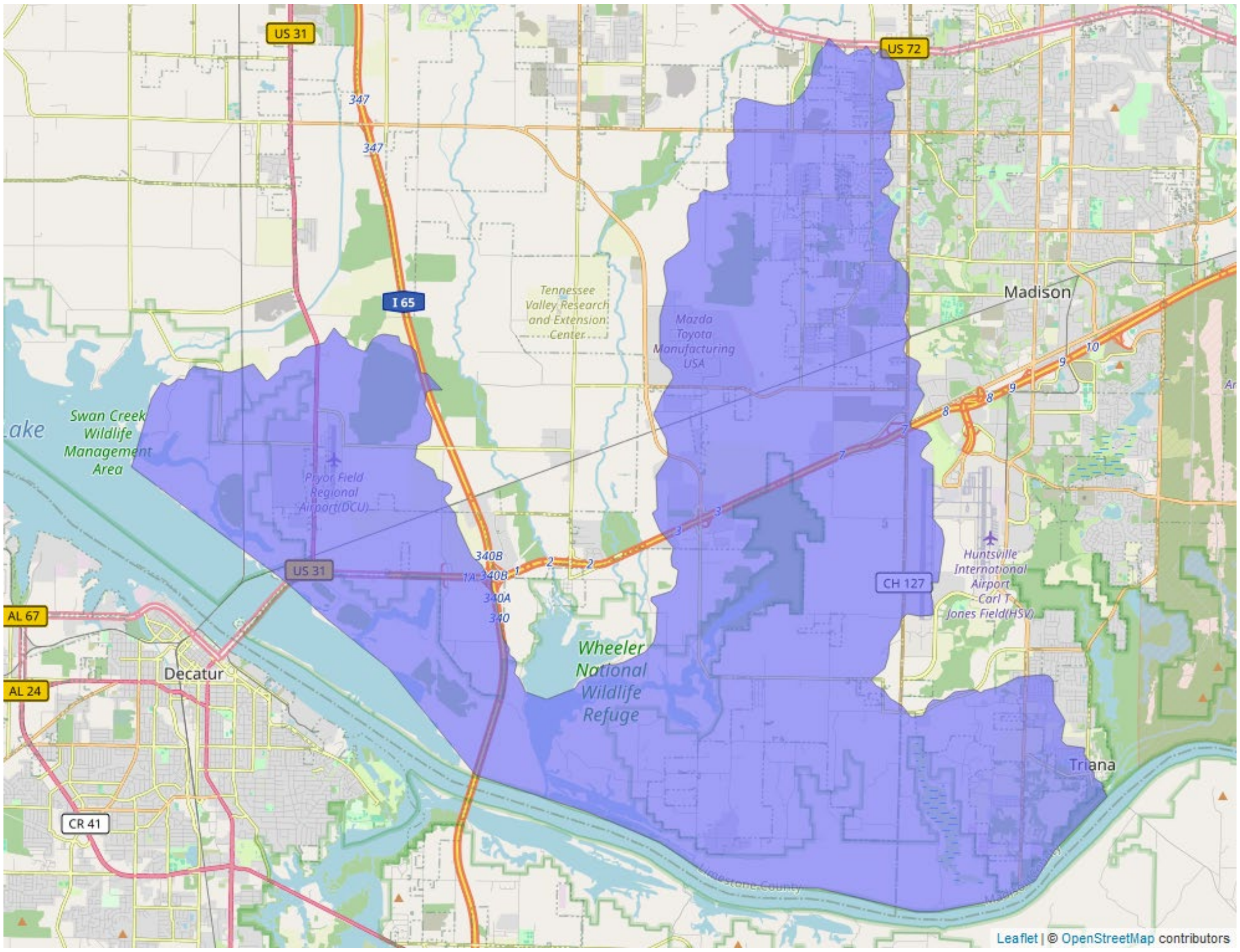


**Figure 15. Range map of spring pygmy sunfish (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/652.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Threatened

**Most recent 5-Year Review recommendation:**

**Most recently completed 5-Year Review:**

**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 in Service documents as a threat to the species:** yes

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

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

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

**Overall Vulnerability:** Medium

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 35.2% of the species range will contain use sites (Table 35).

### Usage

Past usage data indicate that up to 1.8 % of the species' range has been treated with methomyl annually (Table 35).

**Table 35. Overlap and annual usage data (% Range Treated) for the spring pygmy sunfish. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | <0.1 | <0.1 |
| Citrus | NA | NA |
| Corn | 15.7 | 0.8 |
| Cotton | 8.5 | 0.4 |
| Other Grains | 0.3 | <0.1 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | <0.1 | <0.1 |
| **Soybeans**[16] | 26.2 | 1.3 |
| Vegetables and Ground Fruit | <0.1 | 0.1 |
| Wheat | NA | NA |
| **Total** | **35.2** | **1.8** |

[16] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Additional Exposure Considerations**

There are a number of conservation agreements in place for the spring pygmy sunfish. Nearly 3,900 acres of land are covered through three candidate conservation agreements with assurances, conservation tracts acquired by the North Alabama Land Trust, and the Wheeler National Wildlife Refuge. Available data on pesticide usage in national wildlife refuges show no methomyl has been used previously in the Wheeler National Wildlife Refuge. Additionally, we have high confidence that there are no agricultural areas within the conservation tracts acquired by the North Alabama Land Trust. Thus, we anticipate a large portion of the species' range will not be treated with methomyl, reducing the likelihood of individuals experiencing exposure.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. The species benefits from a number of conservation agreements, including three candidate conservation agreements with assurances, which specify protections required for agricultural activities to protect aquatic habitats, conservation tracts acquired by the North Alabama Land Trust, and a National Wildlife Refuge. Given these various protections in place for the species, we anticipate only a very small number of individuals are likely to experience any exposure to methomyl.

**Overall Exposure:** Low

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**Conservation Measures:**

**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 36**Error! Reference source not found.** the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

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## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations within the spring pygmy sunfish's habitat can reach up to 164.7 µg/L(Table 36). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish, we expect this range of exposure concentrations will cause only low levels of mortality (i.e., up to 0.01% of exposed individuals are likely to die). Similarly, we anticipate exposed individuals will only experience low levels of sublethal adverse effects, such as reduced growth or reproduction, which will only be limited to individuals that are exposed in low flow or low water volume habitats.

**Table 36. Predicted environmental concentrations of methomyl within the spring pygmy sunfish's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| Large volume waterbodies | HUC 6 | 12.86 | 0.00 |
| Low flow/Low volume waterbodies | HUC 6 | 164.70 | 0.01 |

**Indirect Effects:**

The Spring pygmy sunfish can consume invertebrate species as a food resources, including small crustaceans, aquatic insects, and snails. We anticipate methomyl exposure is likely to reduce the abundance of sensitive prey species, such as arthropod species. However, available toxicity data in other invertebrate taxa indicate that mollusk species are not sensitive to methomyl and are not likely to experience any mortality at concentrations predicted to occur in the spring pygmy sunfish's habitat. As such, we expect only low levels of indirect adverse effects are likely as sufficient prey resources in the form of less sensitive invertebrate taxa (like snails) will be available for individuals to consume.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats that the spring pygmy sunfish is found in, we expect exposed individuals will only experience, at most, low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction). We do not expect more than low levels of indirect effects are likely as the spring pygmy sunfish can use prey species that are not likely to experience any reductions in abundance with methomyl exposure, such as snails. Given the low level of direct adverse effects to exposed individuals, the spring pygmy sunfish has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The spring pygmy sunfish has a low exposure ranking. While there is a high extent of overlap between the species' range and the action area (35.2% total overlap), the low level of past usage (up to 1.8% range treated annually) suggests only a small portion of the range is likely to be treated each year. Additionally, a large portion of the species' range is protected by the Wheeler National Wildlife Refuge or is included in conservation tract lands purchased by the North Alabama Land trust, which are areas we expect will have little to no methomyl usage. As such, we anticipate only a small number of individuals, at most, are likely to be exposed to methomyl.

The spring pygmy sunfish has a low toxicity ranking. Predicted environmental concentrations of methomyl are not likely to cause more than low levels of direct adverse effects (e.g., mortality, reduced growth, reduced reproduction). Similarly, we anticipate only low levels of indirect effects are likely as individuals can rely on prey species that are not sensitive to methomyl and are not likely to experience any reductions in abundance, like snails.

This low level of toxicity, coupled with the low exposure potential, suggests that only a small number of individuals are likely to experience any adverse effects from methomyl use. As such, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The threatened Spring Pygmy Sunfish inhabits a delicate and specialized ecosystem within the Beaverdam Spring/Creek system in Alabama. Despite its ecological needs and vulnerability due to a limited range, small population size, and declining habitat quality, methomyl usage within its range is minimal, and overall risk of adverse effects is low. Conservation measures—including Candidate Conservation Agreements with Assurances, critical habitat designations, and long-term conservation tracts—further reduce the potential for pesticide exposure. These measures prohibit pesticide use in critical areas, establish vegetative buffers, and restrict groundwater withdrawals, significantly mitigating the species' risk. Although there is a high overlap of 35.2% between the action area and the species' range, the low past usage of methomyl and the protections afforded by conservation agreements limit the risk of significant adverse effects. Predicted environmental concentrations of methomyl in the Spring Pygmy Sunfish's habitat are low, and we anticipate only localized, minor adverse effects. Indirect effects, such as reductions in prey availability, are expected to be minimal due to the species' dietary flexibility and its ability to utilize less sensitive prey species, like mollusks. Considering the species' ecological traits, the existing conservation measures, and the limited toxicity of methomyl, we anticipate only localized, minor adverse effects. After incorporating conservation measures into the effects of the action and accounting for cumulative effects on the environmental baseline, and in light of the species' status, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the Spring Pygmy Sunfish in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Spring Pygmy Sunfish.

## References

U.S. Fish and Wildlife Service. 2019. Designation of Final Critical Habitat for the Spring Pygmy Sunfish. Federal Register 84: 24987-25009. Manson, M. 2020. Partnership Preserves 700 Acres for Habitat Protection. Alabama Land Trust Website:

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

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

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

## Integration and Synthesis Summary: Longfin smelt

| Scientific Name: | Common Name: | Entity ID: |
| --- | --- | --- |
| *Spirinchus thaleichthys* | Longfin smelt | 10012 |

### Species Overview

In reviewing the status of the longfin smelt, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. Although there is a high overlap of the action area with the species' range, past usage of methomyl within the species' range has been minimal, indicating a low extent of exposure. Exposed individuals are unlikely to experience mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of sensitive prey species. Given that both exposure and indirect effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the longfin smelt in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the longfin smelt. We discuss our rationale for this conclusion for the species in the sections below.

### Species range

Based on range map dated: 2/14/2023; San Francisco Bay-Delta Distinct Population Segment; *States within the range:* CA. Figure 16 depicts the species' range.

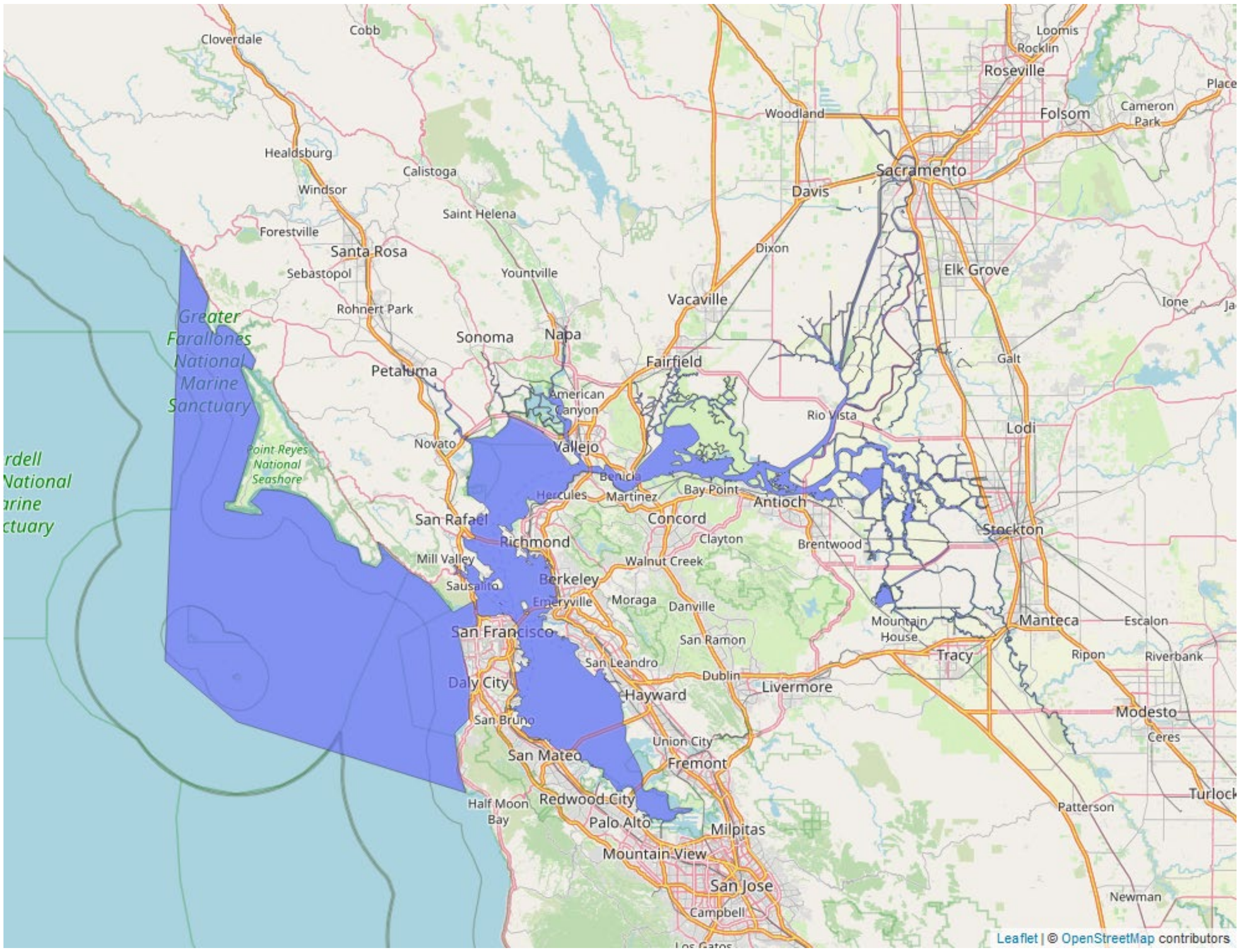


**Figure 16. Range map of longfin smelt (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/9011.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

### Summary of status

**Listing status:** Proposed Endangered

**Most recent 5-Year Review recommendation:**

**Most recently completed 5-Year Review:**

**Distribution:** Species/Populations widespread or wide-ranging

**Number of populations:** Single population

**Species trends:** Declining population(s) - one or more populations declining

**Pesticides noted in Service documents as a threat to the species:** yes

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

The longfin smelt is found along the Pacific coastline from California to Alaska, USA. The Bay-Delta population (DPS) has experienced declines since the 1980s. Relative abundance indices for longfin smelt have generally declined further since 2004 (abundance has been very low since 2000). The primary threat to the Bay-Delta longfin smelt is reduced freshwater flows. In the Bay-Delta, freshwater flow is strongly related to the natural hydrologic cycles of drought and flood. As California's population has grown, demands for reliable water supplies and flood protection have grown. In response, local, state, and federal agencies have built dams and canals and captured water in reservoirs to increase capacity for water storage and conveyance, resulting in one of the largest anthropogenic water systems in the world (Nichols et al. 1986, p. 569). Operation of this system has altered the seasonal pattern of freshwater flows in the Bay-Delta. Storage in the upper watershed of peak runoff and release of the captured water for irrigation and urban needs during subsequent low flow periods result in a broader, flatter hydrograph with less seasonal variability in freshwater flows into the estuary (Kimmerer 2004, p. 15). In addition to the system of dams and canals built throughout the Sacramento and San Joaquin River basins, the Bay-Delta is unique in having the largest water diversion system on the west coast. The State Water Project and Central Valley Project each operate two water export facilities in the Delta (Kimmerer and Nobriga 2008, p. 2). In total, an estimated 39% of the estuary's unimpaired flow is consumed upstream or diverted from the estuary (Cloern and Jassby 2012, p. 8). Water operations are regulated in part by the California State Water Resources Control Board according to the Water Quality Control Plan (SWRCB 2000, entire). The Water Quality Control Plan limits Delta water exports in relation to Delta (the Export/Inflow, or E/I ratio). Operations are also regulated by both our and National Marine Fisheries Service 's current Biological Opinions for the long-term operation of the State Water Project and Central Valley Project (USFWS 2008, NMFS 2009). These restrictions are also thought to provide protections for longfin smelt.

Additionally, the State of California has been experiencing drought conditions which further decreased freshwater flows. Physiological stress from warm water temperatures and additional related impacts may occur through changes in the availability and distribution of habitat. These habitat impacts may occur as a result of (1) changes in the timing and availability of freshwater flow into the estuary due to reduced snowpack and earlier melting of the snowpack; (2) sea level rise and saltwater intrusion into the estuary; (3) effects associated with increased water temperatures; and (4) effects related to changes in frequency and intensity of storms, floods, and droughts. Channel maintenance dredging in the Bay-Delta is an ongoing periodic disturbance of longfin smelt habitat. Dredging and other channel disturbances potentially degrade or remove spawning habitat and suction dredging can entrain fish and eggs. Other factors affecting the continued existence of the Bay-Delta Distinct Population Segment (DPS) of longfin smelt are entrainment losses due to water diversions, food web changes caused by introduced species and contaminants, and possibly, physiological or behavioral impairment from contaminants.

There are several examples of pesticides issues that have been recognized. In 2014, over 21 million pounds of pesticides were applied within the five-county Bay-Delta area, and Bay-Delta waters are listed under the Clean Water Act section 303(d) as impaired for several legacy and currently used pesticides (California Department of Pesticide Regulation 2016, p. 1). Contaminants have been identified in the delta, including high ammonium concentrations and other pesticides. Concentrations of dissolved pesticides vary in the Delta both temporally and spatially (Kuivila 1999, entire). For example, several areas of the Delta, particularly the San Joaquin River and its tributaries, and the tributaries of the Yolo Bypass, are impaired due to elevated levels of diazinon and chlorpyrifos, which are toxic to some aquatic organisms at low concentrations (MacCoy et al. 1995, pp. 21–30). The effects to longfin smelt can be direct or indirect (effects that reduce the food supply of the longfin smelt). Pyrethroid insecticides are of particular concern because of their widespread use, and their tendency to be genotoxic (DNA damaging) to fishes at low doses (in the range of micrograms per liter) (Campana et al. 1999, p. 159). In addition, pyrethroids may interfere with nerve cell function, which could eventually result in paralysis (Bradbury and Coats 1989, pp.377–378; Shafer and Meyer 2004, pp. 304–305). Indirect effects to longfin smelt through the food web have been documented. Additionally, complex mixtures of contaminants spanning many different classes can be common in regions heavily influenced by agricultural or urban environments. The threats discussed above are ongoing and likely to continue into the future.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 19.5% of the species range will contain use sites (Table 37).

**Table 37. Overlap data for the longfin smelt. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) |
|---|---|
| Alfalfa | 3 |
| Citrus | <0.1 |
| **Corn**[17] | 2.1 |
| Cotton | <0.1 |
| Other Grains | 2.4 |
| **Other Orchards**[18] | 5.7 |
| Other Row Crops | 1.2 |
| Soybeans | <0.1 |
| Vegetables and Ground Fruit | 2.7 |
| Wheat | 2.6 |
| **Total** | **19.5** |

**Usage**

Mandatory reporting data from the state of California indicates that, between 2012-2019, the maximum yearly overlap between the species' range and agricultural areas reporting any pesticide usage was 25.3%. Of those areas reporting pesticide usage, up to 16.8% reported use on any insecticide. Based on this reporting data, we expect 1.4% of the species' range is likely to be treated with methomyl, specifically (Table 38).

**Table 38. Overlap between areas treated with any pesticide, any insecticide, and methomyl with the longfin smelt's range as reported by the California Department of Pesticide Regulation.**

| % range treated with all pesticides | % range treated with all insecticides | % range treated with methomyl |
|---|---|---|
| 25.3 | 16.8 | 1.4 |

[17] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

[18] We expect 'other orchards' and 'citrus' use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

**Exposure Summary**

There is a high extent of overlap between the action area and the species' range. Based on past usage data, we expect a low level of usage within the species' range. The past usage data comes from the California Department of Pesticide Regulation, which mandates reporting and presents usage data at fine spatial scales, which gives us high confidence in the usage assessment for this species. Thus, given that the California-specific data reports very little methomyl usage within the species' range in the past, we have higher confidence that usage is low. As such, we expect only a small number of individuals are likely to experience exposure to methomyl from the proposed action.

**Overall Exposure:** Low

**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 39the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations of methomyl within the longfin smelt's habitat can reach up to 19.57 µg/L (Table 39). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies. Based on available toxicity data in fish, we do not expect any exposed individuals will experience any mortality or sublethal adverse effects (e.g., reduced growth or reduced reproduction).

**Table 39. Predicted environmental concentrations of methomyl within the longfin smelt's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 18a | 19.57 | 0 |
| High flow waterbodies | HUC 18b | 15.44 | 0 |
| Large volume waterbodies | HUC 18a | 11.41 | 0 |
| Large volume waterbodies | HUC 18b | 10.55 | 0 |

**Indirect Effects:**

The longfin smelt primarily consumes small crustaceans, such as copepods and mysid shrimp. Available toxicity data indicate that invertebrate species, particularly arthropods, are sensitive to methomyl and are likely to die with exposure to methomyl at the predicted environmental concentrations. However, we do not anticipate all arthropod species will be equally sensitive to methomyl exposure as natural variations in species' physiologies and behaviors will result in different responses to methomyl exposure. Since the longfin smelt is an invertebrate generalist that can consume a wide range of invertebrate prey, we anticipate individuals will still have some food resources available despite a reduction in the abundance of sensitive species. As such, we anticipate there will likely be some food resources available to individuals even if there is a reduction in the availability of sensitive prey species. Therefore, we expect no more than low levels of adverse indirect effects in the form of lost prey resources.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats where the longfin smelt is found, we expect no mortality or sublethal effects are likely. While the longfin smelt's primary food source is highly susceptible to methomyl exposure, as an invertebrate generalist, we anticipate some food resources in the form of less sensitive invertebrate species are likely to still remain after methomyl exposure. Thus, we anticipate only low levels of indirect effect are likely. As such, we determine the species has a low toxicity ranking based on indirect effects alone.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The longfin smelt has a low exposure ranking. Mandatory pesticide usage reporting data from the state of California indicate that only a small portion of the species' range is likely to be treated with methomyl (up to 1.4% range treated annually in the past). As such, we expect only a small number of individuals are likely to experience any exposure to methomyl.

The longfin smelt has a low toxicity ranking. We do not expect any mortality or sublethal effects to growth and reproduction are likely at predicted environmental concentrations of methomyl. Similarly, while we anticipate there will be large reductions in the abundance of sensitive prey species, we do not anticipate the entire invertebrate prey community will die and that there will still be sufficient food resources available for individuals to use after methomyl exposure.

Given that we anticipate only a small number of individuals are likely to be exposed to methomyl and that there will be a low level of direct and indirect adverse effects to exposed individuals, we anticipate only a small number of individuals will experience adverse effects from the proposed action. Therefore, we determine the overall risk of adverse effects to the species is low.

## Conclusion

The longfin smelt is a proposed endangered species that inhabits estuarine and coastal ecosystems, with a significant presence in the San Francisco Bay-Delta. Despite its declining population and sensitivity to environmental changes, the species remains highly adaptive within its habitat. Methomyl usage within the species' range is minimal, and the overall risk of adverse effects is low. This, along with California's mandatory pesticide reporting and conservation measures, significantly reduces the potential for pesticide exposure from agricultural activities. Considering these factors and the limited direct toxicity of methomyl, we anticipate no direct mortality or sublethal effects and only localized, minor indirect effects through reductions in the abundance of sensitive prey species. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the longfin smelt in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the longfin smelt.

## References

U.S. Fish and Wildlife Service. 2016. Species Assessment Form for the *Spirinchus thaleichthys* (San Francisco Bay delta population).

# Integration and Synthesis Summary: Peppered chub

| Scientific Name: | Common Name: | Entity ID: |
|---|---|---|
| *Macrhybopsis tetranema* | Peppered chub | 4243 |

## Species Overview

In reviewing the status of the peppered chub, alongside the environmental baseline and cumulative effects within the action area, we determined that the species' vulnerability is high. Although there is a high overlap of the action area with the species' range, past usage of methomyl within the species' range has been low, indicating a medium extent of exposure. Exposed individuals are unlikely to experience significant mortality or sublethal effects but may face low levels of indirect effects, primarily through reductions in the availability of sensitive invertebrate prey species. Given that exposure is medium and indirect effects are low, we assess the risk of adverse effects to the species as low. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not likely to appreciably reduce the survival and recovery of the peppered chub in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the peppered chub. We discuss our rationale for this conclusion for the species in the sections below.

**.Species range**

Based on range map dated: 12/20/2023; Wherever found; *States within the range:* KS, NM, OK, TX

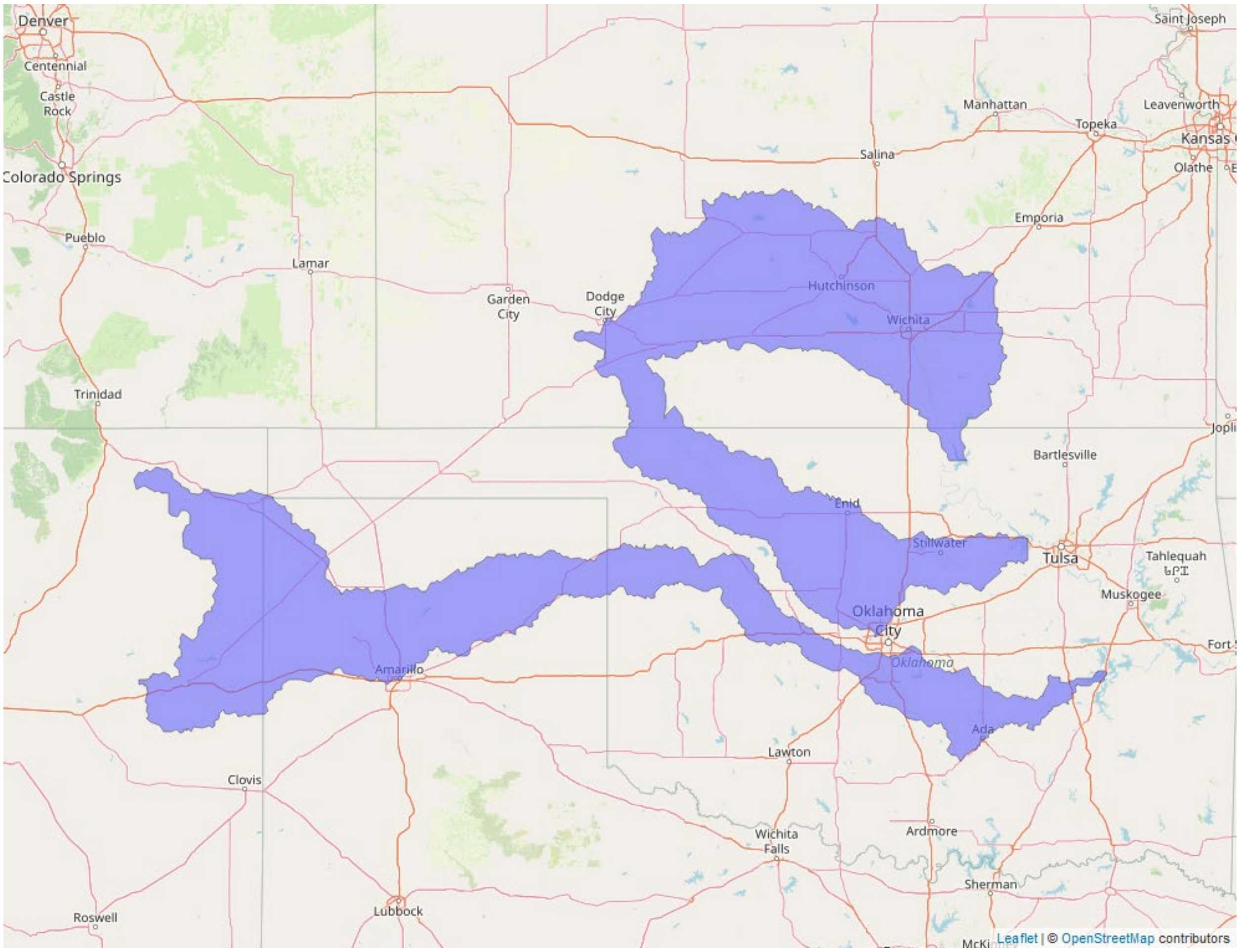


**Figure 17. Range map of Peppered chub (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/532.**

## Vulnerability

As mentioned above, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

**Summary of status**

**Listing status:** Endangered

**Most recent 5-Year Review recommendation:** N/A

**Most recently completed 5-Year Review:** N/A

**Distribution:** Small, endemic, constrained, and/or isolated population(s)

**Number of populations:** Single population

**Species trends:** Declining population

**Pesticides noted in Service documents as a threat to the species:** Yes

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

The peppered chub (*Macrhybopsis tetranema*) is restricted primarily to the contiguous river segments of the South Canadian River basin spanning eastern New Mexico downstream to eastern Oklahoma (although the peppered chub is less widespread). Only a single functioning population exists between the Ute Dam, New Mexico and Lake Meredith, Texas. Distribution has significantly declined in the last 25 years and recent surveys in the Ninnescah River in Kansas have not resulted in peppered chubs. Habitat for the peppered chub consisted historically of the main channels of wide, shallow, sandy bottomed rivers and larger streams of the Arkansas River basin. The species appeared more adapted for headwater areas, and they have adaptations to tolerate drought conditions (e.g., elevated temperatures, low dissolved oxygen) common in the streams they inhabit. Adults prefer shallow channels where currents flow over clean fine sand, and generally avoid calm waters and silted stream bottoms. Peppered chubs appear associated with turbid water. Peppered chubs need a minimum length (135 miles) of unimpounded and connected river for long-term successful reproduction. Peppered chubs are generalist feeders that feed aggressively on larval insects, small crustaceans, immature aquatic insects, and plant material to fuel rapid growth. Peppered chubs have evolved for feeding in highly turbid streams. Peppered chubs have barbels, large olfactory lamellae, and taste buds covering their bodies, including their eyes, that help them find prey in turbid waters where sight feeding is difficult (USFWS 2018).

The peppered chub has experienced substantial declines in distribution and abundance due to habitat destruction and modification from stream dewatering or depletion from diversion of surface water and groundwater pumping, construction of impoundments, and water quality degradation. Current threats include altered flow regimes, including impoundments, groundwater losses, and impacts of climate change; stream fragmentation; modified geomorphology; decreased water quality; introduction of invasive species; and the physical removal of fish or direct mortality.

**Overall Vulnerability:** High

## Effects of the Action: Exposure

### Overlap

We do not expect listed fish species will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this would not functionally change the expected exposures that listed aquatic species are likely to experience. We expect up to 17.3% of the species range will contain use sites (Table 40).

**Usage**

Past usage data indicate that up to 4.2% of the species' range has been treated with methomyl annually (Table 40).

**Table 40. Overlap data for the peppered chub. Where specific crops are not registered for methomyl use in a state where the species is found, rows are designated as NA (not applicable).**

| Use Layer | Use Site Overlap (% range) | % Range Treated (On-field) |
|---|---:|---:|
| Alfalfa | 1.4 | 0.1 |
| Citrus | NA | NA |
| **Corn**[19] | 5.9 | 1.4 |
| Cotton | 1.1 | 0.9 |
| Other Grains | 8.7 | 1.5 |
| Other Orchards | <0.1 | <0.1 |
| Other Row Crops | <0.1 | 0.1 |
| Soybeans | 5.8 | 0.9 |
| Vegetables and Ground Fruit | 0.1 | <0.1 |
| Wheat | NA | NA |
| **Total** | **17.3** | **4.2** |

**Additional Exposure Considerations**

Peppered chub broadcast spawn semi buoyant eggs, which are kept suspended until hatching in flowing water. This reproductive strategy appears to be an adaptation to highly variable environments where stream flows are unpredictable and suspended sediments and shifting sand can cover eggs laid in nests or crevices. Without stream flow, eggs sink to the bottom where they may be covered with silt and die. After hatching, adequate stream length likewise provides the extended flow time needed by larval fish, which may require strong currents to keep them

[19] We expect corn and soybean use sites are highly redundant with each other and only use the higher of the two layers in our calculation of total percent overlap and total percent treated range.

suspended in the water column until they are capable of horizontal movement and strong enough to leave the main channel. At about 10 days old, they begin to forage among sediments on the river bottom. They also sometimes rise to the top and hit the surface to dislodge food (held by surface tension).

**Exposure Summary**

There is a high extent of overlap between the species' range and the action area (17.3% of the species' range). There is a low level of past methomyl usage within the species' range (up to 4.2% of the range treated annually). While there is a low level of usage anticipated, we expect a moderate number of individuals are likely to be exposed over the duration of the proposed action given that there is a high extent of overlap. As such, the species' exposure ranking is medium.

**Overall Exposure Ranking:** Medium

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**Conservation Measures:**
**Rain restriction:** The methomyl label has language designed to reduce the likelihood of pesticide runoff from use sites which is the following: "Do not apply during rain. Do not apply when soil in the area to be treated is saturated (if there is standing water on the field or if water can be squeezed from soil) or if NOAA/National Weather Service predicts a total rainfall of 1 inch or greater over the 48 hours following the day of application, only considering a 48-hour period when, at any point during the 48-hour period, the precipitation potential is 50% or greater. Detailed National Weather Service forecasts for local weather conditions should be obtained on-line at: www.weather.gov or by contacting your local National Weather Service Forecasting Office." This rain restriction language provides for a reduction in the concentration of methomyl in aquatic habitats by providing time for methomyl to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk. Thus, we provide in Table 41 the maximum predicted EEC from the highest overlap use site within the species range to illustrate the resulting concentrations of methomyl in the aquatic habitats where this species is found as a result of this rain restriction measure.

**Aquatic habitat buffers:** The methomyl label also has language to reduce the likelihood of pesticide spray drift from use sites specifically to nearby aquatic habitats. The label language states "Do not apply by ground equipment within 25 feet, or by air within 100 feet, of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds".

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## Effects of the Action: Toxicity

**Direct Effects:**

Maximum predicted environmental concentrations or methomyl within the Arkansas River shiner's habitat can reach up to 309.6 µg/L (Table 41). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies . Based on available toxicity data in fish species, we anticipate this range of exposure concentrations will cause mortality in up to 4% of exposed individuals. However, this level of mortality is only associated with low flow or low water volume habitats within one particular region of the species' range (i.e., HUC 11a). Available life history data indicate that the species typically inhabits the main channels of wide, shallow, sandy bottom rivers and larger streams and generally avoid calm waters. As such, we expect individuals will more typically inhabit areas that will only accumulate low levels of methomyl, where only 0.49% of exposed individuals will likely experience mortality. We do not anticipate any sublethal adverse effects (e.g., reduced growth or reproduction) will occur.

**Table 41. Predicted environmental concentrations of methomyl within the peppered chub's habitat and the associated level of mortality expected to occur with exposure.**

| Aquatic Habitat Bin | HUC 2 Region | Max EEC (µg/L) | Percent fish mortality |
|---|---|---:|---:|
| High flow waterbodies | HUC 11a | 18.86 | 0.00 |
| High flow waterbodies | HUC 11b | 22.68 | 0.00 |
| High flow waterbodies | HUC 12b | 17.57 | 0.00 |
| High flow waterbodies | HUC 13 | 11.67 | 0.00 |
| Low flow/Low volume waterbodies | HUC 11a | 309.60 | 0.49 |
| Low flow/Low volume waterbodies | HUC 11b | 475.20 | 4.06 |
| Low flow/Low volume waterbodies | HUC 12b | 148.50 | 0.00 |
| Low flow/Low volume waterbodies | HUC 13 | 257.40 | 0.16 |

**Indirect Effects:**

The peppered chub primarily consumes invertebrate prey, including larval insects, small crustaceans, immature aquatic insects, in addition to plant material. The species forages by taking in large quantities of sand into the mouth and sorting for any food while ejecting sand from its mouth and gills, suggesting that the species is a generalist feeder and is not particularly reliant on any specific invertebrate species. While available toxicity data indicate that invertebrate species are generally sensitive to methomyl, we do not expect all invertebrate species will experience the same level of adverse effects. As such, we anticipate the abundance of some invertebrate species will be reduced while other species may not exhibit a reduction in abundance. While there will be reductions in the availability of some prey species, we anticipate sufficient food resources in the form of other prey species that are less sensitive to methomyl exposure will be present for individuals. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of adverse indirect effect to the peppered chub.

**Toxicity Summary**

Based on the predicted environmental concentrations of methomyl within the aquatic habitats that the peppered chub is found in (e.g., areas of high flow), we do not anticipate any mortality or sublethal adverse effects to growth or reproduction will occur. Given that the species can rely on a wide variety of invertebrate prey (in addition to plant matter) as food resources, we expect individuals can rely on different food resources when methomyl exposure reduces the availability of sensitive prey species, indicating that the species is only likely to experience low levels of indirect adverse effects. As such, we anticipate the species will has a low toxicity ranking.

**Overall Toxicity Ranking:** Low

## Effects of the Action Summary

The peppered chub has a medium exposure ranking. While there is a low level of past methomyl usage within the species' range, the high extent of overlap suggests that a moderate number of individuals are likely to be exposed over the duration of the proposed action, particularly if the areas treated change each year. The peppered chub has a low toxicity ranking as we anticipate very few exposed individuals will die or experience sublethal adverse effects to growth or reproduction at estimated environmental concentrations, particularly in the specific habitats that the species prefers (e.g., high flow areas). While there may be some prey loss from methomyl exposure, we anticipate the species will have sufficient alternative food resources available as the peppered chub can consume a wide diversity of invertebrate prey (as well as plant matter), indicating only low levels of indirect adverse effects are likely. As such, we expect the overall risk of adverse effects to the species is low.

## Conclusion

The endangered peppered chub inhabits a highly dynamic and specialized habitat within the South Canadian River basin, spanning New Mexico, Texas, and Oklahoma. This species relies on long stretches of flowing rivers with sandy substrates and high turbidity, which provide necessary conditions for feeding, reproduction, and survival. Although the peppered chub's range has significantly declined, the remaining population persists in a single contiguous river segment. Despite the species' high vulnerability due to restricted range, habitat fragmentation, and declining population trends, the overall risk of adverse effects from methomyl usage is low. Methomyl usage within the species' range has been limited, with an estimated 4.2% of the range treated annually. The predicted environmental concentrations of methomyl indicate a low likelihood of mortality or sublethal effects, particularly in high-flow areas where the species is most likely to occur. Mortality estimates for individuals exposed in high-flow habitats are less than 0.5%, and indirect effects due to reductions in prey species are expected to be minor, given the peppered chub's dietary flexibility and ability to utilize alternative prey sources. Considering these factors and the species' adaptive traits, we anticipate only localized, minor adverse effects. After incorporating conservation measures into the effects of the action, adding cumulative effects to the environmental baseline, and in light of the status of the species, we conclude that the proposed action is not likely to appreciably reduce the survival and recovery of the peppered chub in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the peppered chub.

## References

U.S. Fish and Wildlife Service. 2018. Species status assessment report for the Arkansas River shiner (*Notropis girardi*) and peppered chub (*Macrhybopsis tetranema*), Version 1.0. Albuquerque, New Mexico. 172 pp.