# Critical Habitat Determinations and Rationales

## Introduction

Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR 402.02). While there are general physical and biological features (PBFs) that serve as the basis for all critical habitat designations, many critical habitat rules list specific PBFs related to the habitat needs of the species. In this assessment, when critical habitat rules did not list specific PBFs (primarily older critical habitat rules), we reviewed available information about the species' biology and habitat requirements to determine if features essential to the conservation value of the critical habitat for the species would be affected by the proposed action. We also reviewed other sections of the critical habitat rules, such as descriptions of special management considerations or protection and the application of the destruction or adverse modification standards for section 7(a)(2) consultations, to determine if these sections included information relevant to the effects of the Action on critical habitat.

### Methodology

We assessed whether the registration of carbaryl is likely to appreciably reduce the conservation value of designated critical habitat. Critical habitat designation rules have included a variety of terms, such as "physical or biological features" (PBFs), "primary constituent elements" (PCEs), or "essential features" to characterize the key components of critical habitat essential for the conservation of the listed species. Our analytical approach is the same regardless of whether the original critical habitat designation identified PCEs, PBFs or essential features. For those reasons, in this Opinion, we broadly use the term PBFs when referring to the key components of critical habitat that are described as essential for the conservation of the listed species in critical habitat designations as a standardized way to cover all features described by these terms.

We used information related to the PBFs to categorize the critical habitats and frame our critical habitat effects analyses. We identified four types of PBFs that would be susceptible to the effects of carbaryl, specifically, those related to: (1) water quality, (2) arthropods as prey, pollinators, or seed dispersers, (3) non-arthropods, including prey, pollinators/seed dispersers and host fish, and (4) general habitat function requiring no or low levels of chemical contaminants. These types of PBFs are described in more detail in the "Critical Habitat Approach to the Assessment" section of the Opinion and are collectively referred to herein as the "relevant PBFs." We reviewed each critical habitat rule to determine if PBFs related to one or more of these factors is listed or discussed, and identified comparable habitat features, where applicable, for those critical habitats with rules that do not include specific PBFs. We then categorized designated critical habitats into two groups:

- Critical habitats that have specified PBFs, but not one of the four relevant types of PBFs that we anticipate would be affected by carbaryl (e.g., PBFs that are not arthropods as

prey or pollinators, non-arthropod as prey or hosts, water quality, or general habitat function).
- Critical habitats that have relevant types of PBFs (whether explicitly outlined or inferred and assigned by our review of the critical habitat designation) that we anticipate would be affected by carbaryl.

In cases where there were no relevant PBFs, we could not link the consequences of the proposed action to the PBFs of the critical habitat, including elements of the habitat that require special management considerations or protection and considerations when applying the adverse modification standard. Thus, based on the rationale that none of the essential features of the critical habitat would be affected by the proposed action, we determined that the proposed action was not likely to destroy or adversely modify critical habitats that fell into this category.

In cases where we identified relevant PBFs that we anticipate would be affected by carbaryl, we continued our assessment of the consequences of the proposed action by evaluating the extent to which the critical habitat will be exposed to carbaryl, the degree of anticipated adverse effects to the PBF(s), and anticipated effects on the critical habitat as a whole.

**Exposure to Agricultural Uses**

We characterize the expected level of exposure from agricultural uses of carbaryl using overlap data (including on- and off-field overlap), past carbaryl usage data, including EPA's State Use and Usage Matrix (SUUM), USDA's Census of Agriculture (CoA), and the California Department of Pesticide Regulation's Pesticide Use Report (CalPUR), and any species-specific considerations such as life history information (e.g., habitat preferences, dispersal behavior) and existing protections or conservation actions. Critical habitats with greater than 10% total overlap with carbaryl use sites and off-site transport areas are assigned a high overlap score, critical habitats with 5-10% overlap are assigned a medium overlap score, and critical habitats with less than 5% total overlap are assigned a low overlap score. In addition to overlaps with carbaryl agricultural use sites, we considered past carbaryl usage within critical habitat (as informed by the SUUM) to determine the proportion of critical habitat we expect to be treated with carbaryl each year of the proposed action. For critical habitats occurring in California, we replace the SUUM usage data with CalPUR data as this data is spatially specific and likely a more accurate description of potential agricultural exposure. Critical habitats that usage data indicate will have a large portion of their range (>10%) treated with carbaryl each year are assigned a high usage score. Critical habitats that will have a medium proportion (5-10%) treated with carbaryl each year are assigned a medium usage score, and critical habitats that data indicate will have a low proportion (<5%) treated with carbaryl each year are assigned a low usage score.

Past usage data for carbaryl is not available for critical habitats located on Pacific or Caribbean islands including Hawaiʻi or Puerto Rico. Thus, in the absence of any additional exposure considerations for these species, our exposure assessment is based on total overlap of carbaryl use sites for critical habitats that occur in these areas. If any additional considerations are available, we qualitatively describe how those considerations influence the overall level of exposure.

**Exposure to Non-Agricultural Uses**

Carbaryl has several registered non-agricultural uses, including use sites within developed, open space developed, nurseries, rangeland, managed forests, and rights of way Use Data Layers (UDLs). In many cases, data provided by EPA indicate low to high levels of overlap between species' ranges and non-agricultural UDLs. However, UDLs for non-agricultural uses tend to be less defined than those for agricultural UDLs and may not accurately represent the actual footprint of these use sites on the landscape. As such, we assess exposure of critical habitat to non-agricultural uses of carbaryl in a qualitative manner, considering the life history of species and relationship to the PBFs, methods of application, carbaryl usage, and any existing conservation measures to reduce drift and runoff or otherwise limit exposure to critical habitat. To facilitate this analysis, for every critical habitat in this Appendix, we reviewed species' documents (e.g., 5-Year Reviews, recovery plans, listing rules) to determine if the critical habitat and its PBFs could occur in non-agricultural carbaryl use sites (i.e., managed forests, rights of way, developed, open space developed, nurseries, or rangelands) and the importance of these sites to the overall function of the PBFs and critical habitat.

For most critical habitats, we anticipate that non-agricultural uses will not meaningfully add to the overall level of anticipated exposure considered in our analysis of agricultural uses and discuss each use in more detail in the *Overall Considerations for the Opinion* section. Briefly, we expect critical habitats are generally not likely to be exposed to non-agricultural uses of carbaryl due to low levels of past usage or existing mitigation measures that are protective of listed species that are also expected to protect the recovery function of their corresponding critical habitat. Usage data summarized by the EPA indicate that all non-agricultural UDLs have very low levels of past usage (at most 2.5% treatable areas treated with carbaryl annually). Some use patterns, like rights of way, have particularly low usage, with less than 500 lbs. of carbaryl applied nationally each year.

Additionally, based on application information, we anticipate carbaryl use in these UDLs is largely restricted to small application areas that are treated infrequently over long periods of time. Use patterns like forestry, rangeland, or rights of way may also be geographically restricted as available past usage data indicate carbaryl usage only occurs in certain areas of the country, such as the western conterminous United States. Available usage data from the U.S. Forest Service indicate that, over a five-year period (from 2016-2020), the Forest Service treated 322 acres of forests in California and 557 acres of forests across three Forest Service Regions (covering North Dakota, Montana, South Dakota, Idaho, Kansas, Nebraska, Colorado, Wyoming, Utah, and Nevada), with the majority of applications taking place in small areas (less than 1 acre in size). Similarly, usage data from the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) show limited past carbaryl usage as well. From 2019-2023, APHIS treated 92,309 acres of rangeland in seven states (Arizona, Idaho, Montana, Nevada, Utah, Washington, Wyoming) and 25 counties. While this represents a large area overall, when distributed across the areas within the seven states where usage occurs, we anticipate only a small percentage of any species' range is likely to be treated for this use pattern. Additionally, all but one of these applications were made using carbaryl bait, which we expect has a much lower risk profile as bait applications are not likely to cause off target exposures as there is no spray drift or contact exposure likely to occur.

Additionally, there are several existing conservation and mitigation measures for non-agricultural uses of carbaryl that will reduce the likelihood of exposure to critical habitat. For example, from the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, most residential treatments are limited to spot treatments (defined as a 2 $ft^2$ area), crack-and-crevice treatment, or narrow perimeter bands around urban structures (from 1 inch to 6 feet). This limitation in application method renders off-site spray drift unlikely and greatly reduces the areal extent that can be treated on many use sites within the developed, open space developed, and nurseries UDLs. Similarly, we anticipate all rangeland applications of carbaryl will be carried out in association with USDA APHIS as part of their grasshopper and Mormon cricket suppression program (USFWS 2024), which include many conservation measures that are meant to protect listed species and their critical habitats from exposure. Examples of measures include a reduced agent area treatment strategy that minimizes the amount of pesticide applied within a treatment block, allowance of only one application per year, reduced application rates, minimized treatment area size within 500 feet and 1,000 feet from listed species ranges for ground and aerial applications, respectively, and extended application buffers when applications are made near the listed species' habitat (e.g., up to 750 feet for some ground applications and up to a mile for some aerial applications).

To assess the likelihood of exposure to non-agricultural uses of carbaryl, we conducted a habitat assessment for each listed species, incorporating available information regarding habitat preferences and requirements, relevant life history traits or behaviors, as well as relevant available usage data (summarized above). For species whose critical habitat is known or presumed to include non-agricultural use sites, we consider, individually and qualitatively, the extent and manner of non-agricultural carbaryl usage within critical habitat to determine whether a small, moderate, or large portion of critical habitat is likely to be exposed and the expected level of adverse effect from non-agricultural exposure of carbaryl.

**Toxicity**

We characterize the expected impacts to critical habitats based on the anticipated level of adverse effects to PBFs. Our analysis of toxicity assumes critical habitats are exposed to carbaryl 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. We consider estimated concentrations of carbaryl on the landscape or within the environment and effects reported in available toxicity studies of various taxa of organisms to determine the level of impact to relevant PBFs. We also include any additional considerations regarding a listed species' life history that provides additional context to the specific parameters that PBFs need to meet to maintain their function (e.g., how sensitive a listed species is to carbaryl may influence the level of impact to a water quality PBF relative to another species). We score the expected impact to each PBF by considering both the expected impact as informed by reference toxicity data and additional effect considerations and assign each relevant PBF a score of high, medium, or low.

**Additional Considerations**

The general framework for our critical habitat analysis is largely similar to our analysis for listed species. However, the nature of critical habitat results in some inherent differences and notable trends that we think are worth bringing to the readers' attention. While overlap and usage metrics are derived using the same data sources as for species ranges, we tend to see higher levels of overlap and usage, which is likely a result of the small size of designated critical habitat units relative to the species range. For instance, we observed that the percent critical habitat likely to be treated each year is the same as the total overlap for critical habitats where we used SUUM data to characterize past levels of usage. This is in contrast to results seen in our analysis of listed species where the past level of usage typically indicates that a portion of the range smaller than the total overlap is likely to be treated each year.

Similar to the analyses for listed species, for critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

## Conclusion

To determine the overall impact of the proposed action to designated critical habitat, we assessed the impact score of each relevant PBF alongside the exposure ranking to determine both the overall adverse effect of carbaryl exposure and the footprint of the anticipated adverse effect across the entire critical habitat.

In our analysis below, some critical habitats that had the same or very similar rationales for their conclusion were grouped together to increase efficiency and avoid repetition. Relevant information and data unique to each individual species and critical habitat was considered when assigning critical habitats to groups and incorporated into the rationales as appropriate. Species- and critical habitat-specific information (e.g., environmental baseline, cumulative effects, status of the species, exposure, and toxicity) for all critical habitats, including those in the grouped analyses, are included in Appendices B and E. Critical habitats with rationales that did not fit in a group, or warranted a separate rationale, have an individual discussion. To be clear, we conducted a critical habitat-specific analysis for each critical habitat as part of this formal consultation (considering the status of the species, environmental baseline, cumulative effects, and effects of the action, for each species, as explained further in Appendices B and E); our process and analysis for each critical habitat remained the same, regardless of the format of the discussion presented below (i.e., a grouped or individual discussion).

## Critical Habitats with No Relevant PBFs

Our review found no relevant PBFs for the designated critical habitats listed in Table 1. Given that there is no link between carbaryl exposure to any impacts to critical habitat function as defined by the relevant PBFs, we determine that the proposed action will not cause destruction or adverse modification to the critical habitats listed in Table 1.

**Table 1. Summary of critical habitats with no relevant PBFs listed in their critical habitat designation.**

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Amphibians | *Ambystoma californiense* | California tiger salamander | No Destruction or Adverse Modification |
| Amphibians | *Plethodon neomexicanus* | Jemez Mountains salamander | No Destruction or Adverse Modification |
| Amphibians | *Rana muscosa* | Mountain yellow-legged frog | No Destruction or Adverse Modification |
| Birds | *Eremophila alpestris strigata* | Streaked horned lark | No Destruction or Adverse Modification |
| Birds | *Pipilo crissalis eremophilus* | Inyo California towhee | No Destruction or Adverse Modification |
| Birds | *Polioptila californica californica* | Coastal California gnatcatcher | No Destruction or Adverse Modification |
| Birds | *Strix occidentalis caurina* | Northern spotted owl | No Destruction or Adverse Modification |
| Birds | *Strix occidentalis lucida* | Mexican spotted owl | No Destruction or Adverse Modification |
| Birds | *Vireo bellii pusillus* | Least Bell's vireo | No Destruction or Adverse Modification |
| Birds | *Zosterops rotensis* | Rota bridled white-eye | No Destruction or Adverse Modification |
| Crustaceans | *Palaemonias ganteri* | Kentucky cave shrimp | No Destruction or Adverse Modification |
| Ferns and Allies | *Trichomanes punctatum* ssp. *floridanum* | Florida bristle fern | No Destruction or Adverse Modification |
| Fishes | *Acipenser transmontanus* | White sturgeon | No Destruction or Adverse Modification |
| Fishes | *Etheostoma nianguae* | Niangua darter | No Destruction or Adverse Modification |
| Flowering Plants | *Abutilon eremitopetalum* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Acaena exigua* | Liliwai | No Destruction or Adverse Modification |

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| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Acanthomintha ilicifolia* | San Diego thornmint | No Destruction or Adverse Modification |
| Flowering Plants | *Agave eggersiana* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Allium munzii* | Munz's onion | No Destruction or Adverse Modification |
| Flowering Plants | *Ambrosia pumila* | San Diego ambrosia | No Destruction or Adverse Modification |
| Flowering Plants | *Amsinckia grandiflora* | Large-flowered fiddleneck | No Destruction or Adverse Modification |
| Flowering Plants | *Arabis georgiana* | Georgia rockcress | No Destruction or Adverse Modification |
| Flowering Plants | *Arenaria ursina* | Bear Valley sandwort | No Destruction or Adverse Modification |
| Flowering Plants | *Argyroxiphium kauense* | Mauna Loa (=Ka'u) silversword | No Destruction or Adverse Modification |
| Flowering Plants | *Asclepias welshii* | Welsh's milkweed | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus albens* | Cushenbury milk-vetch | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus brauntonii* | Braunton's milk-vetch | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus lentiginosus var. coachellae* | Coachella Valley milk-vetch | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus magdalenae var. peirsonii* | Peirson's milk-vetch | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus montii* | Heliotrope milk-vetch | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus phoenix* | Ash meadows milk-vetch | No Destruction or Adverse Modification |
| Flowering Plants | *Berberis nevinii* | Nevin's barberry | No Destruction or Adverse Modification |
| Flowering Plants | *Calamagrostis hillebrandii* | Hillebrand's reedgrass | No Destruction or Adverse Modification |
| Flowering Plants | *Carex lutea* | Golden sedge | No Destruction or Adverse Modification |
| Flowering Plants | *Carex specuicola* | Navajo sedge | No Destruction or Adverse Modification |
| Flowering Plants | *Castilleja campestris ssp. succulenta* | Fleshy owl's-clover | No Destruction or Adverse Modification |
| Flowering Plants | *Castilleja cinerea* | Ash-grey paintbrush | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Catesbaea melanocarpa* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Ceanothus ophiochilus* | Vail Lake ceanothus | No Destruction or Adverse Modification |
| Flowering Plants | *Cenchrus agrimonioides* | Kamanomano | No Destruction or Adverse Modification |
| Flowering Plants | *Centaurium namophilum* | Spring-loving centaury | No Destruction or Adverse Modification |
| Flowering Plants | *Chamaesyce hooveri* | Hoover's spurge | No Destruction or Adverse Modification |
| Flowering Plants | *Chromolaena frustrata* | Cape Sable Thoroughwort | No Destruction or Adverse Modification |
| Flowering Plants | *Clermontia pyrularia* | `Oha wai | No Destruction or Adverse Modification |
| Flowering Plants | *Cyanea magnicalyx* | haha | No Destruction or Adverse Modification |
| Flowering Plants | *Cyanea pinnatifida* | Haha | No Destruction or Adverse Modification |
| Flowering Plants | *Cyanea profuga* | Haha | No Destruction or Adverse Modification |
| Flowering Plants | *Cyanea shipmanii* | Haha | No Destruction or Adverse Modification |
| Flowering Plants | *Cyrtandra subumbellata* | Ha`iwale | No Destruction or Adverse Modification |
| Flowering Plants | *Cyrtandra waiolani* | Haiwale | No Destruction or Adverse Modification |
| Flowering Plants | *Deinandra increscens ssp. villosa* | Gaviota Tarplant | No Destruction or Adverse Modification |
| Flowering Plants | *Dubautia herbstobatae* | Na`ena`e | No Destruction or Adverse Modification |
| Flowering Plants | *Enceliopsis nudicaulis var. corrugata* | Ash Meadows sunray | No Destruction or Adverse Modification |
| Flowering Plants | *Eragrostis fosbergii* | Fosberg's love grass | No Destruction or Adverse Modification |
| Flowering Plants | *Erigeron decumbens* | Willamette daisy | No Destruction or Adverse Modification |
| Flowering Plants | *Erigeron parishii* | Parish's daisy | No Destruction or Adverse Modification |
| Flowering Plants | *Eriodictyon capitatum* | Lompoc yerba santa | No Destruction or Adverse Modification |
| Flowering Plants | *Eriogonum gypsophilum* | Gypsum wild-buckwheat | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Eriogonum kennedyi var. austromontanum* | Southern mountain wild-buckwheat | No Destruction or Adverse Modification |
| Flowering Plants | *Eriogonum ovalifolium var. vineum* | Cushenbury buckwheat | No Destruction or Adverse Modification |
| Flowering Plants | *Eriogonum pelinophilum* | Clay-Loving wild buckwheat | No Destruction or Adverse Modification |
| Flowering Plants | *Erysimum capitatum var. angustatum* | Contra Costa wallflower | No Destruction or Adverse Modification |
| Flowering Plants | *Euphorbia haeleeleana* | `Akoko | No Destruction or Adverse Modification |
| Flowering Plants | *Euphorbia skottsbergii var. skottsbergii* | `Akoko | No Destruction or Adverse Modification |
| Flowering Plants | *Festuca ligulata* | Guadalupe fescue | No Destruction or Adverse Modification |
| Flowering Plants | *Fremontodendron mexicanum* | Mexican flannelbush | No Destruction or Adverse Modification |
| Flowering Plants | *Gardenia mannii* | Nanu | No Destruction or Adverse Modification |
| Flowering Plants | *Geranium arboreum* | Nohoanu | No Destruction or Adverse Modification |
| Flowering Plants | *Geranium hillebrandii* | Nohoanu | No Destruction or Adverse Modification |
| Flowering Plants | *Gonocalyx concolor* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Gouania meyenii* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Grindelia fraxinipratensis* | Ash Meadows gumplant | No Destruction or Adverse Modification |
| Flowering Plants | *Hedeoma todsenii* | Todsen's pennyroyal | No Destruction or Adverse Modification |
| Flowering Plants | *Helianthus paradoxus* | Pecos (=puzzle, =paradox) sunflower | No Destruction or Adverse Modification |
| Flowering Plants | *Helianthus verticillatus* | Whorled Sunflower | No Destruction or Adverse Modification |
| Flowering Plants | *Hibiscus dasycalyx* | Neches River rose-mallow | No Destruction or Adverse Modification |
| Flowering Plants | *Hudsonia montana* | Mountain golden heather | No Destruction or Adverse Modification |
| Flowering Plants | *Ischaemum byrone* | Hilo ischaemum | No Destruction or Adverse Modification |
| Flowering Plants | *Isodendrion laurifolium* | Aupaka | No Destruction or Adverse Modification |

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| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Ivesia kingii var. eremica* | Ash Meadows ivesia | No Destruction or Adverse Modification |
| Flowering Plants | *Kadua coriacea* | Kio`ele | No Destruction or Adverse Modification |
| Flowering Plants | *Kadua degeneri* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Labordia triflora* | Kamakahala | No Destruction or Adverse Modification |
| Flowering Plants | *Lasthenia conjugens* | Contra Costa goldfields | No Destruction or Adverse Modification |
| Flowering Plants | *Leavenworthia crassa* | Fleshy-fruit gladecress | No Destruction or Adverse Modification |
| Flowering Plants | *Leavenworthia texana* | Texas golden Gladecress | No Destruction or Adverse Modification |
| Flowering Plants | *Lesquerella kingii ssp. bernardina* | San Bernardino Mountains bladderpod | No Destruction or Adverse Modification |
| Flowering Plants | *Lilaeopsis schaffneriana var. recurva* | Huachuca water-umbel | No Destruction or Adverse Modification |
| Flowering Plants | *Limnanthes floccosa ssp. californica* | Butte County meadowfoam | No Destruction or Adverse Modification |
| Flowering Plants | *Limnanthes pumila ssp. grandiflora* | Large-flowered woolly meadowfoam | No Destruction or Adverse Modification |
| Flowering Plants | *Lipochaeta fauriei* | nehe | No Destruction or Adverse Modification |
| Flowering Plants | *Lobelia monostachya* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Lomatium cookii* | Cook's lomatium | No Destruction or Adverse Modification |
| Flowering Plants | *Melanthera kamolensis* | nehe | No Destruction or Adverse Modification |
| Flowering Plants | *Melicope balloui* | Alani | No Destruction or Adverse Modification |
| Flowering Plants | *Melicope lydgatei* | Alani | No Destruction or Adverse Modification |
| Flowering Plants | *Mentzelia leucophylla* | Ash Meadows blazingstar | No Destruction or Adverse Modification |
| Flowering Plants | *Mezoneuron kavaiense* | Uhiuhi | No Destruction or Adverse Modification |
| Flowering Plants | *Myrsine linearifolia* | Kolea | No Destruction or Adverse Modification |
| Flowering Plants | *Navarretia fossalis* | Spreading navarretia | No Destruction or Adverse Modification |

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| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Neostapfia colusana* | Colusa grass | No Destruction or Adverse Modification |
| Flowering Plants | *Neraudia ovata* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Neraudia sericea* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Nitrophila mohavensis* | Amargosa niterwort | No Destruction or Adverse Modification |
| Flowering Plants | *Nototrichium humile* | Kulu`i | No Destruction or Adverse Modification |
| Flowering Plants | *Oenothera deltoides ssp. howellii* | Antioch Dunes evening-primrose | No Destruction or Adverse Modification |
| Flowering Plants | *Orcuttia inaequalis* | San Joaquin Valley Orcutt grass | No Destruction or Adverse Modification |
| Flowering Plants | *Orcuttia pilosa* | Hairy Orcutt grass | No Destruction or Adverse Modification |
| Flowering Plants | *Orcuttia tenuis* | Slender Orcutt grass | No Destruction or Adverse Modification |
| Flowering Plants | *Orcuttia viscida* | Sacramento Orcutt grass | No Destruction or Adverse Modification |
| Flowering Plants | *Oxytheca parishii var. goodmaniana* | Cushenbury oxytheca | No Destruction or Adverse Modification |
| Flowering Plants | *Packera franciscana* | San Francisco Peaks ragwort | No Destruction or Adverse Modification |
| Flowering Plants | *Pentachaeta lyonii* | Lyon's pentachaeta | No Destruction or Adverse Modification |
| Flowering Plants | *Phyllostegia pilosa* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Physaria globosa* | Short's bladderpod | No Destruction or Adverse Modification |
| Flowering Plants | *Physaria thamnophila* | Zapata bladderpod | No Destruction or Adverse Modification |
| Flowering Plants | *Poa atropurpurea* | San Bernardino bluegrass | No Destruction or Adverse Modification |
| Flowering Plants | *Remya mauiensis* | Maui remya | No Destruction or Adverse Modification |
| Flowering Plants | *Sanicula purpurea* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Schenkia sebaeoides* | Awiwi | No Destruction or Adverse Modification |
| Flowering Plants | *Schiedea haleakalensis* | No common name | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Schiedea hawaiiensis* | Ma`oli`oli | No Destruction or Adverse Modification |
| Flowering Plants | *Schiedea kealiae* | Ma`oli`oli | No Destruction or Adverse Modification |
| Flowering Plants | *Schiedea obovata* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Schiedea salicaria* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Schiedea sarmentosa* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Schiedea trinervis* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Sidalcea oregana var. calva* | Wenatchee Mountains checkermallow | No Destruction or Adverse Modification |
| Flowering Plants | *Silene alexandri* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Solanum sandwicense* | `Aiakeakua, popolo | No Destruction or Adverse Modification |
| Flowering Plants | *Stenogyne kanehoana* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Stenogyne kauaulaensis* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Stenogyne kealiae* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Stephanomeria malheurensis* | Malheur wire-lettuce | No Destruction or Adverse Modification |
| Flowering Plants | *Taraxacum californicum* | California taraxacum | No Destruction or Adverse Modification |
| Flowering Plants | *Tetramolopium arenarium* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Tetramolopium rockii* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Tuctoria greenei* | Greene's tuctoria | No Destruction or Adverse Modification |
| Flowering Plants | *Tuctoria mucronata* | Solano grass | No Destruction or Adverse Modification |
| Flowering Plants | *Urera kaalae* | Opuhe | No Destruction or Adverse Modification |
| Flowering Plants | *Varronia rupicola* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Vigna o-wahuensis* | No common name | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Flowering Plants | *Viola chamissoniana ssp. chamissoniana* | Pamakani | No Destruction or Adverse Modification |
| Flowering Plants | *Viola lanaiensis* | No common name | No Destruction or Adverse Modification |
| Flowering Plants | *Yermo xanthocephalus* | Desert yellowhead | No Destruction or Adverse Modification |
| Flowering Plants | *Zanthoxylum hawaiiense* | A`e | No Destruction or Adverse Modification |
| Insects | *Ambrysus amargosus* | Ash Meadows naucorid | No Destruction or Adverse Modification |
| Insects | *Dinacoma caseyi* | Casey's June Beetle | No Destruction or Adverse Modification |
| Insects | *Drosophila digressa* | Hawaiian picture-wing fly | No Destruction or Adverse Modification |
| Insects | *Elaphrus viridis* | Delta green ground beetle | No Destruction or Adverse Modification |
| Insects | *Trimerotropis infantilis* | Zayante band-winged grasshopper | No Destruction or Adverse Modification |
| Mammals | *Dipodomys merriami parvus* | San Bernardino Merriam's kangaroo rat | No Destruction or Adverse Modification |
| Mammals | *Dipodomys nitratoides exilis* | Fresno kangaroo rat | No Destruction or Adverse Modification |
| Mammals | *Lynx canadensis* | Canada Lynx | No Destruction or Adverse Modification |
| Mammals | *Microtus californicus scirpensis* | Amargosa vole | No Destruction or Adverse Modification |
| Mammals | *Oryzomys palustris natator* | Silver rice rat | No Destruction or Adverse Modification |
| Mammals | *Ovis canadensis nelsoni* | Peninsular bighorn sheep | No Destruction or Adverse Modification |
| Mammals | *Ovis canadensis sierrae* | Sierra Nevada bighorn sheep | No Destruction or Adverse Modification |
| Mammals | *Panthera onca* | Jaguar | No Destruction or Adverse Modification |
| Mammals | *Peromyscus polionotus allophrys* | Choctawhatchee beach mouse | No Destruction or Adverse Modification |
| Mammals | *Peromyscus polionotus ammobates* | Alabama beach mouse | No Destruction or Adverse Modification |
| Mammals | *Peromyscus polionotus peninsularis* | St. Andrew beach mouse | No Destruction or Adverse Modification |
| Mammals | *Peromyscus polionotus trissyllepsis* | Perdido Key beach mouse | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Mammals | *Rangifer tarandus ssp. caribou* | Southern Mountain Caribou DPS | No Destruction or Adverse Modification |
| Mammals | *Tamiasciurus fremonti grahamensis* | Mount Graham red squirrel | No Destruction or Adverse Modification |
| Mammals | *Thomomys mazama pugetensis* | Olympia pocket gopher | No Destruction or Adverse Modification |
| Mammals | *Thomomys mazama tumuli* | Tenino pocket gopher | No Destruction or Adverse Modification |
| Mammals | *Thomomys mazama yelmensis* | Yelm pocket gopher | No Destruction or Adverse Modification |
| Mammals | *Trichechus manatus* | West Indian Manatee | No Destruction or Adverse Modification |
| Mammals | *Ursus maritimus* | Polar bear | No Destruction or Adverse Modification |
| Mammals | *Zapus hudsonius preblei* | Preble's meadow jumping mouse | No Destruction or Adverse Modification |
| Reptiles | *Anolis roosevelti* | Culebra Island giant anole | No Destruction or Adverse Modification |
| Reptiles | *Chelonia mydas* | Green sea turtle | No Destruction or Adverse Modification |
| Reptiles | *Chelonia mydas* | Green sea turtle | No Destruction or Adverse Modification |
| Reptiles | *Chelonia mydas* | Green sea turtle | No Destruction or Adverse Modification |
| Reptiles | *Chelonia mydas* | Green sea turtle | No Destruction or Adverse Modification |
| Reptiles | *Uma inornata* | Coachella Valley fringe-toed lizard | No Destruction or Adverse Modification |

## Critical Habitats with Low Toxic Effects

The critical habitats in Table 2 are not likely to experience more than low levels of adverse effects to their PBFs. These include critical habitats designated for listed snail species and listed animal species (primarily insects) that only have plants as a necessary resource within critical habitat. Aside from the Morro shoulderband snail, all snail species in this group have one relevant PBF, which is water quality. The Morro shoulderband snail's only relevant PBF is habitat function as its critical habitat designation specifies a low level of chemical contaminants are required within designated units. Available toxicity data for mollusks indicate that snails are not sensitive to carbaryl and are not likely to experience any adverse effects to survival, growth, or reproduction at environmentally relevant concentrations. Therefore, we do not anticipate any level of carbaryl contamination in critical habitat resulting from the proposed action will result in more than low levels of water quality or general habitat function impairment for these listed snail species.

Similarly, the critical habitat designated for listed insect species in Table 2 (with the exception of the Hawaiian blackline damselfly) have only one relevant PBF: presence of host plants. Additionally, the Mariana crow and Mariana fruit bat critical habitats also have only one relevant PBF, which is the presence of plant habitat and food resources. Available toxicity data for plants indicate that no adverse effects to survival, growth, or reproduction are likely to occur to any plants exposed to carbaryl at estimated environmental concentrations. Therefore, we do not anticipate any level of carbaryl contamination in critical habitat resulting from the proposed action will result in more than low levels of adverse effects to key plant resources within the critical habitat designated for the insect species in Table 2, as well as for the Mariana crow and Mariana fruit bat.

While the blackline Hawaiian damselfly has water quality as a necessary critical habitat PBF, we do not anticipate the species' critical habitat is likely to experience any exposure to carbaryl. As a result of the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, all carbaryl products registered for agricultural uses are prohibited from use in the state of Hawaii, with only residential and open space developed uses (e.g., turf or golf course use) remaining as registered uses in Hawaii. We do not anticipate designated critical habitat units for this species occur on or near residential or open space developed use sites, suggesting that exposure and subsequent adverse effects to critical habitat are not expected to occur. Visual inspection of areas surrounding the species' designated critical habitat units further corroborate our finding that no residential or open space developed use sites are likely to occur within the vicinity of critical habitat.

Similarly, while the Kauai cave wolf spider and the Kauai cave amphipod critical habitats have relevant PBFs (including water quality for both the amphipod and the spider and arthropod prey for the spider), we do not anticipate these species' critical habitat will be exposed to carbaryl as these species' critical habitat consists of subterranean caves. Given carbaryl's rapid degradation rate, we anticipate most carbaryl residues will degrade before surface waters can enter these species' subterranean habitats, resulting in no more than low levels of exposure and adverse effects to critical habitat PBFs. Additionally, as a result of the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, most residential and developed area uses of carbaryl are limited to spot treatments (defined as a 2 $ft^2$ area), crack-and-crevice treatment, or narrow perimeter bands around urban structures (from 1 inch to 6 feet) using hand-applicators. This limitation in application method renders off-site spray drift unlikely and will minimize or prevent exposure to critical habitat for these species.

In summary, given that the species' critical habitats in Table 2 are not likely to experience adverse effects as carbaryl is not likely to adversely affect their PBFs (in the cases of critical habitats with only plant-related PBFs) or is unlikely to expose critical habitat (in the case of the blackline Hawaiian damselfly, Kauai cave wolf spider, and the Kauai cave amphipod), we determine the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the species listed in Table 2.

**Table 2. Critical habitat designated for listed species that are not likely to experience more than low levels of adverse effects.**

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Arachnids | *Adelocosa anops* | Kauai cave wolf (pe'e pe'e maka 'ole) spider | No Destruction or Adverse Modification |
| Birds | *Corvus kubaryi* | Mariana (=aga) Crow | No Destruction or Adverse Modification |
| Crustaceans | *Spelaeorchestia koloana* | Kauai cave amphipod | No Destruction or Adverse Modification |
| Ferns and Allies | *Trichomanes punctatum* ssp. *floridanum* | Florida bristle fern | No Destruction or Adverse Modification |
| Flowering Plants | *Eryngium sparganophyllum* | Arizona eryngo | No Destruction or Adverse Modification |
| Flowering Plants | *Scutellaria ocmulgee* | Ocmulgee skullcap | No Destruction or Adverse Modification |
| Insects | *Atlantea tulita* | Puerto Rican harlequin butterfly | No Destruction or Adverse Modification |
| Insects | *Desmocerus californicus dimorphus* | Valley elderberry longhorn beetle | No Destruction or Adverse Modification |
| Insects | *Euchloe ausonides insulanus* | Island marble Butterfly | No Destruction or Adverse Modification |
| Insects | *Euphydryas anicia cloudcrofti* | Sacramento Mountains checkerspot butterfly | No Destruction or Adverse Modification |
| Insects | *Euphydryas editha bayensis* | Bay checkerspot butterfly | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Insects | *Euphydryas editha quino (=E. e. wrighti)* | Quino checkerspot butterfly | No Destruction or Adverse Modification |
| Insects | *Euphydryas editha taylori* | Taylor's (=whulge) Checkerspot | No Destruction or Adverse Modification |
| Insects | *Glaucopsyche lygdamus palosverdesensis* | Palos Verdes blue butterfly | No Destruction or Adverse Modification |
| Insects | *Hesperia dacotae* | Dakota Skipper | No Destruction or Adverse Modification |
| Insects | *Icaricia (Plebejus) shasta charlestonensis* | Mount Charleston blue butterfly | No Destruction or Adverse Modification |
| Insects | *Icaricia icarioides fenderi* | Fender's blue butterfly | No Destruction or Adverse Modification |
| Insects | *Lycaena hermes* | Hermes copper butterfly | No Destruction or Adverse Modification |
| Insects | *Manduca blackburni* | Blackburn's sphinx moth | No Destruction or Adverse Modification |
| Insects | *Megalagrion nigrohamatum nigrolineatum* | Blackline Hawaiian damselfly | No Destruction or Adverse Modification |
| Insects | *Pyrgus ruralis lagunae* | Laguna Mountains skipper | No Destruction or Adverse Modification |
| Insects | *Speyeria zerene hippolyta* | Oregon silverspot butterfly | No Destruction or Adverse Modification |
| Mammals | *Dipodomys elator* | Texas kangaroo rat | No Destruction or Adverse Modification |
| Mammals | *Martes caurina* | Pacific marten | No Destruction or Adverse Modification |
| Mammals | *Pteropus mariannus mariannus* | Mariana fruit Bat (=Mariana flying fox) | No Destruction or Adverse Modification |
| Reptiles | *Pituophis ruthveni* | Louisiana pinesnake | No Destruction or Adverse Modification |
| Snails | *Antrobia culveri* | Tumbling Creek cavesnail | No Destruction or Adverse Modification |
| Snails | *Assiminea pecos* | Pecos assiminea snail | No Destruction or Adverse Modification |
| Snails | *Erinna newcombi* | Newcomb's snail | No Destruction or Adverse Modification |
| Snails | *Helminthoglypta walkeriana* | Morro shoulderband (=Banded dune) snail | No Destruction or Adverse Modification |
| Snails | *Juturnia kosteri* | Koster's springsnail | No Destruction or Adverse Modification |
| Snails | *Leptoxis foremani* | Interrupted (=Georgia) Rocksnail | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Determination |
|---|---|---|---|
| Snails | *Partulina semicarinata* | Lanai tree snail | No Destruction or Adverse Modification |
| Snails | *Partulina variabilis* | Lanai tree snail | No Destruction or Adverse Modification |
| Snails | *Pleurocera foremani* | Rough hornsnail | No Destruction or Adverse Modification |
| Snails | *Pseudotryonia adamantina* | Diamond Tryonia | No Destruction or Adverse Modification |
| Snails | *Pyrgulopsis bernardina* | San Bernardino springsnail | No Destruction or Adverse Modification |
| Snails | *Pyrgulopsis chupaderae* | Chupadera springsnail | No Destruction or Adverse Modification |
| Snails | *Pyrgulopsis roswellensis* | Roswell springsnail | No Destruction or Adverse Modification |
| Snails | *Pyrgulopsis texana* | Phantom Springsnail | No Destruction or Adverse Modification |
| Snails | *Pyrgulopsis trivialis* | Three Forks Springsnail | No Destruction or Adverse Modification |
| Snails | *Tryonia cheatumi* | Phantom Tryonia | No Destruction or Adverse Modification |
| Snails | *Tryonia circumstriata (=stocktonensis)* | Gonzales tryonia | No Destruction or Adverse Modification |

## Critical habitats with low exposure (informed by low overlap with agriculture)

The critical habitats in Table 3 have a low extent of overlap between designated critical habitat and agricultural uses of carbaryl. Given the conservative nature of our estimate of total overlap (e.g., does not consider information on past carbaryl usage, does not fully account for redundancy between crop use sites, assumes exposure is occurring in all possible areas at the same time), we have high confidence that these critical habitats will experience low levels of exposure from agricultural uses. We discuss any anticipated effects to relevant PBFs within these small portions of the critical habitats below.

**Table 3. Critical habitats that have a low total overlap with agricultural use s of carbaryl.**

| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Amphibians | *Ambystoma cingulatum* | Frosted Flatwoods salamander | 1.5 | No Destruction or Adverse Modification |
| Amphibians | *Anaxyrus californicus* | Arroyo (=arroyo southwestern) toad | 2.4 | No Destruction or Adverse Modification |
| Amphibians | *Anaxyrus canorus* | Yosemite toad | 0.2 | No Destruction or Adverse Modification |
| Amphibians | *Anaxyrus williamsi* | Dixie Valley toad | <0.1 | No Destruction or Adverse Modification |
| Amphibians | *Batrachoseps relictus* | Relictual slender salamander | 0.2 | No Destruction or Adverse Modification |
| Amphibians | *Batrachoseps simatus* | Kern Canyon slender salamander | 0.7 | No Destruction or Adverse Modification |
| Amphibians | *Eleutherodactylus cooki* | Guajon | 0.0 | No Destruction or Adverse Modification |
| Amphibians | *Eleutherodactylus jasperi* | Golden coqui | 0.0 | No Destruction or Adverse Modification |
| Amphibians | *Eurycea nana* | San Marcos salamander | 3.9 | No Destruction or Adverse Modification |
| Amphibians | *Eurycea tonkawae* | Jollyville Plateau Salamander | 4.2 | No Destruction or Adverse Modification |
| Amphibians | *Eurycea waterlooensis* | Austin blind Salamander | 1.0 | No Destruction or Adverse Modification |
| Amphibians | *Rana muscosa* | Mountain yellow-legged frog | 0.4 | No Destruction or Adverse Modification |
| Amphibians | *Rana pretiosa* | Oregon spotted frog | 3.6 | No Destruction or Adverse Modification |
| Amphibians | *Rana sevosa* | Dusky gopher frog | 0.8 | No Destruction or Adverse Modification |

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| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Amphibians | *Rana sierrae* | Sierra Nevada yellow-legged frog | 0.5 | No Destruction or Adverse Modification |
| Birds | *Agelaius xanthomus* | Yellow-shouldered blackbird | 0.9 | No Destruction or Adverse Modification |
| Birds | *Ammodramus maritimus mirabilis* | Cape Sable seaside sparrow | 0.4 | No Destruction or Adverse Modification |
| Birds | *Antigone canadensis pulla* | Mississippi sandhill crane | 0.1 | No Destruction or Adverse Modification |
| Birds | *Charadrius melodus* | Piping plover | 2.8 | No Destruction or Adverse Modification |
| Birds | *Halcyon cinnamomina cinnamomina* | Guam Micronesian kingfisher | 0.0 | No Destruction or Adverse Modification |
| Birds | *Polysticta stelleri* | Steller's eider | 0.0 | No Destruction or Adverse Modification |
| Birds | *Rostrhamus sociabilis plumbeus* | Everglade snail kite | 0.4 | No Destruction or Adverse Modification |
| Birds | *Setophaga angelae* | Elfin-woods warbler | 0.0 | No Destruction or Adverse Modification |
| Birds | *Somateria fischeri* | Spectacled eider | 0.0 | No Destruction or Adverse Modification |
| Bivalves | *Alasmidonta atropurpurea* | Cumberland elktoe | 1.6 | No Destruction or Adverse Modification |
| Bivalves | *Alasmidonta raveneliana* | Appalachian elktoe | 2.7 | No Destruction or Adverse Modification |
| Bivalves | *Alasmidonta triangulata* | Southern elktoe | 1.0 | No Destruction or Adverse Modification |
| Bivalves | *Cambarus callainus* | Big Sandy crayfish | <0.1 | No Destruction or Adverse Modification |
| Bivalves | *Cambarus veteranus* | Guyandotte River crayfish | <0.1 | No Destruction or Adverse Modification |
| Bivalves | *Cyclonaias necki* | Guadalupe orb | 4.3 | No Destruction or Adverse Modification |
| Bivalves | *Cyprogenia sp. cf. aberti* | Ouachita fanshell | 0.8 | No Destruction or Adverse Modification |
| Bivalves | *Lampsilis bergmanni* | Guadalupe fatmucket | 1.6 | No Destruction or Adverse Modification |
| Bivalves | *Lampsilis bracteata* | Texas fatmucket | 3.3 | No Destruction or Adverse Modification |
| Bivalves | *Pleurobema athearni* | Canoe Creek clubshell | 2.5 | No Destruction or Adverse Modification |
| Bivalves | *Pleurobema furvum* | Dark pigtoe | 3.0 | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Bivalves | *Pleurobema riddellii* | Louisiana pigtoe | 3.3 | No Destruction or Adverse Modification |
| Bivalves | *Popenaias popeii* | Texas hornshell | 1.6 | No Destruction or Adverse Modification |
| Bivalves | *Potamilus amphichaenus* | Texas heelsplitter | 2.9 | No Destruction or Adverse Modification |
| Bivalves | *Quadrula cylindrica strigillata* | Rough rabbitsfoot | 1.7 | No Destruction or Adverse Modification |
| Bivalves | *Villosa perpurpurea* | Purple bean | 1.7 | No Destruction or Adverse Modification |
| Crustaceans | *Branchinecta sandiegonensis* | San Diego fairy shrimp | 1.5 | No Destruction or Adverse Modification |
| Crustaceans | *Faxonius peruncus* | Big Creek crayfish | 1.9 | No Destruction or Adverse Modification |
| Crustaceans | *Faxonius quadruncus* | St. Francis River crayfish | 1.9 | No Destruction or Adverse Modification |
| Crustaceans | *Gammarus pecos* | Pecos amphipod | 3.6 | No Destruction or Adverse Modification |
| Crustaceans | *Streptocephalus woottoni* | Riverside fairy shrimp | 2.5 | No Destruction or Adverse Modification |
| Fishes | *Acipenser oxyrinchus (=oxyrhynchus) desotoi* | Gulf sturgeon | 1.0 | No Destruction or Adverse Modification |
| Fishes | *Catostomus discobolus yarrowi* | Zuni bluehead Sucker | 0.0 | No Destruction or Adverse Modification |
| Fishes | *Catostomus santaanae* | Santa Ana sucker | 1.3 | No Destruction or Adverse Modification |
| Fishes | *Catostomus warnerensis* | Warner sucker | 3.6 | No Destruction or Adverse Modification |
| Fishes | *Chasmistes liorus* | June sucker | 3.2 | No Destruction or Adverse Modification |
| Fishes | *Chrosomus saylori* | Laurel dace | 3.4 | No Destruction or Adverse Modification |
| Fishes | *Crenichthys baileyi baileyi* | White River springfish | 0.6 | No Destruction or Adverse Modification |
| Fishes | *Crenichthys baileyi grandis* | Hiko White River springfish | 2.3 | No Destruction or Adverse Modification |
| Fishes | *Crenichthys nevadae* | Railroad Valley springfish | 2.6 | No Destruction or Adverse Modification |
| Fishes | *Cyprinella formosa* | Beautiful shiner | 0.6 | No Destruction or Adverse Modification |
| Fishes | *Cyprinodon bovinus* | Leon Springs pupfish | 2.0 | No Destruction or Adverse Modification |

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| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Fishes | *Cyprinodon macularius* | Desert pupfish | 0.0 | No Destruction or Adverse Modification |
| Fishes | *Cyprinodon nevadensis mionectes* | Ash Meadows Amargosa pupfish | 1.1 | No Destruction or Adverse Modification |
| Fishes | *Dionda diaboli* | Devils River minnow | 3.6 | No Destruction or Adverse Modification |
| Fishes | *Eremichthys acros* | Desert dace | 0.8 | No Destruction or Adverse Modification |
| Fishes | *Erimonax monachus* | Spotfin chub | 2.4 | No Destruction or Adverse Modification |
| Fishes | *Erimystax cahni* | Slender chub | 1.9 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma chermocki* | Vermilion darter | 1.5 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma fonticola* | Fountain darter | 3.9 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma moorei* | Yellowcheek darter | 0.1 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma osburni* | Candy darter | 2.2 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma spilotum* | Kentucky arrow darter | 0.5 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma susanae* | Cumberland darter | 0.9 | No Destruction or Adverse Modification |
| Fishes | *Gila bicolor ssp. snyderi* | Owens Tui chub | 0.3 | No Destruction or Adverse Modification |
| Fishes | *Gila cypha* | Humpback chub | 0.3 | No Destruction or Adverse Modification |
| Fishes | *Gila ditaenia* | Sonora chub | 0.2 | No Destruction or Adverse Modification |
| Fishes | *Gila elegans* | Bonytail | 0.4 | No Destruction or Adverse Modification |
| Fishes | *Gila intermedia* | Gila chub | 0.2 | No Destruction or Adverse Modification |
| Fishes | *Gila purpurea* | Yaqui chub | 0.6 | No Destruction or Adverse Modification |
| Fishes | *Gila seminuda (=robusta)* | Virgin River chub | 3.5 | No Destruction or Adverse Modification |
| Fishes | *Ictalurus pricei* | Yaqui catfish | 0.6 | No Destruction or Adverse Modification |
| Fishes | *Lepidomeda vittata* | Little Colorado spinedace | 0.1 | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Fishes | *Meda fulgida* | Spikedace | 0.8 | No Destruction or Adverse Modification |
| Fishes | *Noturus baileyi* | Smoky madtom | 0.1 | No Destruction or Adverse Modification |
| Fishes | *Noturus flavipinnis* | Yellowfin madtom | 2.5 | No Destruction or Adverse Modification |
| Fishes | *Noturus munitus* | Frecklebelly madtom | 2.6 | No Destruction or Adverse Modification |
| Fishes | *Oncorhynchus aguabonita whitei* | Little Kern golden trout | 0.1 | No Destruction or Adverse Modification |
| Fishes | *Percina pantherina* | Leopard darter | 0.2 | No Destruction or Adverse Modification |
| Fishes | *Percina williamsi* | Sickle darter | 2.0 | No Destruction or Adverse Modification |
| Fishes | *Plagopterus argentissimus* | Woundfin | 3.5 | No Destruction or Adverse Modification |
| Fishes | *Rhinichthys osculus nevadensis* | Ash Meadows speckled dace | 0.8 | No Destruction or Adverse Modification |
| Fishes | *Salmo salar* | Atlantic salmon | 4.4 | No Destruction or Adverse Modification |
| Fishes | *Tiaroga cobitis* | Loach minnow | 0.8 | No Destruction or Adverse Modification |
| Flowering Plants | *Arabis perstellata* | Braun's rock-cress | 2.6 | No Destruction or Adverse Modification |
| Flowering Plants | *Asclepias prostrata* | Prostrate milkweed | 2.6 | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus ampullarioides* | Shivwits milk-vetch | 0.4 | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus holmgreniorum* | Holmgren milk-vetch | 1.7 | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus jaegerianus* | Lane Mountain milk-vetch | 0.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus lentiginosus var. piscinensis* | Fish Slough milk-vetch | 2.9 | No Destruction or Adverse Modification |
| Flowering Plants | *Astragalus pycnostachyus var. lanosissimus* | Ventura Marsh Milk-vetch | 1.4 | No Destruction or Adverse Modification |
| Flowering Plants | *Chlorogalum purpureum* | Purple amole | 4.2 | No Destruction or Adverse Modification |
| Flowering Plants | *Chorizanthe robusta var. hartwegii* | Scotts Valley spineflower | 0.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Consolea corallicola* | Florida semaphore cactus | 0.5 | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Flowering Plants | *Deinandra (=Hemizonia) conjugens* | Otay tarplant | 1.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Delphinium luteum* | Yellow larkspur | 2.5 | No Destruction or Adverse Modification |
| Flowering Plants | *Diplacus vandenbergensis* | Vandenberg monkeyflower | 2.8 | No Destruction or Adverse Modification |
| Flowering Plants | *Echinomastus erectocentrus var. acunensis* | Acuña cactus | 0.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Eriogonum codium* | Umtanum desert buckwheat | 3.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Eriogonum tiehmii* | Tiehm's buckwheat | <0.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Harrisia (=Cereus) aboriginum (=gracilis)* | Aboriginal prickly-apple | 2.9 | No Destruction or Adverse Modification |
| Flowering Plants | *Ipomopsis polyantha* | Pagosa skyrocket | 3.2 | No Destruction or Adverse Modification |
| Flowering Plants | *Ivesia webberi* | Webber's ivesia | 0.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Lepidium papilliferum* | Slickspot peppergrass | 3.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Monardella viminea* | Willowy monardella | 0.7 | No Destruction or Adverse Modification |
| Flowering Plants | *Pectis imberbis* | beardless chinchweed | 0.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Pectis imberbis* | Beardless cinchweed | <0.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Pediocactus peeblesianus ssp. fickeiseniae* | Fickeisen plains cactus | 0.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Penstemon debilis* | Parachute beardtongue | 1.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Phacelia submutica* | DeBeque phacelia | 0.7 | No Destruction or Adverse Modification |
| Flowering Plants | *Piperia yadonii* | Yadon's piperia | 2.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Polygonum hickmanii* | Scotts Valley polygonum | 0.1 | No Destruction or Adverse Modification |
| Flowering Plants | *Sidalcea keckii* | Keck's Checker-mallow | 3.9 | No Destruction or Adverse Modification |
| Flowering Plants | *Solanum conocarpum* | Marron bacora | <0.1 | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Total Agricultural Overlap (% range) | Determination |
|---|---|---|---|---|
| Flowering Plants | *Sphaeralcea gierischii* | Gierisch mallow | 0.8 | No Destruction or Adverse Modification |
| Flowering Plants | *Streptanthus bracteatus* | Bracted twistflower | 0.3 | No Destruction or Adverse Modification |
| Flowering Plants | *Thlaspi californicum* | Kneeland Prairie penny-cress | 0.0 | No Destruction or Adverse Modification |
| Mammals | *Canis lupus* | Gray wolf | 0.9 | No Destruction or Adverse Modification |
| Mammals | *Corynorhinus (=Plecotus) townsendii virginianus* | Virginia big-eared bat | 1.4 | No Destruction or Adverse Modification |
| Mammals | *Pekania pennanti* | Fisher | <0.1 | No Destruction or Adverse Modification |
| Reptiles | *Ameiva polops* | St. Croix ground lizard | 0.0 | No Destruction or Adverse Modification |
| Reptiles | *Crocodylus acutus* | American crocodile | 0.1 | No Destruction or Adverse Modification |
| Reptiles | *Crotalus willardi obscurus* | New Mexican ridge-nosed rattlesnake | 2.2 | No Destruction or Adverse Modification |
| Reptiles | *Diadophis punctatus acricus* | Key ring-necked snake | 0.2 | No Destruction or Adverse Modification |
| Reptiles | *Pituophis melanoleucus lodingi* | Black pinesnake | 0.3 | No Destruction or Adverse Modification |
| Reptiles | *Thamnophis rufipunctatus* | Narrow-headed gartersnake | 3.9 | No Destruction or Adverse Modification |

**Arthropod prey, pollinators, or seed dispersers as PBFs:**

Of the critical habitats in this group, 52 list the presence of arthropods as an essential PBF, either in the form of pollinators (critical habitats for the purple amole, Fish Slough milk-vetch, and parachute beardtongue, among others) or as prey (critical habitats for as the Cape Sable seaside sparrow, woundfin, and the Jollyville Plateau salamander, among others). Available toxicity data indicate that arthropods (such as insects and crustaceans) are likely to experience high levels of mortality when exposed carbaryl (even at low concentrations). We expect there will be large reductions in the abundance of arthropod pollinators and prey in the portion of critical habitats where there is exposure to carbaryl. However, we do not expect all arthropod species are equally sensitive to carbaryl due to natural variations in physiology and biochemistry across species. Therefore, we do not expect complete mortality of arthropod communities and some pollinators and prey will continue to be available to support the function of critical habitat. Furthermore, given carbaryl's rapid degradation rate, we anticipate the arthropod community will recover once carbaryl residues degrade (which should occur on the order of days to weeks), restoring any impairments to the arthropod PBFs for these critical habitats. Thus, while impacts of carbaryl to arthropod pollinators and prey will be high where exposed, some pollinators and prey will be available after exposure and any losses will likely be temporary. As such, we anticipate all critical habitats in this group that list arthropods as a necessary component will experience medium levels of adverse effect to the arthropod PBF in the very small areas exposed to carbaryl.

**Non-arthropods, including prey, pollinators/seed dispersers and host fish as PBFs:**

There are 18 critical habitats in this group that list the presence of non-arthropod species as an essential PBF, either as prey (critical habitats for the gray wolf, snail kite, and crocodile) or as fish hosts (critical habitats for the purple bean, rough rabbitsfoot, and the Cumberland elktoe). Available toxicity data indicate that non-arthropod animals' responses to carbaryl can greatly range in sensitivities. Mollusks, like snails and clams, are not likely to experience measurable adverse effects to survival, growth, or reproduction at environmentally relevant concentrations of carbaryl. As such, we expect only low levels of adverse effects to non-arthropod prey resources in critical habitats designated for the Leon Spring pupfish, Everglade snail kite, San Marcos salamander and the spring pygmy sunfish.

Other critical habitats, like those designated for the gray wolf and the New Mexican ridge-nosed rattlesnake require terrestrial non-arthropod prey as an essential critical habitat feature. Available toxicity data in terrestrial vertebrates indicate that carbaryl can occasionally cause high levels of adverse effects (including mortality), but only at high levels of exposure, and depending on the prey type. We expect mammalian prey species can experience high levels of mortality but only when prey forage directly on carbaryl use sites immediately after an application of carbaryl. We do not anticipate that most bird, reptile, or terrestrial phase amphibian species are likely to experience more than low levels of mortality with exposure to carbaryl. Given the small presence of carbaryl agricultural use sites within the gray wolf and the New Mexican ridge-nosed rattlesnake critical habitats (0.9% and 2.2%, respectively), we anticipate very small reductions in the overall availability of terrestrial non-arthropod prey will occur. As such, we anticipate low levels of adverse effects will occur to the non-arthropod PBF for these critical habitats.

Five critical habitats designated for listed bivalves include the presence of fish hosts as non-arthropod resources as necessary features of their critical habitat. Available toxicity data indicate that fish can experience adverse effects (including mortality), but only in areas that accumulate high levels of carbaryl (like low flow or low volume waterbodies) and only when carbaryl is used on specific crops (e.g., other grains, vegetables, and ground fruit). Given that we only anticipate high levels of adverse effects to fish hosts are likely to occur in some parts of critical habitat, that these species can occur in a variety of flow and water volume conditions (e.g., can occur in high and low flow areas), and that these species are host fish generalists that can use a variety of fish species as hosts, we anticipate there will still be sufficient host fish resources available in critical habitat even in scenarios where estimated environmental concentrations of carbaryl are high. As such, we anticipate low levels of adverse effects to the non-arthropod PBF for these critical habitats in the very small areas exposed to carbaryl.

**Water quality as PBFs:**

There are 52 critical habitats in this group that list water quality as a PBF of critical habitat. Five of these critical habitats are designated for listed bivalve species: the purple bean, the rough rabbitsfoot, the Cumberland elktoe, the Appalachian elktoe, and the dark pigtoe. Available toxicity data in mollusks indicate that these species are not likely to experience any adverse effects to survival, growth, or reproduction at levels of carbaryl predicted to occur in their critical habitats. Thus, we expect these critical habitats will experience low levels of adverse effects to the water quality PBF. Similarly, EPA's exposure modeling show that terrestrial vertebrates are not likely to accumulate more than low levels of carbaryl from exposure to contaminated water, which is not likely to result in mortality, but only low levels of sublethal adverse effects. As such, we do not expect the critical habitats designated for the Stellar's eider, Cape Sable seaside sparrow, Spectacled eider, and piping plover will experience more than low levels of adverse effects to the water quality PBF.

Available toxicity data indicate that fish and amphibians are likely to experience high levels of mortality, but only in areas that accumulate high levels of carbaryl (like low flow or low volume waterbodies). Aside from the Sonora chub, the Hiko White River springfish, laurel dace, Zuni bluehead sucker, and the Cumberland darter, all fish and amphibians in this group occupy a mix of areas that include low flow/low volume waterbodies as well as high flow and large volume waterbodies that will only accumulate low levels of carbaryl. As such, we anticipate high levels of water quality impairment are likely to occur only in select areas of exposed critical habitat, and these effects will be temporary as carbaryl has a rapid degradation rate. As such, we anticipate a medium level of impacts to water quality are likely for these critical habitats in the very small areas exposed to carbaryl.

In contrast, critical habitats designated for the Sonora chub, Hiko White River springfish, laurel dace, Zuni bluehead sucker, and the Cumberland darter, and crustaceans (including the Riverside fairy shrimp, the San Diego fairy shrimp, and Pecos amphipod) are likely to experience high levels of adverse effects to their water quality PBF in areas exposed to carbaryl, as predicted concentrations of carbaryl are higher than levels where toxicity studies have observed adverse effects to fish and arthropods. However, we anticipate these impacts to water quality will be limited to a small area of critical habitat and will be temporary as carbaryl has a rapid degradation rate. As such, even in the event of repeated exposures, we anticipate water quality will not be impaired for more than short periods of time and will improve soon after exposure takes place and that the water quality of the overall critical habitat will not be appreciably reduced.

**General habitat function requiring no or low levels of chemical contaminants as PBFs:**

There are five critical habitats in this group that list a low level of chemical contaminants present within critical habitat units in order for proper function (i.e., habitat function) as an essential critical habitat PBF: the black pinesnake, Acuña cactus, spectacled eider, Stellar's eider, and elfin woods warbler. Available toxicity data on plants indicate no adverse effects to survival, growth, or reproduction are likely to occur at predicted environmental concentrations of carbaryl. Similarly, we do not anticipate contact with carbaryl residues on surfaces is going to result in more than low levels of exposure to terrestrial vertebrates as dermal exposure is not a primary route of exposure for carbaryl. Thus, we do not anticipate terrestrial vertebrates will likely experience more than low levels of sublethal adverse effects from contact with carbaryl residues. As such, we anticipate only low levels of adverse effects to the habitat function PBF for the critical habitats designated for these five species.

In summary, we anticipate a range of impacts will occur to the different PBFs of the critical habitats listed above in Table 3. While adverse effects to arthropod prey and pollinator PBFs are likely high in magnitude, particularly for sensitive species of arthropods, we expect that some arthropods will remain after exposure and the loss of individuals will be temporary within the very small, exposed areas of critical habitat. Adverse effects to non-arthropod species may be high, especially for fish hosts that occur in low flow or low volume waterbodies or for terrestrial vertebrate prey that forage on carbaryl use sites. In contrast, we expect fish hosts in high flow or large volume waterbodies or terrestrial vertebrate prey that do not enter carbaryl use sites are not likely to experience more than small reductions to survival, growth, or reproduction. Similarly, water quality will be impaired by carbaryl exposure, but we expect high levels of impairment are likely to occur only in select areas (i.e., low flow or low volume water bodies). Adverse effects to the basic habitat function PBFs of terrestrial habitats is also likely to occur but are likely highly impaired only for species that are known to be sensitive to carbaryl (i.e., arthropod species). We anticipate all adverse effects to all categories of PBFs will be temporary as carbaryl degrades rapidly in natural environments. Additionally, we expect these adverse effects will be highly limited in area given the low level of overlap between these critical habitats and agricultural use areas (which is a conservative estimator of exposure). Thus, even though some critical habitats in this group will experience high levels of adverse effects to their PBFs, we anticipate these adverse effects will be temporary, limited to a very small area, and are not likely to appreciably reduce the conservation value of critical habitat as a whole for these species.

**Non-agricultural use**

In addition to agricultural uses of carbaryl, critical habitat can experience additional exposure to carbaryl through non-agricultural uses, such as uses on developed, open space developed, managed forests, rangeland, and rights of way use sites. In general, we do not anticipate these non-agricultural uses will substantially contribute to the overall exposure to critical habitat as non-agricultural uses of carbaryl typically have low usage rates and are applied in ways that reduce off-site a transport to adjacent areas.

<u>Developed and Open Space Developed Use (including Nurseries):</u>

Designated critical habitats for the Austin blind salamander, yellow-shouldered blackbird, mountain yellow-legged frog, Oregon spotted frog, Sierra Nevada yellow-legged frog, Mississippi sandhill crane, Virginia big-eared bat, narrow-headed gartersnake, and American crocodile may include developed and open space developed use sites as these species and their critical habitat may occur on or near developed areas. However, we anticipate any critical habitat units that occur on or near these developed or open space developed use sites are not likely to experience more than low levels of exposure to carbaryl. As a result of the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, most residential and developed area uses of carbaryl are limited to spot treatments (defined as a 2 $ft^2$ area), crack-and-crevice treatment, or narrow perimeter bands around urban structures (from 1 inch to 6 feet) using hand-applicators. This limitation in application method renders off-site spray drift unlikely and greatly reduces the extent of area that can be treated in the developed and nurseries UDLs, which we expect will minimize or prevent exposure to critical habitat for these species.

Available usage data on open space developed uses of carbaryl (such as turf or golf course applications) at a national scale indicate that less than 2.5% of open space developed areas across the country have been treated with carbaryl. While this usage may result in a large treatment footprint if all treated areas were concentrated in one location or within one species' critical habitat, we expect this is highly unlikely to occur. Rather, we expect open space developed usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within each of these critical habitats. As such, we similarly anticipate that these critical habitats that may occur on or near open space developed use sites are not likely to experience more than low levels of carbaryl exposure through this use, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

<u>Managed Forest Use:</u>

Designated critical habitats for the frosted flatwoods salamander, mountain yellow-legged frog, Oregon spotted frog, Sierra Nevada yellow-legged frog, Mississippi sandhill crane, purple amole, gray wolf, black pine snake, and narrow-headed gartersnake may be exposed to carbaryl through use on managed forests as these species are known to use forested habitats. Available usage data from the U.S. Forest Service indicate that, from 2016-2020, no carbaryl had been applied to managed forests within the ranges of the frosted flatwoods salamander, Oregon spotted frog, Mississippi sandhill crane, gray wolf, black pine snake, and the narrow-headed gartersnake, suggesting that there is a low likelihood that these critical habitats will be exposed to carbaryl through this use type. Where applications have taken place, the majority of treatments have involved small areas (<1 acre), such that if usage did occur, exposure to any individual critical habitat area would be minimal. While records indicate some carbaryl has been used in the states containing designated critical habitat for the mountain yellow-legged frog, Sierra Nevada yellow-legged frog, and purple amole, we anticipate very little has been used within these designated critical habitats. From 2016-2020, 322 acres of managed forests within the state of California have been treated with carbaryl, specifically to oak woodlands, using ground-based sprayers targeting lower branches and trunks, which we anticipate limits the amount of off-site transport likely to occur. We do not anticipate past carbaryl usage in California would be concentrated in a single area (like a critical habitat unit) and thus, anticipate these designated critical habitats will be exposed to, at most, low levels of carbaryl through managed forest use, resulting in no more than minor reductions in arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Rangeland Use:

Designated critical habitat for the yellow-shouldered blackbird, purple amole, and gray wolf may include or be located in areas adjacent to rangeland use sites as these species are known to occur in or near these habitats. While it is possible these critical habitats can be exposed to carbaryl through rangeland uses, we do not anticipate that is likely to occur as available usage data from USDA APHIS indicate that, from 2019-2023, no carbaryl has been used to treat rangeland habitat within the states or territories containing designated critical habitat. In addition, we anticipate all rangeland applications of carbaryl will be carried out in association with USDA APHIS as part of their grasshopper and Mormon cricket suppression program (USFWS 2024), which includes many conservation measures that are meant to protect listed species and their critical habitats from exposure. As such, we do not anticipate these critical habitats are likely to be exposed to carbaryl through rangeland use, resulting in no more than minor reductions in arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Rights of Way Use:

Designated critical habitat for the guajón and San Diego fairy shrimp may occur on or near rights of way use sites as the species is known to use or occur in areas adjacent to these use sites. However, we do not anticipate these critical habitats will likely experience more than low levels of exposure through rights of way uses as they represent just a portion of the critical habitat area, and we anticipate there is low usage in rights of way use sites. Available usage information indicates that carbaryl is used infrequently in rights of ways, with less than 500 pounds of carbaryl applied to roadways nationally each year. While this may result in a large treatment footprint if all rights of way usage were concentrated in one location or within one species' critical habitat, we expect this is highly unlikely to occur and rather expect rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within these species' critical habitats for rights of way uses, resulting in no more than minor reductions in arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

**Group Conclusion**

In summary, all the critical habitats listed in Table 3 have a low exposure ranking as these critical habitats have a low overlap with agricultural use sites of carbaryl. While it is possible that these critical habitats can also be exposed through non-agricultural uses of carbaryl, available usage data indicate very little carbaryl has been used in these use sites (sometimes with no recent usage at all). Thus, we do not anticipate non-agricultural uses are not likely to expose these critical habitats and any exposures that do occur are likely to be limited to small areas and result in no more than minor and temporary impacts to critical habitat PBFs.

Carbaryl exposure, when it does occur, will likely cause high levels of adverse effects to arthropod prey or pollinator PBFs, and will cause a range of adverse effects to non-arthropod prey, non-arthropod host, water quality, and general habitat function PBFs that will vary depending on the specific species, the estimated environmental concentrations of carbaryl, and other such factors. However, we anticipate any adverse effects that will occur will be limited to a very small area given the low level of overlap between these critical habitats and the action area. Thus, even though some critical habitat PBFs in this group will experience high levels of adverse effects when exposed to carbaryl, we anticipate these adverse effects will be temporary (and that repeated exposures will not increase the level of adverse effects to PBFs), limited to a very small area, and will not cause more than minor impacts to the overall critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitats for the species listed in Table 3.

## Critical habitats with low exposure (informed by low past usage from California Department of Pesticide Regulation Pesticide Use Reporting data)

The critical habitats in Table 4 all have a low level of past agricultural insecticide usage as informed by the California Pesticide Use Report (CalPUR), which includes 10 years of data (2013-2022). Growers in California are required to report pesticide usage to the state, which summarizes this data at a section level (see the *Usage Analysis* section in the main Opinion for more details). Given that this data is spatially specific to the critical habitats within California and usage reporting is mandatory, we have high confidence that the past carbaryl usage patterns reported in this dataset are accurate. As such, we have high confidence that critical habitats reporting low levels of usage are not likely to experience more than low levels of exposure to agricultural uses of carbaryl. We discuss any anticipated effects to relevant PBFs within the portions of critical habitats that are likely to be treated with agricultural or non-agricultural uses of carbaryl below. In cases where there is a small sample size of growers reporting agricultural usage in the sections containing critical habitats, we pull those critical habitats out of the grouped rationale for additional analysis to provide a more thorough analysis to ensure that our assumptions of low exposure are maintained or if additional analyses are needed.

**Table 4. Critical habitats with low exposure informed by low past usage from the California Department of Pesticide Regulation Pesticide Use Reporting (CalPUR) data.**

| Taxa Group | Scientific Name | Common Name | Total % range treated annually (CalPUR data) | Determination |
|---|---|---|---:|---|
| Amphibians | *Ambystoma californiense* | California tiger salamander | 0.2 | No Destruction or Adverse Modification |
| Amphibians | *Ambystoma californiense* | California tiger salamander | 0.3 | No Destruction or Adverse Modification |
| Amphibians | *Rana draytonii* | California red-legged frog | 0.1 | No Destruction or Adverse Modification |
| Crustaceans | *Branchinecta conservatio* | Conservancy fairy shrimp | 0.2 | No Destruction or Adverse Modification |
| Crustaceans | *Branchinecta longiantenna* | Longhorn fairy shrimp | 0.2 | No Destruction or Adverse Modification |
| Crustaceans | *Lepidurus packardi* | Vernal pool tadpole shrimp | 0.3 | No Destruction or Adverse Modification |
| Fishes | *Eucyclogobius newberryi* | Tidewater goby | 0.1 | No Destruction or Adverse Modification |
| Fishes | *Hypomesus transpacificus* | Delta smelt | 0.9 | No Destruction or Adverse Modification |
| Flowering Plants | *Brodiaea filifolia* | Thread-leaved brodiaea | 0.0 | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Total % range treated annually (CalPUR data) | Determination |
|---|---|---|---|---|
| Flowering Plants | *Cirsium hydrophilum var. hydrophilum* | Suisun thistle | 0.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Cirsium loncholepis* | La Graciosa thistle | 0.8 | No Destruction or Adverse Modification |
| Flowering Plants | *Cordylanthus mollis ssp. mollis* | Soft bird's-beak | 0.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Holocarpha macradenia* | Santa Cruz tarplant | 1.1 | No Destruction or Adverse Modification |
| Mammals | *Dipodomys heermanni morroensis* | Morro Bay kangaroo rat | 0.0 | No Destruction or Adverse Modification |
| Reptiles | *Masticophis lateralis euryxanthus* | Alameda whipsnake (=striped racer) | 0.0 | No Destruction or Adverse Modification |

**Arthropod prey, pollinators, or seed dispersers as PBFs:**

There are seven critical habitats in this group that list the presence of arthropods, either as pollinators (like the thread-leaved brodiaea, the Suisun thistle, the Santa Cruz tarplant, soft bird's-beak, and the Kneeland Prairie penny-cress) or as prey (like the Delta smelt and the Morro Bay kangaroo rat) as an essential PBF. Available toxicity data indicate that arthropods (such as insects and crustaceans) are likely to experience high levels of mortality when exposed to carbaryl (even at low concentrations). We expect there will be large reductions in the abundance of arthropod pollinators and prey in portions of critical habitats exposed to carbaryl. However, we do not expect all arthropod species are equally sensitive to carbaryl due to natural variations in physiology and biochemistry across species. Therefore, we do not expect complete mortality of arthropod communities and expect there will still be some pollinators and prey available to support the function of critical habitat. Furthermore, given carbaryl's rapid degradation rate, we anticipate the arthropod community will recover within a short period of time (from days to weeks), restoring any impairments to the arthropod PBFs for these critical habitats. Thus, while impacts of carbaryl to arthropod pollinators and prey will be high, we anticipate some pollinators and prey will be available after exposure and any losses will likely be temporary. As such, we anticipate all critical habitats in this group that list arthropods as a necessary component will experience medium levels of adverse effect to the arthropod PBF in the very small areas exposed to carbaryl.

**Non-arthropods, including prey, pollinators/seed dispersers and host fish as PBFs:**

The Alameda whipsnake and Morro Bay kangaroo rat critical habitats lists non-arthropod species as an essential critical habitat PBF. In addition to vegetation and insects, the Morro Bay kangaroo rat can consume terrestrial snails, making them a non-arthropod prey resource. Available data indicate that mollusks, like snails, are not likely to experience any measurable adverse effects to survival, growth, or reproduction at environmentally relevant concentrations of carbamate insecticides. As such, we expect only very low levels of adverse effects to non-arthropod prey resources in areas of the Morro Bay kangaroo rat's critical habitat exposed to carbaryl. Similarly, the Alameda whipsnake's PBF includes presence of preferred prey such as lizards, frogs, birds, and other snakes. We do not expect the whipsnake's terrestrial vertebrate prey (i.e., birds, amphibians, reptiles) will experience more than low levels of adverse effects from carbaryl exposure. As such, we anticipate low levels of adverse effects will occur to the non-arthropod PBF for the critical habitat of the Alameda whipsnake.

**Water quality as a PBF:**

There are seven critical habitats in this group that list water quality as an essential critical habitat feature: the California tiger salamander (Central California and Santa Barbara DPS), the California red-legged frog, the conservancy fairy shrimp, the longhorn fairy shrimp, the tidewater goby, and the Delta smelt.

Available toxicity data indicate that fish (and presumably amphibians) are likely to experience high levels of mortality, but only in areas that accumulate high levels of carbaryl (like in low flow or low volume waterbodies). Thus, critical habitats designated for fish (such as the Delta smelt) and amphibian species that only occupy areas of high flow or large water volume are unlikely to experience more than low levels of water quality impairment as these areas will accumulate only low levels of carbaryl. Critical habitats designated for fish and amphibians (such as the California tiger salamander DPSs, the California red-legged frog, and tidewater goby) that occupy habitats with a variety of flow and volume conditions are likely to experience high levels of water quality impairment only in select areas of exposed critical habitat. However, we anticipate these adverse effects to water quality will be restricted in area as CalPUR data indicate that only a small portion (0.1-0.3%) of critical habitat is likely to be treated each year. Furthermore, we anticipate these impacts to water quality will only be temporary as carbaryl degrades rapidly (on the order of days to weeks), indicating that areas with impaired water quality will recover soon after exposure. As such, while we anticipate some areas of critical habitat will experience high levels of water quality impairment, we anticipate these adverse effects will be limited in area and temporary, resulting in a medium level of adverse effects to water quality overall.

As noted above, arthropods (including crustaceans) are likely to experience high levels of adverse effects (e.g., mortality) with exposure to carbaryl, even at low levels of exposure. As such, we anticipate carbaryl exposure will cause high levels of adverse effects to the water quality PBF of the conservancy fairy shrimp and the longhorn fairy shrimp. However, CalPUR data indicate that very little (0.2%) carbaryl has been used within the areas containing critical habitat from 2013-2022, so we have high confidence that very little of critical habitat is likely to experience this high level of water quality impairment. Furthermore, should any portion of critical habitat be exposed to carbaryl in the future, we anticipate any adverse effects to water quality would not persist for long periods of time given the rapid degradation rate of carbaryl. As such, while exposure could result in high levels of adverse effects to the water quality PBF in areas exposed to carbaryl for the conservancy fairy shrimp and longhorn fairy shrimp's critical habitats, we anticipate exposure will only occur in a very small portion of critical habitat and that any adverse effects that result would be temporary.

**Non-agricultural use**

In addition to agricultural uses of carbaryl, critical habitat can experience additional exposure to carbaryl through non-agricultural uses, such as uses on developed, open space developed, managed forests, rangeland, and rights of way use sites. The CalPUR data described above is inclusive of certain non-agricultural uses, such as those performed by professional commercial applicators. While these data no not capture all non-agricultural usage, such as residential applications by consumers, given our broad understanding of carbaryl usage, general information on non-agricultural use practices, and existing conservation measures, we expect limited exposure from these uses of carbaryl.

<u>Developed and Open Space Developed Use (including Nurseries):</u>

Designated critical habitats for the California tiger salamander DPSs and the Alameda whipsnake may include developed and open space developed use sites as these species and their critical habitat may occur on or near developed areas. However, we anticipate any critical habitat units that occur on or near these developed or open space developed use sites are not likely to experience more than low levels of exposure to carbaryl. As a result of the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, most residential and developed area uses of carbaryl are limited to spot treatments (defined as a 2 $ft^2$ area), crack-and-crevice treatment, or narrow perimeter bands around urban structures (from 1 inch to 6 feet) using hand-applicators. This limitation in application method renders off-site spray drift unlikely and greatly reduces the extent of area that can be treated in the developed and nurseries UDLs, which we expect will minimize or prevent exposure to critical habitat for these species.

We expect that many carbaryl applications within the open space developed UDL, such as turf or golf course applications, would be performed by commercial applicators and therefore captured within the CalPUR data. However, carbaryl use for these applications is expected to be low as less than 2.5% of open space developed areas across the country have been treated with carbaryl. While this usage may result in a large treatment footprint if all treated areas were concentrated in one location or within one species' critical habitat, we expect this is highly unlikely to occur. Rather, we expect open space developed usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within each of these critical habitats. As such, we similarly anticipate that these critical habitats that may occur on or near open space developed use sites are not likely to experience more than low levels of carbaryl exposure through this use, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Managed Forest Use:

Designated critical habitats for the California tiger salamander DPSs and the Alameda whipsnake may be exposed to carbaryl through use on managed forests as these species are known to use forested habitats. Available usage data from the U.S. Forest Service indicate that, from 2016-2020, 322 acres of managed forests within the state of California have been treated with carbaryl, specifically to oak woodlands, using ground-based sprayers targeting lower branches and trunks, which we anticipate limit the amount of off-site transport likely to occur. We do not anticipate past carbaryl usage in California would be concentrated in a single area (like a critical habitat unit) and thus, anticipate these designated critical habitats will be exposed to, at most, low levels of carbaryl through managed forest use, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Rangeland Use:

Designated critical habitat for the California tiger salamander DPSs, Morro Bay kangaroo rat, and Alameda whipsnake may include or be located in areas adjacent to rangeland use sites as these species are known to occur in or near these habitats. While it is possible these critical habitats can be exposed to carbaryl through rangeland uses, we do not anticipate that is likely to occur as available usage data from USDA APHIS indicate that, from 2019-2023, no carbaryl has been used to treat rangeland habitat within California. In addition, we anticipate all rangeland applications of carbaryl will be carried out in association with USDA APHIS as part of their grasshopper and Mormon cricket suppression program (USFWS 2024), which includes many conservation measures that are meant to protect listed species and their critical habitats from exposure. As such, we do not anticipate these critical habitats are likely to be exposed to carbaryl through rangeland use, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Rights of Way Use:

Designated critical habitat for the Conservancy fairy shrimp, longhorn fairy shrimp, and vernal pool tadpole shrimp may occur on or near rights of way use sites as the species is known to use or occur in areas adjacent to these use sites. However, we do not anticipate these critical habitats will likely experience more than low levels of exposure through rights of way uses as they represent just a portion of the critical habitat area, and we anticipate there is low usage in rights of way use sites. Available usage information indicates that carbaryl is used infrequently in rights of ways, with less than 500 pounds of carbaryl applied to roadways nationally each year. While this may result in a large treatment footprint if all rights of way usage were concentrated in one location or within one species' critical habitat, we expect this is highly unlikely to occur and rather expect rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within these species' critical habitats for rights of way uses, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

**Group Conclusion**

In summary, we anticipate a range of impacts will occur to the different PBFs of the critical habitats listed above in Table 4. Adverse effects to arthropod prey and pollinator PBFs are likely high in magnitude, particularly for sensitive species of arthropods, but we anticipate some pollinators and prey will be available after exposure and any losses will likely be only temporary given that we expect carbaryl residues will degrade rapidly. Adverse effects to non-arthropod species are likely to be low as toxicity studies show only low levels of adverse effects to mollusk prey (like snails) and terrestrial vertebrate communities at predicted environmental concentrations of carbaryl. We expect water quality will be impaired by carbaryl exposure, but only in areas of low flow or low water volume. We anticipate all adverse effects to all categories of PBFs will be temporary as carbaryl degrades rapidly in natural environments. Additionally, we expect these adverse effects will be highly limited in area given the low level of past carbaryl usage as reported by CalPUR. Thus, even though some critical habitats in this group will experience high levels of adverse effects to their PBFs, we anticipate these adverse effects will be temporary (indicating that repeated exposures will not increase the level of adverse effects to PBFs), limited to a very small area, and will not cause more than minor impacts to the overall critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitats for the species listed in Table 4.

## Critical Habitat with low exposure (informed by low past usage from USDA's Census of Agriculture (CoA))

The critical habitats in Table 5 all have a low level of past insecticide usage as informed by the USDA's Census of Agriculture (CoA). The CoA all insecticide usage data includes information on all insecticides, not just carbaryl, and thus, is a very conservative measure of agricultural usage of carbaryl. Given that this additional usage dataset indicates very little of these critical habitats are likely to be treated with insecticides, we have high confidence that these critical habitats will experience low levels of carbaryl exposure from agriculture. We discuss any anticipated effects to relevant PBFs within these small portions of critical habitats that are likely to be treated with carbaryl below.

**Table 5. Critical habitats with low exposure, informed by low past usage from USDA's Census of Agriculture (CoA).**

| Taxa Group | Scientific Name | Common Name | Total % range treated (CoA) | Determination |
|---|---|---|---|---|
| Amphibians | *Bufo houstonensis* | Houston toad | 1.0 | No Destruction or Adverse Modification |
| Amphibians | *Eleutherodactylus juanariveroi* | Llanero coqui | 1.6 | No Destruction or Adverse Modification |
| Amphibians | *Eurycea chisholmensis* | Salado salamander | 3.7 | No Destruction or Adverse Modification |
| Amphibians | *Eurycea naufragia* | Georgetown salamander | 1.4 | No Destruction or Adverse Modification |
| Amphibians | *Necturus alabamensis* | Black warrior (=Sipsey Fork) waterdog | 1.1 | No Destruction or Adverse Modification |
| Amphibians | *Rana chiricahuensis* | Chiricahua leopard frog | 1.6 | No Destruction or Adverse Modification |
| Birds | *Centrocercus minimus* | Gunnison sage-grouse | 0.9 | No Destruction or Adverse Modification |
| Birds | *Charadrius melodus* | Piping Plover – Great Lakes Watershed DPS | 0.5 | No Destruction or Adverse Modification |
| Birds | *Charadrius nivosus nivosus* | Western snowy plover | 1.9 | No Destruction or Adverse Modification |
| Birds | *Empidonax traillii extimus* | Southwestern willow flycatcher | 3.3 | No Destruction or Adverse Modification |
| Bivalves | *Epioblasma brevidens* | Cumberlandian combshell | 1.4 | No Destruction or Adverse Modification |
| Bivalves | *Epioblasma capsaeformis* | Oyster mussel | 1.4 | No Destruction or Adverse Modification |
| Bivalves | *Fusconaia escambia* | Narrow pigtoe | 3.7 | No Destruction or Adverse Modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Scientific Name | Common Name | Total % range treated (CoA) | Determination |
|---|---|---|---|---|
| Bivalves | *Hamiota altilis* | Finelined pocketbook | 2.0 | No Destruction or Adverse Modification |
| Bivalves | *Hamiota perovalis* | Orangenacre mucket | 2.5 | No Destruction or Adverse Modification |
| Bivalves | *Lasmigona decorata* | Carolina heelsplitter | 4.9 | No Destruction or Adverse Modification |
| Bivalves | *Margaritifera marrianae* | Alabama pearlshell | 2.0 | No Destruction or Adverse Modification |
| Bivalves | *Medionidus acutissimus* | Alabama moccasinshell | 2.2 | No Destruction or Adverse Modification |
| Bivalves | *Medionidus parvulus* | Coosa moccasinshell | 2.5 | No Destruction or Adverse Modification |
| Bivalves | *Pleurobema decisum* | Southern clubshell | 2.8 | No Destruction or Adverse Modification |
| Bivalves | *Pleurobema georgianum* | Southern pigtoe | 2.5 | No Destruction or Adverse Modification |
| Bivalves | *Pleurobema hanleyianum* | Georgia pigtoe | 2.9 | No Destruction or Adverse Modification |
| Bivalves | *Pleurobema perovatum* | Ovate clubshell | 1.9 | No Destruction or Adverse Modification |
| Bivalves | *Pleuronaia dolabelloides* | Slabside Pearlymussel | 2.5 | No Destruction or Adverse Modification |
| Bivalves | *Ptychobranchus greenii* | Triangular Kidneyshell | 1.8 | No Destruction or Adverse Modification |
| Bivalves | *Ptychobranchus subtentus* | Fluted kidneyshell | 1.6 | No Destruction or Adverse Modification |
| Bivalves | *Reginaia rotulata* | Round Ebonyshell | 3.5 | No Destruction or Adverse Modification |
| Crustaceans | *Cambarus cracens* | Slenderclaw crayfish | 3.8 | No Destruction or Adverse Modification |
| Crustaceans | *Gammarus hyalleloides* | Diminutive Amphipod | 0.1 | No Destruction or Adverse Modification |
| Crustaceans | *Stygobromus (=Stygonectes) pecki* | Peck's cave amphipod | 0.2 | No Destruction or Adverse Modification |
| Fishes | *Chasmistes brevirostris* | Shortnose Sucker | 0.8 | No Destruction or Adverse Modification |
| Fishes | *Deltistes luxatus* | Lost River sucker | 1.0 | No Destruction or Adverse Modification |
| Fishes | *Etheostoma phytophilum* | Rush darter | 1.8 | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Total % range treated (CoA) | Determination |
|---|---|---|---|---|
| Fishes | *Etheostoma trisella* | Trispot darter | 1.6 | No Destruction or Adverse Modification |
| Fishes | *Hybognathus amarus* | Rio Grande silvery minnow | 1.2 | No Destruction or Adverse Modification |
| Fishes | *Lepidomeda albivallis* | White River spinedace | 1.0 | No Destruction or Adverse Modification |
| Fishes | *Lepidomeda mollispinis pratensis* | Big Spring spinedace | 0.5 | No Destruction or Adverse Modification |
| Fishes | *Menidia extensa* | Waccamaw silverside | 4.9 | No Destruction or Adverse Modification |
| Fishes | *Notropis buccula* | Smalleye shiner | 3.8 | No Destruction or Adverse Modification |
| Fishes | *Notropis mekistocholas* | Cape Fear shiner | 1.6 | No Destruction or Adverse Modification |
| Fishes | *Notropis oxyrhynchus* | Sharpnose shiner | 3.8 | No Destruction or Adverse Modification |
| Fishes | *Notropis simus pecosensis* | Pecos bluntnose shiner | 2.6 | No Destruction or Adverse Modification |
| Fishes | *Noturus crypticus* | Chucky madtom | 0.9 | No Destruction or Adverse Modification |
| Fishes | *Percina antesella* | Amber darter | 1.6 | No Destruction or Adverse Modification |
| Fishes | *Percina jenkinsi* | Conasauga logperch | 1.8 | No Destruction or Adverse Modification |
| Fishes | *Ptychocheilus lucius* | Colorado pikeminnow | 0.6 | No Destruction or Adverse Modification |
| Fishes | *Salvelinus confluentus* | Bull trout | 1.0 | No Destruction or Adverse Modification |
| Fishes | *Scaphirhynchus suttkusi* | Alabama sturgeon | 3.7 | No Destruction or Adverse Modification |
| Fishes | *Xyrauchen texanus* | Razorback sucker | 1.8 | No Destruction or Adverse Modification |
| Flowering Plants | *Chorizanthe pungens var. pungens* | Monterey spineflower | 4.8 | No Destruction or Adverse Modification |
| Flowering Plants | *Chorizanthe robusta var. robusta* | Robust spineflower | 3.0 | No Destruction or Adverse Modification |
| Flowering Plants | *Leavenworthia exigua laciniata* | Kentucky glade cress | 0.3 | No Destruction or Adverse Modification |
| Flowering Plants | *Lupinus sulphureus ssp. kincaidii* | Kincaid's lupine | 2.9 | No Destruction or Adverse Modification |

| Taxa Group | Scientific Name | Common Name | Total % range treated (CoA) | Determination |
|---|---|---|---|---|
| Insects | *Anaea troglodyta floridalis* | Florida leafwing butterfly | 2.3 | No Destruction or Adverse Modification |
| Insects | *Heterelmis comalensis* | Comal Springs riffle beetle | 0.3 | No Destruction or Adverse Modification |
| Insects | *Somatochlora hineana* | Hine's emerald dragonfly | 1.1 | No Destruction or Adverse Modification |
| Insects | *Strymon acis bartrami* | Bartram's hairstreak butterfly | 4.2 | No Destruction or Adverse Modification |
| Insects | *Stygoparnus comalensis* | Comal Springs dryopid beetle | 0.2 | No Destruction or Adverse Modification |
| Mammals | *Zapus hudsonius luteus* | New Mexico meadow jumping mouse | 0.9 | No Destruction or Adverse Modification |
| Reptiles | *Pseudemys rubriventris bangsi* | Plymouth redbelly turtle = Plymouth redbelly cooter | 3.4 | No Destruction or Adverse Modification |
| Reptiles | *Thamnophis eques megalops* | Northern Mexican gartersnake | 1.5 | No Destruction or Adverse Modification |

**Arthropods as prey, pollinators, or seed dispersers as PBFs:**

Of the critical habitats in this group, 35 list the presence of arthropods as an essential PBF, either in the form of pollinators (like the Kincaid's lupine and the Kentucky glade cress) or as prey (like the Georgetown salamander, the Gunnison sage-grouse, or the rush darter, among others). Available toxicity data indicate that arthropods (such as insects and crustaceans) are likely to experience high levels of mortality when exposed to carbaryl (even at low concentrations). We expect there will be large reductions in the abundance of arthropod pollinators and prey in critical habitats exposed to carbaryl. However, we do not expect all arthropod species are equally sensitive to carbaryl due to natural variations in physiology and biochemistry across species. Therefore, we do not expect complete mortality of arthropod communities and that there will still be some pollinators and prey available to support the function of critical habitat. Furthermore, given carbaryl's rapid degradation rate, we anticipate even sensitive arthropod species that experience high mortality will recover within a short period of time (from days to weeks), restoring any impairments to the arthropod PBFs for these critical habitats. Thus, while impacts of carbaryl to arthropod pollinators and prey will be high, some pollinators and prey will be available after exposure and any losses will likely only be temporary. As such, we anticipate all critical habitats in this group that list arthropods as a necessary component will experience medium levels of adverse effect to the arthropod PBF in the very small areas exposed to carbaryl.

**Non-arthropods, including prey, pollinators/seed dispersers and host fish as PBFs:**

There are 15 critical habitats in this group that list the presence of non-arthropod prey species as an essential PBF, either as prey (including the Black Warrior waterdog, bull trout, Plymouth redbelly turtle, and the Northern Mexican gartersnake) or as fish hosts (such as the Cumberlandian combshell, orangenacre mucket, or the oyster mussel). Available toxicity data indicate that non-arthropod animals show a great range of sensitivities to carbaryl. Mollusks, like snails and clams, are not likely to experience any measurable adverse effects to survival, growth, or reproduction at environmentally relevant concentrations of carbaryl. As such, we expect only very low levels of adverse effects to non-arthropod invertebrate prey resources in critical habitats designated for species that consume these taxa, like the Plymouth redbelly turtle, and the Black Warrior waterdog.

Other critical habitats, like those designated for the bull trout and the Northern Mexican gartersnake require other types of non-arthropod prey as an essential critical habitat feature, such as fish, amphibians, and small terrestrial vertebrates. Available toxicity data indicate that fish (and presumably amphibian) prey are likely to experience high levels of adverse effects (including mortality) when exposed to high levels of carbaryl (such as in areas of low flow and low water volume). Given that the bull trout, and Northern Mexican gartersnake can inhabit or forage in a variety of flow and water volume conditions, we expect mortality of fish and amphibian prey will occur only in select areas of critical habitat that are exposed to carbaryl. As such, we anticipate medium levels of adverse effects to the non-arthropod PBF for these critical habitats. In contrast, we anticipate terrestrial vertebrate prey species will only experience high levels of adverse effects when foraging on carbaryl use sites. Given that the on-field portion of the action area overlap with these critical habitats is low (up to 1.5% overlap with carbaryl use sites), we anticipate adverse effects to terrestrial vertebrate prey will only occur on a very small portion of critical habitat, resulting in only low levels of adverse effects to the non-arthropod PBF.

Similarly, critical habitats designated for listed bivalves also list the presence of fish as essential non-arthropod resources of critical habitat. As noted above, we anticipate high levels of adverse effects to fish hosts are likely to occur only in areas of low flow or low water volume. Thus, for critical habitats designated for bivalves that only inhabit high flow waterbodies, such as the ovate clubshell or the Georgia pigtoe, we anticipate low levels of adverse effects to fish hosts are likely to occur. For critical habitats designated for bivalves that can occupy a variety of flow or volume conditions (such as the finelined pocketbook, southern clubshell, and southern pigtoe, among many others), we expect adverse effects to fish hosts will only occur in some exposed areas of critical habitat, resulting in an overall medium level of adverse effects to the non-arthropod PBF. In cases where critical habitat is designated for listed bivalves that are host fish specialists (i.e., can only use a small number of species for successful reproduction), the risk of adverse effects to PBFs is higher as a reduction in the abundance of a small number of fish may still represent a significant loss of fish hosts. As such, critical habitats for fish host specialists, such as the Coosa moccasinshell, are likely to still experience high levels of adverse effects to the non-arthropod PBF even though we anticipate there will be large reductions in fish host abundance only in select areas of critical habitat exposed to carbaryl. However, we anticipate the effects in these small areas of critical habitat will be temporary as carbaryl has a rapid degradation rate in natural environments.

**Water quality as a PBF:**

There are 51 critical habitats in this group that list water quality as an essential critical habitat PBF. Of these critical habitats, 20 are designated for listed bivalve species (such as the Carolina heelsplitter, the fuzzy pigtoe, and the fluted kidneyshell). Available toxicity data in mollusks indicate that these species are not likely to experience any adverse effects to survival, growth, or reproduction at levels of carbaryl predicted to occur in their critical habitats. Thus, we expect these critical habitats will experience only low levels of adverse effects to the water quality PBF. Similarly, EPA’s exposure modeling show that terrestrial vertebrates are not likely to accumulate more than low levels of carbaryl from exposure to contaminated water, which is not likely to result in mortality and only low levels of sublethal adverse effects. As such, we do not expect the presence of carbaryl within exposed areas of critical habitat designated for the piping plover (Great Lakes DPS), Plymouth redbellied turtle, and Northern Mexican gartersnake will cause more than low levels of adverse effects to the water quality PBF.

Available toxicity data indicate that fish (and presumably amphibians) are likely to experience high levels of mortality, but only in areas that accumulate high levels of carbaryl (like low flow or low volume waterbodies). Thus, critical habitats designated for fish and amphibian species that only occupy areas of high flow or large volume (such as the Black warrior waterdog, Alabama sturgeon, amber darter, Conasauga logperch, Rio Grande silvery minnow, sharpnose shiner, and smalleye shiner, among others) are unlikely to experience more than low levels of water quality impairment as their habitats will likely accumulate only low levels of carbaryl. Critical habitats designated for fish and amphibian species that inhabit waterbodies with a variety of flow and volume characteristics (such as those designated for the Chiricahua leopard frog, trispot darter, and diamond darter, among many others) are only likely to experience impaired water quality in select areas of exposed critical habitat. We anticipate that these effects will be temporary as carbaryl has a rapid degradation rate in natural environments. As such, we anticipate these critical habitats will experience an overall medium level of adverse effects to the water quality PBF in areas exposed to carbaryl.

In contrast, available toxicity data indicate that arthropod species like insects and crustaceans are likely to experience high levels of adverse effects (even at low predicted levels of carbaryl). As such, critical habitats designated for aquatic insects and crustaceans (like the Peck’s cave amphipod and Comal Springs riffle beetle) are likely to experience high levels of adverse effects to their water quality PBF with carbaryl exposure. However, we anticipate these impacts to water quality will be limited to small areas of critical habitat given the low level of past carbaryl usage, which indicate that only a small portion of critical habitat is likely to be treated with carbaryl (0.2-0.3% critical habitat treated annually with any insecticide, according to the CoA). Furthermore, we anticipate these water quality impairments will be temporary as carbaryl has a rapid degradation rate in natural environments. Thus, we anticipate high but temporary adverse effects to the water quality PBF in small portions of these critical habitats exposed to carbaryl.

In special cases where critical habitat designations involve cave systems, we anticipate only low levels of adverse effects to water quality are likely (even for critical habitats designated for sensitive taxa, like the Peck's cave amphipod). Given the rapid degradation of carbaryl in natural environments as well as the typical slow transport rates from surface water to subterranean cave systems, like those designated for the Peck's cave amphipod, Georgetown salamander and Salado salamander, we expect only minute levels of carbaryl are likely to reach the cave systems that make up critical habitat for these species. As such, we anticipate no more than low levels of adverse effects to these critical habitats.

**General habitat function requiring no or low levels of chemical contaminants as a PBF:**

There are two critical habitats in this group that list a low level of chemical contaminants present within critical habitat units for proper function (i.e., habitat function) as an essential critical habitat PBF: the Bartram's hairstreak butterfly and the Florida leafwing butterfly. Carbaryl residues on surfaces are likely to result in significant exposures to insects like the Bartram's hairstreak butterfly and Florida leafwing butterfly, which will likely result in mortality of individuals given the high sensitivity of insects to carbaryl. However, we expect this level of impact to basic critical habitat function will be restricted in area given the low levels of past insecticide usage within the range (2.3-4.2% of the range treated annually with any insecticide) as indicated by CoA data. Additionally, we anticipate carbaryl residues will degrade quickly after application (i.e., within days to weeks), indicating that these adverse effects will be temporary, and that critical habitat function will be restored soon after exposure. As such, we anticipate high, but restricted and temporary, adverse effects to critical habitat function PBF for the Florida leafwing butterfly and Bartram's hairstreak butterfly's critical habitat in areas exposed to carbaryl.

**Non-agricultural use**

In addition to agricultural uses of carbaryl, critical habitat can experience additional exposure to carbaryl through non-agricultural uses, such as uses on developed, open space developed, managed forests, rangeland, and rights of way use sites. In general, we do not anticipate these non-agricultural uses will substantially contribute to the overall exposure to critical habitat as non-agricultural uses of carbaryl typically have low usage rates and are applied in ways that reduce off-site a transport to adjacent areas.

<u>Developed and Open Space Developed Use (including Nurseries):</u>

Designated critical habitats for the Chiricahua leopard frog, Houston toad, piping plover, Hine's emerald dragonfly, and Northern Mexican gartersnake may include developed and open space developed use sites as these species migrate through, forage in, or otherwise occupy these use sites, suggesting that these use sights may contain some of the necessary PBFs to support the species. While exposure to carbaryl through developed and open space developed uses may be possible, we anticipate it is unlikely to occur. As a result of the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, most residential and developed area uses of carbaryl are limited to spot treatments (defined as a 2 $ft^2$ area), crack-and-crevice treatment, or narrow perimeter bands around urban structures (from 1 inch to 6 feet) using hand-applicators. This limitation in application method renders off-site spray drift unlikely and greatly reduces the extent of area that can be treated in the developed and nurseries UDLs, which we expect will minimize or prevent exposure to critical habitat for these species.

Available usage data on open space developed uses of carbaryl (such as turf or golf course applications) at a national scale indicate that less than 2.5% of open space developed areas across the country have been treated with carbaryl. While this usage may result in a large treatment footprint if all treated areas were concentrated in one location or within one species' critical habitat, we expect this is highly unlikely to occur. Rather, we expect open space developed usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within each of these critical habitats. As such, we similarly anticipate that these critical habitats that may occur on or near open space developed use sites are not likely to experience more than low levels of carbaryl exposure through this use, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Managed Forest Use:

Designated critical habitats for the Chiricahua leopard frog, Houston toad, Southwestern willow flycatcher, Kincaid's lupine, New Mexico meadow jumping mouse, and Northern Mexican gartersnake may be exposed to carbaryl through use on managed forests as these species are known to use forested habitats. Available usage data from the U.S. Forest Service indicate that, from 2016-2020, no carbaryl had been applied to managed forests within the states containing designated critical habitat of the Chiricahua leopard frog, Houston toad, Kincaid's lupine, New Mexico meadow jumping mouse, and Northern Mexican gartersnake, suggesting that there is a low likelihood that these critical habitats will be exposed to carbaryl through this use type. Where applications have taken place, the majority of treatments have involved small areas (<1 acre), such that if usage did occur, exposure to any individual critical habitat area would be minimal. While records indicate some carbaryl has been used in California, which contains some of the southwestern willow flycatcher's designated critical habitat, we anticipate very little has been used within these designated critical habitats. From 2016-2020, 322 acres of managed forests within the state of California have been treated with carbaryl, specifically to oak woodlands, using ground-based sprayers targeting lower branches and trunks, which we anticipate limit the amount of off-site transport likely to occur. Given that only some parts of the southwestern willow flycatcher's critical habitat is located in California, that oak trees are not included in the list of common tree and shrub species the southwestern willow flycatcher uses for nesting, and since we do not anticipate past carbaryl usage in California would be concentrated in a single area (like a critical habitat unit), we anticipate there is a low likelihood that carbaryl will be used in the species' critical habitat and that exposure to carbaryl from managed forests uses is, at most, low, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Rangeland Use:

Designated critical habitat for the Chiricahua leopard frog, Poweshiek skipperling, New Mexico meadow jumping mouse, and northern Mexican gartersnake may include or be located in areas adjacent to rangeland use sites as these species are known to occur in or near these habitats. While it is possible these critical habitats can be exposed to carbaryl through rangeland uses, we do not anticipate that is likely to occur as available usage data from USDA APHIS indicate that, from 2019-2023, no carbaryl has been used to treat rangeland habitat within the states containing designated critical habitat. In addition, we anticipate all rangeland applications of carbaryl will be carried out in association with USDA APHIS as part of their grasshopper and Mormon cricket suppression program (USFWS 2024), which includes many conservation measures that are meant to protect listed species and their critical habitats from exposure. As such, we do not anticipate these critical habitats are likely to be exposed to carbaryl through rangeland use, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

Rights of Way Use:

Designated critical habitat for the western snowy plover may occur on or near rights of way use sites as the species is known to occupy these use sites. While exposure to carbaryl through rights of way uses may be possible, we do not anticipate exposure is likely to occur given the low level of carbaryl usage in rights of ways. Available usage information indicates that carbaryl is used infrequently in rights of ways, with less than 500 pounds of carbaryl applied to roadways nationally each year. While this may result in a large treatment footprint if all rights of way usage were concentrated within the western snowy plover's critical habitat, we expect this is highly unlikely to occur and rather expect rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl, if any, will be used within the western snowy plover's critical habitat for rights of way uses, resulting in no more than minor reductions in the abundance of arthropod prey, non-arthropod prey, and pollinators, or low-level impacts to water quality or general habitat function.

**Group Conclusion**

In summary, we anticipate a range of impacts will occur to the different PBFs of the critical habitats listed above in Table 5. Adverse effects to arthropod prey and pollinator PBFs are likely high in magnitude, particularly for sensitive species of arthropods, but we anticipate some pollinators and prey will still be available after exposure and any losses will likely only be temporary. Adverse effects to non-arthropod species may be high, especially for fish hosts that occur in low flow or low volume waterbodies or for terrestrial vertebrate prey that forage on carbaryl use sites. In contrast, we expect fish hosts in high flow or large volume waterbodies or terrestrial vertebrate prey that do not enter carbaryl use sites are not likely to experience more than small reductions to survival, growth, or reproduction. Similarly, water quality will be impaired by carbaryl exposure, but we expect high levels of impairment are likely to occur only in specific habitat types (i.e., low flow or low volume water bodies). Adverse effects to basic habitat function of terrestrial habitats are also likely to occur but is likely to occur only for species that are known to be sensitive to carbaryl (i.e., arthropod species). We anticipate all adverse effects to all categories of PBFs will be temporary as carbaryl degrades rapidly in natural environments. Additionally, we expect these adverse effects will be highly limited in area given the low level of past carbaryl usage as informed by the CoA all insecticide data. Thus, even though some critical habitats in this group will experience high levels of adverse effects to their PBFs, we anticipate these adverse effects will be temporary (indicating that repeated exposures will not increase the level of adverse effects to PBFs), limited to a very small area, and will not cause more than minor impacts to the overall critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitats for the species listed in Table 5.

## Critical Habitats with Individual Determinations and Rationales

For the following critical habitats, our preliminary assessments indicated that the proposed action may result in levels of adverse effects that warranted an in-depth analysis. As such, we discuss each of these critical habitats in more detail in individual summaries below.

**Table 6. Critical habitats with moderate to high adverse effects anticipated from the proposed action. We address each critical habitat in individual summaries.**

| Taxa Group | Common Name | Scientific Name | Determination |
|---|---|---|---|
| Amphibians | Neuse River waterdog | *Necturus lewisi* | No destruction or adverse modification |
| Amphibians | Reticulated flatwoods salamander | *Ambystoma bishopi* | No destruction or adverse modification |
| Birds | Whooping crane | *Grus americana* | No destruction or adverse modification |
| Birds | Yellow-billed cuckoo | *Coccyzus americanus* | No Destruction or adverse modification |
| Bivalves | Purple bankclimber (mussel) | *Elliptoideus sloatianus* | No destruction or adverse modification |
| Bivalves | Oval pigtoe | *Pleurobema pyriforme* | No destruction or adverse modification |
| Bivalves | Shinyrayed pocketbook | *Hamiota subangulata* | No destruction or adverse modification |
| Bivalves | Fat threeridge (mussel) | *Amblema neislerii* | No destruction or adverse modification |
| Bivalves | Gulf moccasinshell | *Medionidus penicillatus* | No destruction or adverse modification |
| Bivalves | Ochlockonee moccasinshell | *Medionidus simpsonianus* | No destruction or adverse modification |
| Bivalves | Chipola slabshell | *Elliptio chipolaensis* | No destruction or adverse modification |
| Bivalves | Fuzzy pigtoe | *Pleurobema strodeanum* | No destruction or adverse modification |
| Bivalves | Rabbitsfoot | *Quadrula cylindrica cylindrica* | No destruction or adverse modification |
| Bivalves | Choctaw bean | *Obovaria choctawensis* | No destruction or adverse modification |
| Bivalves | Yellow lance | *Elliptio lanceolata* | No destruction or adverse modification |
| Bivalves | Neosho mucket | *Lampsilis rafinesqueana* | No destruction or adverse modification |
| Bivalves | Altamaha spinymussel | *Elliptio spinosa* | No destruction or adverse modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Common Name | Scientific Name | Determination |
|---|---|---|---|
| Bivalves | Tapered pigtoe | *Fusconaia burkei* | No destruction or adverse modification |
| Bivalves | Atlantic pigtoe | *Fusconaia masoni* | No destruction or adverse modification |
| Bivalves | Southern sandshell | *Hamiota australis* | Destruction or adverse modification |
| Bivalves | Suwannee moccasinshell | *Medionidus walkeri* | No destruction or adverse modification |
| Bivalves | Southern kidneyshell | *Ptychobranchus jonesi* | Destruction or adverse modification |
| Bivalves | Green floater | *Lasmigona subviridis* | No destruction or adverse modification |
| Bivalves | False spike | *Fusconaia mitchelli* | Destruction or adverse modification |
| Bivalves | Western fanshell | *Cyprogenia aberti* | No destruction or adverse modification |
| Bivalves | Salamander mussel | *Simpsonaias ambigua* | No destruction or adverse modification |
| Bivalves | Texas fawnsfoot | *Truncilla macrodon* | Destruction or adverse modification |
| Bivalves | Texas pimpleback | *Cyclonaias petrina* | Destruction or adverse modification |
| Bivalves | Round hickorynut | *Obovaria subrotunda* | No destruction or adverse modification |
| Bivalves | Longsolid | *Fusconaia subrotunda* | No destruction or adverse modification |
| Crustaceans | Brawleys Fork crayfish | *Cambarus williamsi* | Destruction or adverse modification |
| Crustaceans | Panama City crayfish | *Procambarus econfinae* | No destruction or adverse modification |
| Crustaceans | Vernal pool fairy shrimp | *Branchinecta lynchi* | No destruction or adverse modification |
| Crustaceans | Noel's amphipod | *Gammarus desperatus* | No destruction or adverse modification |
| Fishes | Peppered chub | *Macrhybopsis tetranema* | Destruction or adverse modification |
| Fishes | Maryland darter | *Etheostoma sellare* | No destruction or adverse modification |
| Fishes | Alabama cavefish | *Speoplatyrhinus poulsoni* | No destruction or adverse modification |
| Fishes | Slackwater darter | *Etheostoma boschungi* | No destruction or adverse modification |

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

| Taxa Group | Common Name | Scientific Name | Determination |
|---|---|---|---|
| Fishes | Arkansas River shiner | *Notropis girardi* | Destruction or adverse modification |
| Fishes | Topeka shiner | *Notropis topeka (=tristis)* | No destruction or adverse modification |
| Fishes | Carolina madtom | *Noturus furiosus* | No destruction or adverse modification |
| Fishes | Diamond darter | *Crystallaria cincotta* | No destruction or adverse modification |
| Fishes | Spring pygmy sunfish | *Elassoma alabamae* | No destruction or adverse modification |
| Flowering Plants | Sand dune phacelia | *Phacelia argentea* | Destruction or adverse modification |
| Flowering Plants | Wright's marsh thistle | *Cirsium wrightii* | No destruction or adverse modification |
| Flowering Plants | Florida brickell-bush | *Brickellia mosieri* | Destruction or adverse modification |
| Flowering Plants | White Bluffs bladderpod | *Physaria douglasii ssp. tuplashensis* | No destruction or adverse modification |
| Flowering Plants | Carter's small-flowered flax | *Linum carteri carteri* | Destruction or adverse modification |
| Insects | Salt Creek Tiger beetle | *Cicindela nevadica lincolniana* | Destruction or adverse modification |
| Insects | Poweshiek skipperling | *Oarisma poweshiek* | Destruction or adverse modification |
| Mammals | Indiana bat | *Myotis sodalis* | No destruction or adverse modification |
| Mammals | Buena Vista Lake ornate shrew | *Sorex ornatus relictus* | Destruction or adverse modification |
| Reptiles | Rim rock crowned snake | *Tantilla oolitica* | No destruction or adverse modification |

## *Amphibians*

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**Neuse River waterdog (*Necturus lewisi*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of native aquatic fauna (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt- free gravel, small cobble, coarse sand, and leaf litter substrates) as well as abundant cover and burrows used for nesting.
- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain instream habitats where the species is found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the waterdog's habitat, food availability, and ample oxygenated flow for spawning and nesting habitat.
- Water quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- Invertebrate and fish prey items, which are typically hellgrammites, crayfish, mayflies, earthworms, snails, beetles, centipedes, slugs, and small fish.

The features essential to the conservation of the Carolina madtom and Neuse River waterdog may require special management considerations or protections to reduce the following threats: (1) Urbanization of the landscape, including (but not limited to) land conversion for urban and commercial use, infrastructure (roads, bridges, utilities), and urban water uses (water supply reservoirs, wastewater treatment, etc.); (2) nutrient pollution and sedimentation from agricultural activities that impact water quantity and quality; (3) significant alteration of water quality; (4) improper forest management or clearcuts in riparian areas; (5) culvert and pipe installation that create barriers to movement; (6) impacts from invasive species; (7) changes and shifts in seasonal precipitation patterns as a result of climate change; and (8) other watershed and floodplain disturbances that release sediments or nutrients into the water.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey, non-arthropod prey, and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between the agricultural use sites and the critical habitat (41.1% total overlap) (Table 7). There is a high level of past carbaryl usage (up to 23.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 7. Overlap and past usage data for the critical habitat of the Neuse River waterdog.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 41.1 | 23.6 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations up to 862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods are highly sensitive to carbaryl and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Since the Neuse River waterdog is an invertebrate generalist, we anticipate individuals will have sufficient food resources available as we expect some arthropod prey will be still available after exposure and any losses will likely only be temporary. Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 8).

In contrast, available toxicity data indicate that non-arthropod prey species, such as gastropods and small fish that the waterdog can consume, are not likely to experience any adverse effects as estimated environmental concentrations of carbaryl are below levels where adverse effects are expected to occur to these non-arthropod species. We do not anticipate any gastropod prey will die and expect no more than low levels of fish prey mortality (i.e., <0.1% of exposed individuals will die). As such, we anticipate only low levels of adverse effects are likely to occur to the non-arthropod PBF.

Based on available toxicity data in fish (which we use as surrogate data for aquatic phase amphibians), we anticipate amphibians will not experience more than low levels of mortality as maximum estimated environmental concentrations are well below the $HC_{05}$ for fish mortality that EPA reported in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at maximum predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate a low likelihood that individual Neuse River waterdogs will experience high levels of mortality within critical habitat. As such, we do not anticipate the presence of carbaryl residues in critical habitat will prevent individuals from occupying critical habitat, indicating no more than low levels of adverse impacts to the water quality PBF.

**Table 8. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Low |
| non-arthropods (as prey or hosts) | X | presence of small fish, gastropods, annelids prey | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and the agricultural use areas and a high level of past agricultural usage, we do not anticipate more than low levels of adverse effects to the water quality or non-arthropod prey PBFs as estimated environmental concentrations are not high enough to cause more than low levels of non-arthropod prey or amphibian mortality (Table 8). Because non-agricultural uses of carbaryl will result in similar estimated environmental concentrations of carbaryl as agricultural uses, we also anticipate non-agricultural uses will not cause more than low levels of adverse impacts to non-arthropod and water quality PBFs. While we anticipate sensitive arthropod species will experience high levels of mortality, we anticipate this decrease in available prey species will only be temporary as we anticipate the prey community will recover once carbaryl residues degrade. Furthermore, as an arthropod prey generalist, we anticipate the Neuse River waterdog can rely on other, less sensitive prey species, while the arthropod prey community recovers. As such, we anticipate no more than medium levels of adverse effects to the arthropod prey PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Neuse River waterdog.

***References***

U. S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Neuse River Waterdog, Endangered Species Status for Carolina Madtom, and Designations of Critical Habitat. Final Rule. Federal Register 86.

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**Reticulated flatwoods salamander (*Ambystoma bishopi*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Small (generally less than 1-10 ac), isolated ponds that are typically acidic, tannin-stained, ephemeral, and located within mesic to intermediate-mesic flatwoods
    - Seasonally flooded by rainfall in late fall or early winter and dry in late spring or early summer
    - Relatively open canopy to maintain herbaceous layers
    - Have burrowing crayfish fauna, but lack large, predatory fish due to periodic drying
- Upland pine flatwoods-savanna habitat that is open, mesic woodland maintained by frequent fires and that contains crayfish burrows or other underground habitat that flatwoods salamanders depend upon and dominated by wiregrasses in abundant herbaceous ground cover to support the flatwoods salamander’s arthropod prey
- Upland areas that facilitate movement between breeding and non-breeding area, characterized by subsurface structures like those created by deep litter cover or crayfish burrows.

The critical habitat final rule (see *Primary Constituent Elements: Food, Water, Air, Light, or Other Nutritional or Physiological Requirements*) states that "[w]etland water quality is important to maintain the aquatic invertebrate fauna eaten by larval salamanders. An unpolluted wetland with water free of predaceous fish, sediment, pesticides, and the chemicals associated with road runoff, is important to maintain the aquatic invertebrate fauna [that is] eaten by larval salamanders." Water quality would be reduced with the use of pesticides, which would affect the arthropod prey (particularly, crustaceans and other aquatic invertebrates) upon which larva and adult reticulated flatwoods salamanders rely for food.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

There is a high extent of overlap between the agricultural use sites and the critical habitat (36.2% total overlap) (Table 9). There is a high level of past carbaryl usage (up to 33.7% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl. However, we do not anticipate these uses will expose more than a small portion of critical habitat, if at all. Available usage data from the U.S. Forest Service and USDA APHIS indicate that no carbaryl has been used in managed forests and rangeland habitats within the regions where the reticulated flatwoods salamander's critical habitat is located, indicating a low likelihood of exposure from these uses. If applications did occur for either of these uses, we would expect them to be in small areas only (<1 acre) or include conservation measures in accordance with the USDA APHIS grasshopper and Mormon cricket suppression program (USFWS 2024). Existing product labels require applicators in residential and developed uses sites to use spot and crack-and-crevice applications for most uses and apply carbaryl using a 25-ft buffer to waterbodies, which renders off-site transport through spray drift and runoff unlikely for developed and nursery uses of carbaryl. Available data on open space developed uses of carbaryl (such as turf or golf course applications) indicate that less than 2.5% of open space developed areas have been treated with carbaryl while only 500 pounds of carbaryl are used on rights of ways annually. While this open space developed and rights of way usage may result in a large treatment footprint if all treated areas were concentrated within a single critical habitat, we expect this is highly unlikely to occur. Rather, we expect open space developed and rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within a particular critical habitat. Based on the past usage data and current label requirements, we anticipate that non-agricultural uses of carbaryl are not likely to expose more than a small portion of critical habitat, if at all.

**Table 9. Overlap and past usage data for the critical habitat of the reticulated flatwoods salamander.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---|---|---|---|---|---|
| 18.5 | 17.7 | 36.2 | 17.3 | 16.5 | 33.7 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations up to 862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Since the reticulated flatwoods salamander is an invertebrate generalist, we anticipate individuals will have sufficient food resources available as we expect some arthropod prey will be still available after exposure and any losses will likely only be temporary. Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 10).

Based on available toxicity data in fish (which we use as surrogate data for aquatic phase amphibians), we anticipate amphibians will not experience more than low levels of mortality as maximum estimated environmental concentrations are well below the $HC_{05}$ for fish mortality that EPA reported in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at maximum predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate a low likelihood that reticulated flatwoods salamander individuals will experience high levels of mortality within critical habitat. As such, we do not anticipate the presence of carbaryl residues in critical habitat will prevent individuals from occupying critical habitat, indicating no more than low levels of adverse effects to the water quality PBF.

**Table 10. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and the agricultural use areas and a high level of past agricultural usage, we do not anticipate more than low levels of adverse effects to the water quality PBF as estimated environmental concentrations are not high enough to cause more than low levels of amphibian mortality (Table 10). Because non-agricultural uses of carbaryl will result in similar estimated environmental concentrations of carbaryl as agricultural uses, we also anticipate non-agricultural uses will not cause more than low levels of adverse impacts to non-arthropod and water quality PBFs. While we anticipate sensitive arthropod species will experience high levels of mortality, we anticipate this decrease in available prey species will be only temporary as we anticipate the prey community will recover once carbaryl residues degrade. Furthermore, as an arthropod prey generalist, we anticipate the reticulated flatwoods salamander can rely on other, less sensitive prey species, while the arthropod prey community recovers. As such, we anticipate no more than medium levels of adverse effects to the arthropod prey PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the reticulated flatwoods salamander.

***References***

U.S. Fish and Wildlife Service. 2009. Endangered and Threatened Wildlife and Plants, Determination of Endangered Status for Reticulated Flatwoods Salamander, Designation of Critical Habitat for Frosted Flatwoods Salamander and Reticulated Flatwoods Salamander. Federal Register 74(26): 6700-6774.

## *Birds*

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### Whooping crane (*Grus americana*)

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Each pair requires several hundred acres of undisturbed habitat. Unmated subadults must have suitable habitat that is not regularly defended by paired cranes.
- Various crustaceans and mollusks (i.e., prey) found in tidal flats and marshes. During spring migration, whooping cranes prey on crayfish, frogs, small fish, and other small animals in wetlands. During fall migration, whooping cranes seem to feed more extensively in recently harvested grain fields where insects and wasted grains constitute the bulk of their diet.
- Open expanse for nightly roosting; cranes use sand or gravel bars in rivers and lakes for nightly roosting. During migrations, feeding cranes are often found within short flight distances of reservoirs, lakes, and large rivers that offer bare islands for nightly roosting.
- Habitats essential to the rearing of young whooping cranes, including sites for training and protection as well as feeding and other normal behavior.
- Close proximity to wetlands that provide undisturbed roosting sites.

The description of the critical habitat for the whooping crane includes the elements above. The rule states that "The Critical Habitat zones include roosting areas used during migration, as well as rearing and wintering areas." Adequate invertebrate and small vertebrate prey populations are needed within those habitats for suitable foraging opportunities to breed, rear young, migrate and overwinter.

***Effects of the Action***

We expect carbaryl use will impact arthropod and non-arthropod prey, which are critical habitat PBFs that are essential for the conservation of the species.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (23% total overlap) (Table 11). There is a high level of past carbaryl usage (up to 23% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl. Our review of the specific PBF requirements listed above indicates that managed forests, developed, and nursery use sites are not likely to contain or produce many of the PBF requirements. As such, we do not expect these non-agricultural uses of carbaryl will expose critical habitat. In contrast, open space developed, rangeland, and rights of way use sites are likely to contain at least some of the PBFs required to support the species. However, available usage data from USDA APHIS indicate no carbaryl has been used in rangeland habitats within the states containing the whooping crane's critical habitat, suggesting that there is a low likelihood that critical habitat will be exposed through this use. Available data on open space developed uses of carbaryl (such as turf or golf course applications) indicate that less than 2.5% of open space developed areas have been treated with carbaryl while only 500 pounds of carbaryl are used nationally on rights of ways annually. While this open space developed and rights of way usage may result in a large treatment footprint if all treated areas were concentrated in a single critical habitat, we expect this is highly unlikely to occur. Rather, we expect open space developed and rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within a particular critical habitat. As such, we anticipate that non-agricultural uses of carbaryl are not likely to expose more than a small portion of critical habitat, if at all.

**Table 11. Overlap and past usage data for the critical habitat of the whooping crane.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 16 | 7 | 23 | 16 | 7 | 23 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect maximum estimated environmental concentrations in aquatic areas are likely to reach up to 780.4 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the whooping crane consumes, are highly sensitive to carbaryl and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Since the whooping crane is an opportunistic omnivore, we anticipate individuals will have sufficient food resources available as we expect other prey and dietary items will still be available after exposure and any losses of arthropod prey are temporary. Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur.

Based on available toxicity data in fish and birds (which we use as surrogates for aquatic phase amphibians and reptiles, respectively), we anticipate fish, bird, amphibian, and reptile prey will not experience more than low levels of mortality (i.e., <0.1% of exposed individuals will die) at predicted environmental concentrations within critical habitat. We anticipate small mammals that forage on agricultural use sites will experience high levels of mortality, but small mammal prey exposed in off-site areas are not likely to experience any direct adverse effects. While there will be some reductions in small mammal prey availability from on-field exposure, we do not expect this will result in more than low levels of adverse effects to the non-arthropod prey PBF as we anticipate the whooping crane will still have sufficient non-arthropod prey resources available as other non-arthropod prey species will only experience low levels of mortality.

**Table 12. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | X | presence of amphibians, mammals (small), birds, fruit, seeds, benthic invertebrates, fish prey | Low |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs (Table 12). While estimated environmental concentrations of carbaryl will cause high levels of mortality to small mammal prey, we expect this adverse effect will be limited to small mammal prey that forage in agricultural use sites and that other non-arthropod prey species will not experience any adverse effects to survival, indicating that there will be sufficient non-arthropod prey available for the whooping crane. Similarly, while we anticipate carbaryl exposure will cause high levels of mortality in sensitive arthropod species, we expect this decrease in arthropod prey abundance will be temporary as we anticipate the prey community will recover once carbaryl residues degrade. Furthermore, as an opportunistic generalist feeder, we anticipate the whooping crane can rely on other, less sensitive prey species while the arthropod prey community recovers. Given that only a small portion of critical habitat, if any, will be exposed by non-agricultural uses of carbaryl, we anticipate no more than minor adverse effects to critical habitat PBFs are likely from these uses. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the whooping crane.

***References***

U.S. Fish and Wildlife Service. 1978. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Whooping Crane. Final Rule. Federal Register 43: 20938-20942.

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**Yellow-billed Cuckoo (*Coccyzus americanus*)**

***Conclusion:*** Not likely to destroy of adversely modify designated critical habitat

***Physical & Biological Features:***

- Range-wide breeding habitat. Riparian woodlands across the Distinct Population Segment (DPS); Southwestern breeding habitat, primarily in Arizona and New Mexico: Drainages with varying combinations of riparian, xeroriparian, and/or non-riparian trees and large shrubs. This physical or biological feature includes breeding habitat found throughout the DPS range as well as additional breeding habitat characteristics unique to the Southwest.
- Adequate prey base. Presence of prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies, moth larvae, spiders), lizards, or frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas.
- Hydrologic processes. The movement of water and sediment in natural or altered systems that maintains and regenerates breeding habitat. This physical or biological feature includes hydrologic processes found in range-wide breeding habitat as well as additional hydrologic processes unique to the Southwest in southwestern breeding habitat.

These habitat features can be summarized as riparian woodlands with dynamic riverine processes that support adequate arthropod and non-arthropod prey. As stated in the critical habitat final rule (see *Application of the "Adverse Modification" Standard*), "[s]praying of pesticides that would reduce insect prey populations within or adjacent to riparian habitat" is an action that "would appreciably diminish habitat value or quality through direct or indirect effects" for the yellow-billed cuckoo.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and non-arthropod prey, which are critical habitat PBFs that are essential for the conservation of the species. The yellow-billed cuckoo consumes a wide range of insects as well as some vertebrate prey like tree frogs and lizards.

There is a high extent of overlap between agricultural uses of carbaryl area and the critical habitat (30.9% total overlap) (Table 13). There is a high level of past carbaryl usage (up to 29.4%

critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action (particularly if the areas treated change each year).

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl. Our review of the specific PBF requirements listed above indicates that developed and nursery use sites do not likely contain or produce many of the PBF requirements. As such, we do not expect these non-agricultural uses will expose critical habitat. In contrast, managed forests, rangeland, open space developed, and rights of way use sites are likely to contain at least some of the PBFs required to support the species. However, we do not anticipate more than low levels of usage for these particularly use patterns. Available usage data from the U.S. Forest Service and USDA APHIS indicate no carbaryl has been used in managed forests or rangeland habitats within the yellow-billed cuckoo's critical habitat, suggesting that there is a low likelihood that critical habitat will be exposed through these uses. If applications did occur for either of these uses, we would expect them to be in small areas only (<1 acre) or include conservation measures in accordance with the USDA APHIS grasshopper and Mormon cricket suppression program (USFWS 2024). Available data on open space developed uses of carbaryl (such as turf or golf course applications) indicate that less than 2.5% of open space developed areas have been treated with carbaryl while only 500 pounds of carbaryl are used nationally on rights of ways annually. While this open space developed and rights of way usage may result in a large treatment footprint if all treated areas were concentrated in a single critical habitat and applied all at once, we expect this is highly unlikely to occur. Rather, we expect open space developed and rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within a particular critical habitat each year. As such, we anticipate that non-agricultural uses of carbaryl are not likely to expose more than a small portion of critical habitat, if at all.

**Table 13. Overlap and past usage data for the critical habitat of the yellow-billed cuckoo.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 13.5 | 17.3 | 30.9 | 13.1 | 16.4 | 29.4 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below.

Available toxicity data indicate that arthropods are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl as natural variations in species' physiologies, life histories, and behaviors will result in different responses to carbaryl. As such, we anticipate there will likely still be food resources in critical habitat despite a reduction in the abundance of sensitive prey species. Furthermore, the yellow-billed cuckoo is generalist feeder that can consume a wide range of insect prey, and they are able to forage in dense vegetation where insects would be less likely to be exposed and would remain available. We anticipate individuals will often still have food resources available despite a reduction in the abundance of sensitive species. Additionally, we anticipate impacted prey species will recover over time once carbaryl residues have degraded after applications (which should occur within days to weeks of exposure). As such, we expect that some arthropod prey will still be available after exposure and any losses will likely only be temporary, resulting in moderate, episodic impacts to the arthropod prey PBF (Table 14).

Based on available toxicity data in birds (which we use as surrogates for terrestrial-phase amphibians and reptiles), we anticipate amphibian and reptile prey will not experience more than low levels of mortality (i.e., <0.1% of exposed individuals will die) at predicted environmental concentrations within critical habitat. As such, we do not expect carbaryl use will result in more than low levels of adverse effects to the non-arthropod prey PBF as we anticipate the yellow-billed cuckoo will have sufficient non-arthropod food resources available within critical habitat even in high exposure scenarios.

**Table 14. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | X | Presence of amphibian and reptile prey | Low |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we anticipate only low to medium levels of adverse effects to critical habitat PBFs. While estimated environmental concentrations of carbaryl will cause high levels of mortality to sensitive arthropod species, we expect this decrease in arthropod prey abundance will be temporary as we anticipate the prey community will recover once carbaryl residues degrade. Furthermore, as an opportunistic generalist feeder, we anticipate the yellow-billed cuckoo can rely on other, less sensitive prey species while the arthropod prey community recovers, such as amphibian and lizard prey, which are not likely to experience more than low levels of adverse effects from carbaryl exposure. Given that only a small portion of critical habitat, if any, will be exposed by non-agricultural uses of carbaryl, we anticipate no more than minor adverse effects to critical habitat PBFs are likely from these uses. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the yellow-billed cuckoo.

***References***

U.S. Fish and Wildlife Service. 1976. Determination of the yellow-shouldered blackbird as an endangered species and designation of critical habitat. Federal Register 41: 51019 51022.

U.S. Fish and Wildlife Service. 2023. Status Review, Yellow-shouldered blackbird or mariquita (*Agelaius xanthomus*). Mayagüez, Puerto Rico. 19 pp.

## *Bivalves*

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**Purple bankclimber (mussel) (*Elliptoideus sloatianus*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.
- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.
- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat final rule, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "[s]everal studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the critical habitat final rule states "[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves." As stated in the critical habitat final rule, "[t]he temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for purple bankclimbers have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for purple bankclimbers is further complicated by their dependency on fish hosts, which may exhibit different tolerances" (see *Principle Constituent Elements* section in the critical habitat final rule).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (33.8% total overlap) (Table 15). There is a high level of past carbaryl usage (up to 6.5% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 15. Overlap and past usage data for the critical habitat of the purple bankclimber.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 33.8 | 6.5 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations up to 862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 16).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the purple bankclimber's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, and since the purple bankclimber is a host fish generalist that can use a variety of fish species as hosts, we anticipate the purple bankclimber is not likely to experience a large reduction in available host fish within critical habitat. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 16. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. Because we expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the purple bankclimber.

***References***

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286 – 64340.

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**Oval pigtoe (*Pleurobema pyriforme*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.

- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.
- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat final rule, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "[s]everal studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the critical habitat final rule states "[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves." As stated in the critical habitat final rule, "[t]he temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for oval pigtoes have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for oval pigtoes is further complicated by their dependency on fish hosts, which may exhibit different tolerances" (see *Principle Constituent Elements* section).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (35.9% total overlap) (Table 17). There is a high level of past carbaryl usage (up to 10.1% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 17. Overlap and past usage data for the critical habitat of the oval pigtoe.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---|---|
| 35.9 | 10.1 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations up to 103.7 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 18).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the oval pigtoe's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 18. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at maximum estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the oval pigtoe.

***References***

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286-64340.

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**Shinyrayed pocketbook (*Hamiota subangulata*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.
- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.
- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat final rule, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "[s]everal studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the final rule states "[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves." As stated in the critical habitat final rule, "[t]he temperature, dissolved oxygen

(DO), pH, and conductivity ranges that define suitable habitat conditions for shinyrayed pocketbooks have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for shinyrayed pocketbooks is further complicated by their dependency on fish hosts, which may exhibit different tolerances" (see *Principle Constituent Elements* section).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (37.6% total overlap) (Table 19). There is a high level of past carbaryl usage (up to 10.5% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 19. Overlap and past usage data for the critical habitat of the shinyrayed pocketbook.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 37.6 | 10.5 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach up to 647-862.8µg/L, depending on the specific water body characteristics (e.g., flow rate, volume of water) and the specific crops treated. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 20).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for the species. However, we expect the shinyrayed pocketbook's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, and since the shinyrayed pocketbook is a host fish generalist that can use a variety of fish species as hosts, we anticipate the shinyrayed pocketbook is not likely to experience a large reduction in available host fish within critical habitat. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 20. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of exposure, we anticipate no more than low levels of adverse effects to the water quality PBF and, at most, low adverse effects to the fish host PBF. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the shinyrayed pocketbook.

***References***

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286-64340.

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**Fat threeridge (mussel) (*Amblema neislerii*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.
- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.
- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat final rule, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "Several studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the critical habitat final rule states “[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves.” As stated in the critical habitat final rule, “[t]he temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for fat threeridge mussels have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for fat threeridge mussels is further complicated by their dependency on fish hosts, which may exhibit different tolerances” (see *Primary Constituent Elements* section).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (46.3% total overlap) (Table 21). There is a high level of past carbaryl usage (up to 19.5% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 21. Overlap and past usage data for the critical habitat of the fat threeridge.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 46.3 | 19.5 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 22).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the fat threeridge's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, and since the fat threeridge is a host fish generalist that can use a variety of fish species as hosts, we anticipate the fat threeridge is not likely to experience a large reduction in available host fish within critical habitat. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 22. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the fat threeridge.

***References***

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286-64340.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for Fat Threeridge (*Amblema neislerii*), Amendment. Atlanta, Georgia. 10 pp.

**Gulf moccasinshell (*Medionidus penicillatus*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.
- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.
- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat final rule, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "[s]everal studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the final rule states "[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves." As stated in the critical habitat final rule, "[t]he temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for Gulf moccasinshells have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for Gulf moccasinshells is further complicated by their dependency on fish hosts, which may exhibit different tolerances" (see *Principle Constituent Elements* section).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are

deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (39.8% total overlap) (Table 23). There is a high level of past carbaryl usage (up to 11.7% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 23. Overlap and past usage data for the critical habitat of the Gulf moccasinshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 39.8 | 11.7 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-138 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 24).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Gulf moccasinshell's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to survival or reproduction in fish. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 24. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Gulf moccasinshell.

***References***

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286-64340.

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**Ochlockonee moccasinshell (*Medionidus simpsonianus*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.
- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.

- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "[s]everal studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the critical habitat final rule states “[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves.” As stated in the critical habitat final rule, “[t]he temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for Ochlockonee moccasinshells have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for Ochlockonee moccasinshells is further complicated by their dependency on fish hosts, which may exhibit different tolerances” (see *Principle Constituent Elements* section of the critical habitat rule).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (22.5% total overlap) (Table 25). There is a high level of past carbaryl usage (up to 22.3% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 25. Overlap and past usage data for the critical habitat of the Ochlockonee moccasinshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 22.5 | 22.3 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-135 µg/L. We anticipate non-agricultural uses of carbaryl will result estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 26).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Ochlockonee moccasinshell's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to survival or reproduction in fish. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 26. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (unknown) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Ochlockonee moccasinshell.

***References***

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286-64340.

**Chipola slabshell (*Elliptio chipolaensis*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channel.
- Predominantly sand, gravel, and/or cobble stream substrate with low to medium amounts of silt and clay.
- Permanently flowing water.
- Water quality, including temperature, turbidity, dissolved oxygen, and chemical constituents.
- Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval stages.

In the critical habitat, the narrative for the water quality PBF discusses the impacts of pesticides on mussels: "[s]everal studies have described adverse effects of pesticides on mussels … Commonly used pesticides were cited as the likely cause of a mussel die-off in a North Carolina stream." In the Special Management Considerations and Protection section, the critical habitat final rule states “[s]treams that receive a high proportion of their flow from the discharge of springs are vulnerable to nutrient enrichment from fertilizers and to other pollutants applied in the recharge areas of those springs (units 1, 2, and 7), which may extend far from the streams themselves.” As stated in the critical habitat final rule, “[t]he temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for Chipola slabshells have not been specifically investigated. As sedentary animals, mussels must tolerate the full range of these parameters to persist in a stream. Quantifying water quality tolerances for Chipola slabshells is further complicated by their dependency on fish hosts, which may exhibit different tolerances” (see *Principle Constituent Elements* section of the critical habitat rule).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (37% total overlap) (Table 27). There is a high level of past carbaryl usage (up to 28.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 27. Overlap and past usage data for the critical habitat of the Chipola slabshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 37 | 28.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-103 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 28).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Chipola slabshell's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 28. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (specialist) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Chipola slabshell.

### *References*

U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered and Two Threatened Mussels in Four Northeast Gulf of Mexico Drainages. Final Rule. Federal Register 72: 64286-64340.

**Fuzzy pigtoe (*Pleurobema strodeanum*)**

***Conclusion:*** Not likely to destroy or adversely modify critical habitat

***Physical & Biological Features:***

Within the critical habitat areas, the primary constituent elements of the physical or biological features essential to the conservation of the fuzzy pigtoe consist of five components:

- Geomorphically stable stream and river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation).
- Stable substrates of sand or mixtures of sand with clay or gravel with low to moderate amounts of fine sediment and attached filamentous algae.
- A hydrologic flow regime (magnitude, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found, and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for habitat maintenance, food availability, and spawning habitat for native fishes.
- Water quality, including temperature (not greater than 32 °C), pH (between 6.0 to 8.5), oxygen content (not less than 5.0 milligrams per liter), hardness, turbidity, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.
- The presence of fish hosts. Diverse assemblages of native fish species will serve as a potential indication of host fish presence until appropriate host fishes can be identified. For the fuzzy pigtoe and tapered pigtoe, the presence of blacktail shiner (*Cyprinella venusta*) will serve as a potential indication of fish host presence.

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, dams, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on November 9, 2012, with the exception of the impoundments created by Point A and Gantt Lake dams (impounded water, not the actual dam structures).

Many of the threats to this mussel and its habitat are pervasive and common in all the units that are designated as critical habitat. These include the potential of significant changes in stream bed material composition and quality by activities such as construction projects, livestock grazing, timber harvesting, and other watershed and floodplain disturbances that release sediments or nutrients into the water; the potential of significant alteration of water chemistry or water quality; the potential of anthropogenic activities such as channelization, impoundment, and channel excavation that could cause aggradation or degradation of the channel bed elevation or significant bank erosion; and the potential of significant changes in the existing flow regime due to such activities as impoundment, water diversion, or water withdrawal. Because the areas designated as critical habitat are facing these threats, they require special management consideration and protection.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a moderate extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (11.6% total overlap) (Table 29). There is a medium level of past carbaryl usage (up to 5.2% critical habitat treated annually), suggesting that a moderate portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 29. Overlap and past usage data for the critical habitat of the fuzzy pigtoe.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 11.6 | 5.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-103 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 30).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the fuzzy pigtoe's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 30. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (specialist) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a moderate extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the fuzzy pigtoe.

### *References*

U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat. Final Rule. Federal Register: 77

**Rabbitsfoot (*Quadrula cylindrica cylindrica*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Water and sediment quality, including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek that will serve as an indication of appropriate presence and abundance of fish hosts necessary for recruitment of the rabbitsfoot. Suitable fish host for rabbitsfoot may include, but are not limited to, blacktail shiner (*Cyprinella venusta*) from the Black and Little River and cardinal shiner (*Luxilus cardinalis*), red shiner (*C. lutrensis*), spotfin shiner (*C. spiloptera*), bluntface shiner (*C. camura*), rainbow darter (*Etheostoma caeruleum*), rosyface shiner (*Notropis rubellus*), striped shiner (*L. chrysocephalus*), and emerald shiner (*N. atherinoides*).

In the critical habitat rule (see *Physical or Biological Features*), pesticides were identified as a factor that can alter the water quality. Adequate water quality is essential for normal behavior, growth, and viability during all life stages of the rabbitsfoot and fish assemblages are needed with suitable fish hosts. In the Special Management Considerations or Protection section, chemical contaminants, including pesticides, was listed as a primary threat to critical habitat.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (24.7% total overlap) (Table 31). There is a high level of

past carbaryl usage (up to 20.5% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 31. Overlap and past usage data for the critical habitat of the rabbitsfoot.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 24.7 | 20.5 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 61-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 32).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the rabbitsfoot's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, and since the rabbitsfoot is a host fish generalist that can use a variety of fish species as hosts, we anticipate the rabbitsfoot is not likely to experience a large reduction in available host fish within critical habitat. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 32. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the rabbitsfoot.

***References***

U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Neosho Mucket and Rabbitsfoot. Final Rule. Federal Register 80: 24691-24774.

U.S. Fish and Wildlife Service. 2023. Recovery Plan for the Rabbitsfoot (*Quadrula cylindrica cylindrica*). Atlanta, Georgia. 11 pp.

**Choctaw bean (*Obovaria choctawensis*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

Within the critical habitat units, the primary constituent elements of the physical or biological features essential to the conservation of the Choctaw bean consist of five components:

- Geomorphically stable stream and river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation).
- Stable substrates of sand or mixtures of sand with clay or gravel with low to moderate amounts of fine sediment and attached filamentous algae.
- A hydrologic flow regime (magnitude, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found, and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for habitat maintenance, food availability, and spawning habitat for native fishes.
- Water quality, including temperature (not greater than 32 °C), pH (between 6.0 to 8.5), oxygen content (not less than 5.0 milligrams per liter), hardness, turbidity, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.
- The presence of fish hosts. Diverse assemblages of native fish species will serve as a potential indication of host fish presence until appropriate host fishes can be identified. For the fuzzy pigtoe and tapered pigtoe, the presence of blacktail shiner (*Cyprinella venusta*) will serve as a potential indication of fish host presence.

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, dams, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on November 9, 2012, with the exception of the impoundments created by Point A and Gantt Lake dams (impounded water, not the actual dam structures).

Many of the threats to this mussel and their habitat are pervasive and common in all the units that are designated as critical habitat. These include the potential of significant changes in stream bed material composition and quality by activities such as construction projects, livestock grazing, timber harvesting, and other watershed and floodplain disturbances that release sediments or nutrients into the water; the potential of significant alteration of water chemistry or water quality; the potential of anthropogenic activities such as channelization, impoundment, and channel excavation that could cause aggradation or degradation of the channel bed elevation or significant bank erosion; and the potential of significant changes in the existing flow regime due to such activities as impoundment, water diversion, or water withdrawal. Because the areas designated as critical habitat below are facing these threats, they require special management consideration and protection.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (11.6% total overlap) (Table 33). There is a moderate level of past carbaryl usage (up to 5.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 33. Overlap and past usage data for the critical habitat of the Choctaw bean.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 11.6 | 5.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-103 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 34).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Choctaw bean's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 34. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (specialist) | Low |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Choctaw bean.

***References***

U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat. Final Rule. Federal Register: 77

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**Yellow lance (*Elliptio lanceolata*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussels and native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt-free gravel and coarse sand substrates).

- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain benthic habitats where the species is found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussel's and fish host's habitat, food availability, spawning habitat for native fishes, and the ability of newly transformed juveniles to settle and become established in their habitats.
- Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The presence and abundance of fish hosts necessary for yellow lance recruitment.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (16.7% total overlap) (Table 35). There is a high level of past carbaryl usage (up to 16.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 35. Overlap and past usage data for the critical habitat of the yellow lance.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 16.7 | 16.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 36).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the yellow lance's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, and since the yellow lance is a host fish generalist that can use a variety of fish species as hosts, we anticipate the yellow lance is not likely to experience a large reduction in available host fish within critical habitat. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 36. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the yellow lance.

***References***

U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Yellow Lance. Final Rule. Federal Register: 86

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**Neosho Mucket (*Lampsilis rafinesqueana*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Water and sediment quality, including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek that will serve as an indication of appropriate presence and abundance of fish hosts necessary for recruitment of the Neosho mucket. Suitable fish hosts for Neosho mucket glochidia include smallmouth bass (*Micropterus dolomieu*), largemouth bass *(Micropterus salmoides*), and spotted bass *(Micropterus punctulatus*).

In the critical habitat rule (see *Physical or Biological Features*), pesticides were identified as a factor that can alter the water quality. Adequate water quality is essential for normal behavior, growth, and viability during all life stages of the Neosho mucket and fish assemblages are needed with suitable fish hosts. In the Special Management Considerations or Protection section, chemical contaminants, including pesticides, was listed as a primary threat to critical habitat.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (23.2% total overlap) (Table 37). There is a high level of past carbaryl usage (up to 22.3% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 37. Overlap and past usage data for the critical habitat of the Neosho mucket.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 23.2 | 22.3 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 38).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Neosho mucket's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate there will be low levels of host fish mortality within critical habitat. While the Neosho mucket is a host fish specialist that can only metamorphosize on a small number of fish species (including the smallmouth bass, largemouth bass, and spotted bass), we anticipate their host fish are highly abundant within critical habitat, and thus are not particularly susceptible to host fish declines. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 38. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (specialists, but abundant hosts) | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Neosho mucket.

***References***

U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Neosho Mucket and Rabbitsfoot. Final Rule. Federal Register 80: 24691-24774.

U.S. Fish and Wildlife Service. 2018. Final Recovery Plan for the Neosho Mucket (*Lampsilis rafinesqueana*). Atlanta, Georgia. 4 pp.

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**Altamaha Spinymussel (*Elliptio spinosa*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Water quality necessary for normal behavior, growth, and viability of all life stages, including specifically temperature (less than 32.6 °C (90.68 °F) with less than 2 °C (3.6 °F) daily fluctuation)), pH (6.1 to 7.7), oxygen content (daily average DO concentration of 5.0 mg/l and a minimum of 4.0 mg/ l), an ammonia level not exceeding 1.5 mg N/L, 0.22 mg N/L (normalized to pH 8 and 25 °C (77 °F)), and other chemical characteristics.
- The presence of fish hosts (currently unknown) necessary for recruitment of the Altamaha spinymussel. The continued occurrence of diverse native fish assemblages currently occurring in the basin will serve as an indication of host fish presence until appropriate host fishes can be identified for the Altamaha spinymussel.

In the critical habitat rule, the narrative for the water quality PBF states that pesticides are one of the factors that can alter water quality. Fish assemblages with suitable fish hosts is also a PBF. In the critical habitat rule, we also stated “[m]alathion, one of the most important pesticides used in cotton farming, inhibits physiological activities of mussels.”

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are

deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (11.6% total overlap) (Table 39). There is a high level of past carbaryl usage (up to 11.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 39. Overlap and past usage data for the critical habitat of the Altamaha spinymussel.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 11.6 | 11.6 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-138 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 40).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Altamaha spinymussel's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 40. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (presumed generalist) | Low |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Altamaha spinymussel.

***References***

U.S. Fish and Wildlife Service. 2011. Endangered and Threatened Wildlife and Plants; Endangered Status for the Altamaha Spinymussel and Designation of Critical Habitat. Final Rule. Federal Register 76: 62928-62960.

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**Tapered pigtoe (*Fusconaia burkei*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

Within critical habitat areas, the primary constituent elements of the physical or biological features essential to the conservation of the tapered pigtoe consist of five components:

- Geomorphically stable stream and river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation).

- Stable substrates of sand or mixtures of sand with clay or gravel with low to moderate amounts of fine sediment and attached filamentous algae.
- A hydrologic flow regime (magnitude, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found, and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for habitat maintenance, food availability, and spawning habitat for native fishes.
- Water quality, including temperature (not greater than 32 °C), pH (between 6.0 to 8.5), oxygen content (not less than 5.0 milligrams per liter), hardness, turbidity, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.
- The presence of fish hosts. Diverse assemblages of native fish species will serve as a potential indication of host fish presence until appropriate host fishes can be identified. For the fuzzy pigtoe and tapered pigtoe, the presence of blacktail shiner (Cyprinella venusta) will serve as a potential indication of fish host presence.

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, dams, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on November 9, 2012, with the exception of the impoundments created by Point A and Gantt Lake dams (impounded water, not the actual dam structures).

Many of the threats to this species and its habitat are pervasive and common in all the nine units that are designated as critical habitat. These include the potential of significant changes in stream bed material composition and quality by activities such as construction projects, livestock grazing, timber harvesting, and other watershed and floodplain disturbances that release sediments or nutrients into the water; the potential of significant alteration of water chemistry or water quality; the potential of anthropogenic activities such as channelization, impoundment, and channel excavation that could cause aggradation or degradation of the channel bed elevation or significant bank erosion; and the potential of significant changes in the existing flow regime due to such activities as impoundment, water diversion, or water withdrawal. Because the areas are facing these threats, they require special management consideration and protection.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are

deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (11.6% total overlap) (Table 41). There is a moderate level of past carbaryl usage (up to 5.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 41. Overlap and past usage data for the critical habitat of the tapered pigtoe.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 11.6 | 5.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-103 μg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 μg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 42).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the tapered pigtoe's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 42. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | -- | -- | -- |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the tapered pigtoe.

***References***

U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat. Final Rule. Federal Register: 77

**Atlantic pigtoe (*Fusconaia masoni*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt-free gravel and coarse sand substrates).

- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain benthic habitats where the species is found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussel's and fish hosts' habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.
- Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The presence and abundance of fish hosts necessary for recruitment of the Atlantic pigtoe.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (19.7% total overlap) (Table 43). There is a high level of past carbaryl usage (up to 18.1% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 43. Overlap and past usage data for the critical habitat of the Atlantic pigtoe.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 19.7 | 18.1 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 44).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Atlantic pigtoe's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, and since the Atlantic pigtoe is a host fish generalist that can use a variety of fish species as hosts, we anticipate the Atlantic pigtoe is not likely to experience a large reduction in available host fish within critical habitat. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 44. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (generalist) | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Atlantic pigtoe.

***References***

U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Atlantic Pigtoe and Designation of Critical Habitat. Final Rule. Federal Register: 86

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**Southern Sandshell (*Hamiota australis*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Water quality, including temperature (not greater than 32 °C), pH (between 6.0 to 8.5), oxygen content (not less than 5.0 milligrams per liter), hardness, turbidity, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.
- The presence of fish hosts. Diverse assemblages of native fish species will serve as a potential indication of host fish presence until appropriate host fishes can be identified.

In the critical habitat final rule (see *Physical or Biological Features, Water*), pesticides were identified as a factor that can alter the water quality. Adequate water quality is essential for normal behavior, growth, and viability during all life stages of the species.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are

deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (14.9% total overlap) (Table 45). There is a high level of past carbaryl usage (up to 8.8% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 45. Overlap and past usage data for the critical habitat of the southern sandshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 14.9 | 8.8 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 46).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the southern sandshell's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality.

However, given that the southern sandshell's host fish species are unknown, we assume that the species is a host fish specialist. As such, we anticipate the species is more susceptible to adverse effects from host fish loss as even small reduction in host fish availability can represent a large decrease in the available pool of hosts. As such, despite the anticipated low level of toxicity to host fish, we anticipate moderate levels of adverse impacts to the non-arthropod PBF are likely.

**Table 46. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of host fish (unknown; presumed specialist) | Medium |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. While we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl, given that the southern sandshell may be a host fish specialist that is more vulnerable to losses of host fish, we anticipate moderate levels of impacts to the non-arthropod PBF. We anticipate non-agricultural uses of carbaryl will result in similar concentrations of carbaryl entering waterways, and thus, similar levels of adverse effects. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the southern sandshell.

### *References*

U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat. Final Rule. Federal Register 77: 61663-61719.

U.S. Fish and Wildlife Service. 2022. Round Ebonyshell (*Reginaia rotulata*), Southern Kidneyshell (*Ptychobranchus jonesi*), Choctaw Bean (*Obovaria choctawensis*), Tapered Pigtoe (*Fusconaia burkei*), Narrow Pigtoe (*Fusconaia escambia*), Southern Sandshell (*Hamiota *australis*), and Fuzzy Pigtoe (*Pleurobema strodeanum*) Status Review: Summary and Evaluation. Panama City, Florida. 49 pp + appendix.

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**Suwannee moccasinshell (*Medionidus walkeri*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Geomorphically stable stream channels (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation).
- Stable substrates of muddy sand or mixtures of sand and gravel, and with little to no accumulation of unconsolidated sediments and low amounts of filamentous algae.
- A natural hydrologic flow regime (magnitude, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species is found, and connectivity of stream channels with the floodplain, allowing the exchange of nutrients and sediment for habitat maintenance, food availability, and spawning habitat for native fishes.
- Water quality conditions needed to sustain healthy Suwannee moccasinshell populations, including low pollutant levels (not less than State criteria), a natural temperature regime, pH (between 6.0 to 8.5), adequate oxygen content (not less than State criteria), hardness, turbidity, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.
- The presence of abundant fish hosts necessary for recruitment of the Suwannee moccasinshell. The presence of blackbanded darters (*Percina nigrofasciata*) and brown darters (*Etheostoma edwini*) will serve as an indication of fish host presence.

The Suwannee moccasinshell, similar to other mussels, depends on areas with flow refuges, where shear stress is relatively low and sediments remain stable during high flow events. In the Special Management Considerations or Protection section of the critical habitat final rule, "reductions in pesticide and fertilizer use especially in groundwater recharge areas and near stream channels" is one of the items listed to ameliorate threats to Suwannee moccasinshell habitat. The final rule also states "Food availability and quality for the Suwannee moccasinshell is affected by habitat stability, floodplain connectivity, flow, and water and sediment quality" (see *Physical or Biological Features Essential to the Conservation of the Species* section), and "Actions that would introduce contaminants or alter water chemistry or temperature" may destroy or adversely modify critical habitat by altering "water quality conditions to levels that are beyond the tolerances of the mussel or its host fish" (see *Application of the "Destruction of Adverse Modification" Standard* section).

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (27.5% total overlap) (Table 47). There is a high level of past carbaryl usage (up to 11.7% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 47. Overlap and past usage data for the critical habitat of the Suwannee moccasinshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 27.5 | 11.7 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 48).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the Suwannee moccasinshell's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the

BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate there will be low levels of host fish mortality within critical habitat. While the Suwannee moccasinshell is a host fish specialist that can only metamorphosize on a small number of fish species (including the blackbanded darter and the brown darter), we anticipate their host fish are highly abundant within critical habitat, and thus are not particularly susceptible to host fish declines. As such, we anticipate only low levels of adverse impacts to the non-arthropod PBF are likely.

**Table 48. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | presence of host fish (specialist) | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Suwannee moccasinshell.

***References***

U. S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Suwannee Moccasinshell. Final Rule. Federal Register 86: 34979 34998.

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**Southern kidneyshell (*Ptychobranchus jonesi*)**

***Conclusion: Likely to destroy or adversely modify designated critical habitat***

***Physical & Biological Features:***

- Water quality, including temperature (not greater than 32 °C), pH (between 6.0 to 8.5), oxygen content (not less than 5.0 milligrams per liter), hardness, turbidity, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.

- The presence of fish hosts. Diverse assemblages of native fish species will serve as a potential indication of host fish presence until appropriate host fishes can be identified.

In the critical habitat final rule (see *Physical or Biological Features, Water*), pesticides were identified as a factor that can alter the water quality. Adequate water quality is essential for normal behavior, growth, and viability during all life stages of the species.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (12.1% total overlap) (Table 49). There is a moderate level of past carbaryl usage (up to 5.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 49. Overlap and past usage data for the critical habitat of the southern kidneyshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 12.1 | 5.6 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 41-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as bivalves are not sensitive to carbamates. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 50).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the southern kidneyshell's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality.

However, given that the southern kidneyshell's host fish species are unknown, we assume that the species is a host fish specialist. As such, we anticipate the species is more susceptible to adverse effects from host fish loss as even small reduction in host fish availability can represent a large decrease in the available pool of hosts. As such, despite the anticipated low level of toxicity to host fish, we anticipate moderate levels of adverse impacts to the non-arthropod PBF are likely.

**Table 50. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (unknown) | Medium |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. While we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl, given that the southern kidneyshell may be a host fish specialist that is more vulnerable to losses of host fish, we anticipate moderate levels of impacts to the non-arthropod PBF. We anticipate non-agricultural uses of carbaryl will result in similar concentrations of carbaryl entering waterways, and thus, similar levels of adverse effects. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the southern kidneyshell.

***References***

U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat. Final Rule. Federal Register 77: 61663-61719.

U.S. Fish and Wildlife Service. 2022. Round Ebonyshell (*Reginaia rotulata*), Southern Kidneyshell (*Ptychobranchus jonesi*), Choctaw Bean (*Obovaria choctawensis*), Tapered Pigtoe (*Fusconaia burkei*), Narrow Pigtoe (*Fusconaia escambia*), Southern Sandshell (*Hamiota australis*), and Fuzzy Pigtoe (*Pleurobema strodeanum*) Status Review: Summary and Evaluation. Panama City, Florida. 49 pp + appendix.

**Green floater (*Lasmigona subviridis)***

***Conclusion:*** Not likely to destroy or adversely modify proposed critical habitat

***Physical & Biological Features:***

- Flows adequate to maintain both benthic habitats and stream connectivity, allow glochidia and juveniles to become established in their habitats, allow the exchange of nutrients and oxygen to mussels, and maintain food availability and spawning habitat for host fishes. The characteristics of such flows include a stable, not flashy, flow regime, with slow to moderate currents to provide refugia during periods of higher flows.
- Suitable sand and gravel substrates and connected instream habitats characterized by stable stream channels and banks and by minimal sedimentation and erosion.
- Sufficient amount of food resources, including microscopic particulate matter (plankton, bacteria, detritus, or dissolved organic matter).
- Water and sediment quality necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages, including, but not limited to, those general to other mussel species:
  - Adequate dissolved oxygen;
  - Low salinity;
  - Low temperature (generally below 86°F (30°C));
  - Low ammonia (generally below 0.5 parts per million total ammonia- nitrogen), PAHs, PCBs, and heavy metal concentrations; and
  - No excessive total suspended solids and other pollutants, including contaminants of emerging concern.
- The presence and abundance of fish hosts necessary for recruitment of the green floater (including, but not limited to, mottled sculpin (Cottus bairdii), rock bass (Ambloplites rupestris), central stoneroller (Campostoma anomalum), blacknose dace (Rhinichthys atratulus), and margined madtom (Noturus insignis)).

***Effects of the Action***

We expect carbaryl use will impact water quality and fish hosts, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats proposed for aquatic species, rather than using the proposed critical habitat units, the EPA uses the HUC-12 watersheds that contain the proposed critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat proposed for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (12.8% total overlap) (Table 51). There is a low level of past carbaryl usage (up to 5.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 51. Overlap and past usage data for the critical habitat of the green floater.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 12.8 | 5.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 61.1-780.4 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as estimated environmental concentrations of carbaryl are not likely to cause mortality or sublethal adverse effects to mollusks. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 52).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the green floater's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality. Additionally, the green floater is unique among freshwater mussels in that its larvae can also metamorphosize without a host fish. Thus, we expect there will still be sufficient resources within critical habitat to support the species' reproduction even in the rare instance where carbaryl residues cause high host fish mortality. Therefore, we anticipate a low level of adverse impacts to the non-arthropod PBF.

**Table 52. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (generalist; can also metamorphosize without a host) | Low |
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. Additionally, given that the green floater can metamorphosize without a fish host, we anticipate the presence of carbaryl is not likely to adversely impact the reproduction of the species, even in situations where there is high fish mortality. As such, we anticipate no more than low levels of adverse effects to the non-arthropod PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the green floater.

***References***

U.S. Fish and Wildlife Service. 2023. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Green Floater and Designation of Critical Habitat. Proposed Rule. Federal Register: 88.

**False spike (*Fusconaia mitchelli)***

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt-free gravel and coarse sand substrates).
- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain benthic habitats where the species are found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussels' and fish hosts' habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.
- Water and sediment quality (including, but not limited to, dissolved oxygen levels greater than 2 mg/L, conductivity, hardness, turbidity, temperatures below 29°C (84.2°F), pH (low salinity, less than 2 ppt), low total ammonia (less than 0.77 mg/L total ammonia nitrogen), heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The presence and abundance of fish hosts necessary for recruitment of the central Texas mussels.

***Effects of the Action***

We expect carbaryl use will impact water quality and fish hosts, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (11.4% total overlap) (Table 53). There is a moderate level of past carbaryl usage (up to 8.8% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 53. Overlap and past usage data for the critical habitat of the false spike.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 11.4 | 8.8 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect carbaryl use will result in maximum estimated environmental concentrations will reach 76.4-2454 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate any mortality is likely to occur at estimated environmental concentrations. However, we anticipate high levels of sublethal adverse effects (e.g., reduced fecundity) are likely, but only at high exposure concentrations associated with certain use types, such as applications to crops in the "other orchards" or "other grains" UDL and only in areas of low flow or low water volume. In contrast, applications in other UDLs or exposure in areas of high flow will not result in any direct adverse effects to individuals. Given that the false spike can occur in areas with low flow, we anticipate a moderate level of impacts to the water quality PBF is likely (Table 54).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. We expect high levels of mortality are likely to occur as estimated environmental concentrations in the false spike's critical habitat resulting from agricultural uses exceed the $HC_{05}$ calculated by the EPA in the BE for fish species, suggesting that the false spike's host fish are likely to experience high levels of mortality. However, we anticipate mortality is only likely to occur at high-end exposure estimates associated with low flow or low water volume habitats. Available life history data indicate that the species inhabits a range of aquatic habitats and can also be found in larger creeks and areas of moderate flow. We anticipate these habitats will accumulate lower levels of carbaryl (e.g., 76.4-138.3 µg/L), which are not likely to cause more than low levels of host fish mortality. Additionally, while the false spike only has two known host fish species, both of its hosts (the blacktail shiner and red shiner) are common and highly abundant fish species within the mussel's range (and presumably its critical habitat). Thus, while we expect a high level of mortality is likely to occur in some parts of critical habitat, we anticipate there will still be sufficient fish host resources remaining in critical habitat to support the reproduction of the species. Therefore, we anticipate a moderate level of adverse effects to the non-arthropod PBF. Maximum estimated environmental concentrations resulting from non-agricultural uses are below the fish mortality $HC_{05}$, indicating that non-agricultural uses are not likely to cause more than low levels of adverse effects to host fish.

**Table 54. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of host fish (specialist; abundant host fish) | Medium |
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Medium |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

In summary, there is a high extent of overlap and past usage within the watershed containing designated critical habitat. We anticipate a range of adverse effects to critical habitat PBFs depending on the local environmental conditions and the specific uses of carbaryl. Carbaryl use on certain crops, such as those within the “other orchards” and “other grains” UDL, which are highly prevalent within the watershed containing critical habitat, will result in high environmental concentrations of carbaryl in areas of low flow, which will result in high levels of sublethal effects to individuals occupying those areas and high levels of host fish mortality. In contrast, areas of high flow are not likely to accumulate more than low levels of carbaryl that will not result in any direct adverse effects to individuals or host fish. As such, we expect moderate effects to both the water quality and non-arthropod resource PBFs. In contrast, we expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating that these uses are expected to result in no more than low levels of adverse effects to host fish. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the false spike.

***References***

U.S. Fish and Wildlife Service. 2024. Endangered and Threatened Wildlife and Plants; Endangered Species Status with Critical Habitat for Guadalupe Fatmucket, Texas Fatmucket, Guadalupe Orb, Texas Pimpleback, Balcones Spike, and False Spike, and Threatened Species Status with Section 4(d) Rule and Critical Habitat for Texas Fawnsfoot. Final Rule. Federal Register: 89

**Western fanshell (*Cyprogenia aberti)***

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Adequate flows, or a hydrologic flow regime (magnitude, timing, frequency, duration, rate of change, and overall seasonality of discharge over time), necessary to maintain benthic habitats where the species are found and to maintain stream connectivity, specifically providing for the exchange of nutrients and sediment for maintenance of the mussels' and fish hosts' habitat and food availability, maintenance of spawning habitat for native host fishes, and the ability for newly transformed juveniles to settle and become established in their habitats. Adequate flows ensure delivery of oxygen, enable reproduction, deliver food to filter-feeding mussels, and reduce contaminants and fine sediments from interstitial spaces.
- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (that is, channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt- free gravel and coarse sand substrates)
- Water and sediment quality necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages, including, but not limited to: dissolved oxygen (generally above 3 parts per million (ppm)) and water temperature (generally below 80 degrees Fahrenheit (°F) (27 degrees Celsius (°C)). Additionally, water and sediment should be low in ammonia (generally below 1.0 ppm total ammonia-nitrogen) and heavy metals, and lack excessive total suspended solids and other pollutants.
- The presence and abundance of fish hosts necessary for recruitment of the western fanshell [… T]his includes logperch (*Percina caprodes*), rainbow darter (*Etheostoma caeruleum*), slenderhead darter (*Percina phoxocephala*), fantail darter (*Etheostoma flabellare*), or orangebelly darter *(Etheostoma radiosum*)

***Effects of the Action***

We expect carbaryl use will impact water quality and fish hosts, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are

deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (17.5% total overlap) (Table 55). There is a high level of past carbaryl usage (up to 17.1% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 55. Overlap and past usage data for the critical habitat of the western fanshell.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 17.5 | 17.1 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54.8-103.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as estimated environmental concentrations of carbaryl are not likely to cause mortality or sublethal adverse effects to mollusks. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 56).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the western fanshell's host fish are not likely to experience more than low levels of adverse effects as maximum estimated environmental concentrations of carbaryl are well below levels where available toxicity studies have observed adverse effects to fish survival or reproduction. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 56. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (generalist) | Low |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to host fish are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the western fanshell.

***References***

U.S. Fish and Wildlife Service. 2023. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Western Fanshell and ''Ouachita'' Fanshell and Designation of Critical Habitat. Final Rule. Federal Register: 88

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**Salamander mussel (*Simpsonaias ambigua)***

***Conclusion:*** Not likely to destroy or adversely modify proposed critical habitat

***Physical & Biological Features:***

- Adequate flows, or a hydrologic flow regime (magnitude, timing, frequency, duration, rate of change, and overall seasonality of discharge over time), necessary to maintain benthic habitats where the salamander mussel and its host, the mudpuppy, are found and to maintain stream connectivity.
- Suitable substrates and connected instream habitats, characterized by geomorphologically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support the salamander mussel

and mudpuppy (e.g., large rock shelters, woody debris, and bedrock crevices within stable zones of swift current with low amounts of fine sediment silt).

- Water and sediment quality necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages, including (but not limited to) dissolved oxygen (generally above 2 to 3 parts per million (ppm)), salinity (generally below 2 to 4 ppm), and temperature (generally below 86°F (°F) (30° Celsius (°C)). Additionally, concentrations of contaminants, including (but not limited to) ammonia, nitrate, copper, and chloride, are below acute toxicity levels for mussels.
- The presence and abundance of the mudpuppy host.

***Effects of the Action***

We expect carbaryl use will impact water quality and amphibian hosts, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats proposed for aquatic species, rather than using the proposed critical habitat units, the EPA uses the HUC-12 watersheds that contain the proposed critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat proposed for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (25.7% total overlap) (Table 57). There is a high level of past carbaryl usage (up to 14.4% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 57. Overlap and past usage data for the critical habitat of the salamander mussel.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 25.7 | 14.4 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 61.1-103.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 71.9 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as estimated environmental concentrations of carbaryl are not likely to cause mortality or sublethal adverse effects to mollusks. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 58).

Available toxicity data indicate that aquatic amphibians can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair amphibian host resources for individuals of the species. However, we expect the salamander mussel's host amphibians are not likely to experience mortality at predicted exposures as estimated environmental concentrations of carbaryl are well below levels where toxicity studies have observed mortality in amphibians. As such, we anticipate only low levels of adverse impacts, if any, to the non-arthropod PBF are likely.

**Table 58. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of amphibian hosts (specialist) | Low |
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of adverse effects to amphibian hosts are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the salamander mussel.

***References***

U.S. Fish and Wildlife Service. 2023. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Salamander Mussel and Designation of Critical Habitat. Proposed Rule. Federal Register: 88

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**Texas fawnsfoot (*Truncilla macrodon)***

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt-free gravel and coarse sand substrates).
- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain benthic habitats where the species are found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussels' and fish hosts' habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.
- Water and sediment quality (including, but not limited to, dissolved oxygen levels greater than 2 mg/L, conductivity, hardness, turbidity, temperatures below 29°C (84.2°F), pH (low salinity, less than 2 ppt), low total ammonia (less than 0.77 mg/L total ammonia nitrogen), heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The presence and abundance of fish hosts necessary for recruitment of the central Texas mussels.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (23.8% total overlap) (Table 59). There is a high level of past carbaryl usage (up to 19.0% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 59. Overlap and past usage data for the critical habitat of the Texas fawnsfoot.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 23.8 | 19.0 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54.8-1397.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate any individuals occupying critical habitat will die. However, we anticipate high levels of sublethal adverse effects (e.g., reduced fecundity) are likely, but only at high exposure concentrations associated with certain use types, such as applications to crops in the "other grains" UDL and only in areas of low flow or low water volume. In contrast, applications in other UDLs or exposure in areas of high flow will not result in any direct adverse effects to individuals. Given that the Texas fawnsfoot occurs in a variety of aquatic habitats, including areas of low flow, we anticipate water quality will be impacted in only some areas of critical habitat. As such, we anticipate a moderate level of adverse effects to the water quality PBF (Table 60).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. We expect high levels of mortality are likely to occur as estimated environmental concentrations in the Texas fawnsfoot's critical habitat exceed the $HC_{05}$ calculated by the EPA in the BE for fish species, suggesting that the Texas fawnsfoot's host fish are likely to experience high levels of mortality. However, we anticipate mortality is only likely to occur at high-end exposure estimates associated with carbaryl use on crops in the "other crop" UDL and only when host fish are exposed in low flow or low water volume habitats. Available life history data indicate that the species inhabits a range of aquatic habitats and can also be found in medium- to large-sized streams and rivers. We anticipate these habitats will accumulate lower levels of carbaryl (e.g., 54.8-103.8 µg/L), which are not likely to cause mortality or sublethal adverse effects to fish. While the Texas fawnsfoot is a host fish specialist, its presumed host fish (freshwater drum) is a common and highly abundant fish species within the mussel's range (and presumably its critical habitat). Thus, even in situations where high host fish mortality occurs in some parts of critical habitat, we anticipate there will still be some fish hosts available in critical habitat. Therefore, we anticipate an overall medium level of adverse impacts to the non-arthropod PBF. Maximum estimated environmental concentrations resulting from non-agricultural uses are below the fish mortality $HC_{05}$, indicating that non-agricultural uses are not likely to cause more than low levels of adverse effects to host fish.

**Table 60. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (specialist, highly abundant host fish) | Medium |
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Medium |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

In summary, there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat. We anticipate some areas of critical habitat will accumulate high levels of carbaryl, resulting in high levels of sublethal effects to individuals. However, we anticipate only a smaller area of critical habitat is likely to experience these levels of exposure as the species can also occupy areas of high flow. As such, we anticipate an overall moderate impact to the water quality PBF. Similarly, while high end estimates of environmental concentrations can cause high host fish mortality, we anticipate these adverse effects will be limited only to areas of low flow or small water volume. However, given the high abundance of the Texas fawnsfoot's host fish, we anticipate there will still be some host fish available in critical habitat even in high exposure scenarios. As such, we anticipate an overall moderate effect to the non-arthropod PBF. In contrast, we expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating that these uses are expected to result in no more than low levels of adverse effects to host fish. While we only anticipate moderate effects to critical habitat PBFs, given the high extent of overlap and past usage, we anticipate the adverse effect will impact a large portion of designated critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Texas fawnsfoot.

***References***

U.S. Fish and Wildlife Service. 2024. Endangered and Threatened Wildlife and Plants; Endangered Species Status with Critical Habitat for Guadalupe Fatmucket, Texas Fatmucket,

Guadalupe Orb, Texas Pimpleback, Balcones Spike, and False Spike, and Threatened Species Status with Section 4(d) Rule and Critical Habitat for Texas Fawnsfoot. Final Rule. Federal Register: 89

**Texas pimpleback (*Cyclonaias petrina)***

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt-free gravel and coarse sand substrates).
- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain benthic habitats where the species are found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussels' and fish hosts' habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.
- Water and sediment quality (including, but not limited to, dissolved oxygen levels greater than 2 mg/L, conductivity, hardness, turbidity, temperatures below 29°C (84.2°F), pH (low salinity, less than 2 ppt), low total ammonia (less than 0.77 mg/L total ammonia nitrogen), heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- The presence and abundance of fish hosts necessary for recruitment of the central Texas mussels.

***Effects of the Action***

We expect carbaryl use will impact fish hosts and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (18.2% total overlap) (Table 61). There is a high level of past carbaryl usage (up to 16.5% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 61. Overlap and past usage data for the critical habitat of the Texas pimpleback.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 18.2 | 16.5 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use (including all non-agricultural uses of carbaryl) will result in maximum estimated environmental concentrations will reach 54.8-1397.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate any individuals occupying critical habitat will die. However, we anticipate high levels of sublethal adverse effects (e.g., reduced fecundity) are likely, but only at high exposure concentrations associated with certain use types, such as applications to crops in the "other grains" UDL and only in areas of low flow or low water volume. In contrast, applications in other UDLs or exposure in areas of high flow will not result in any direct adverse effects to individuals. Given that the Texas pimpleback occurs in a variety of aquatic habitats, including areas of low flow, we anticipate water quality will be impacted in only some areas of critical habitat. As such, we anticipate a moderate level of adverse effects to the water quality PBF (Table 62).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. We expect high levels of mortality are likely to occur as estimated environmental concentrations in the Texas pimpleback's critical habitat exceed the $HC_{05}$ calculated by the EPA in the BE for fish species, suggesting that the Texas pimpleback's host fish are likely to experience high levels of mortality. However, we anticipate mortality is only likely to occur at high-end exposure estimates associated with carbaryl use on crops in the "other crop" UDL and only when host fish are exposed in low flow or low water volume habitats. Available life history data indicate that the species inhabits a range of aquatic habitats and can also be found in medium- to large-sized streams and rivers. We anticipate these habitats will accumulate lower levels of carbaryl (e.g., 54.8-103.8 µg/L), which are not likely to cause mortality or sublethal adverse effects to fish. Furthermore, given that the Texas pimpleback is a host fish generalist that can successfully reproduce using a wide array of fish host species, we anticipate individuals are even less likely to experience adverse effects as individuals can readily use alternative fish host species when sensitive fish host species die. As such, we anticipate there will still be some host fish available in critical habitat even in high exposure scenarios. As such, we anticipate an overall moderate adverse impact to the non-arthropod PBF are likely. Maximum estimated environmental concentrations resulting from non-agricultural uses are below the fish mortality $HC_{05}$, indicating that non-agricultural uses are not likely to cause more than low levels of adverse effects to host fish.

**Table 62. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (generalist) | Medium |
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Medium |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

In summary, there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat. We anticipate some areas of critical habitat will accumulate high levels of carbaryl, resulting in high levels of sublethal effects to individuals. However, we anticipate only a smaller area of critical habitat is likely to experience these levels of exposure as the species can also occupy areas of high flow. As such, we anticipate an overall moderate impact to the water quality PBF. Similarly, while high end estimates of environmental concentrations can cause high host fish mortality, we anticipate these adverse effects will be limited only to areas of low flow or small water volume. Given that the Texas pimpleback is a host fish generalist, we anticipate there will still be host fish resources available in critical habitat even in high exposure scenarios. Thus, we anticipate an overall moderate impact to the non-arthropod PBF as well. In contrast, we expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating that these uses are expected to result in no more than low levels of adverse effects to host fish. While we only anticipate moderate effects to critical habitat PBFs, given the high extent of overlap and past usage, we anticipate the adverse effect will impact a large portion of designated critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Texas pimpleback.

***References***

U.S. Fish and Wildlife Service. 2024. Endangered and Threatened Wildlife and Plants; Endangered Species Status with Critical Habitat for Guadalupe Fatmucket, Texas Fatmucket, Guadalupe Orb, Texas Pimpleback, Balcones Spike, and False Spike, and Threatened Species Status with Section 4(d) Rule and Critical Habitat for Texas Fawnsfoot. Final Rule. Federal Register: 89

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**Round hickorynut (*Obovaria subrotunda)***

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Clean, flowing water with appropriate water quality and temperate conditions, such as (but not limited to) dissolved oxygen above 2 to 3 parts per million (ppm), ammonia generally below 0.5 ppm total ammonia-nitrogen, temperatures generally below 86 degrees Fahrenheit (°F) (30 degrees Celsius (°C)), and (ideally) an absence of excessive total suspended solids and other pollutants.
- Natural flow regimes that vary with respect to timing, magnitude, duration, and frequency of river discharge events
- Predominantly silt-free, stable sand, gravel, and cobble substrates
- Suspended food and nutrients in the water column including (but not limited to) phytoplankton, zooplankton, protozoans, detritus, and dissolved organic matter
- presence of host fish species to ensure recruitment

***Effects of the Action***

We expect carbaryl use will impact water quality and fish hosts, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (11.3% total overlap) (**Table 63**). There is a high level of past carbaryl usage (up to 10.7% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 63. Overlap and past usage data for the critical habitat of the round hickorynut.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 11.3 | 10.7 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54.8-785.6 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as estimated environmental concentrations of carbaryl are not likely to cause mortality or sublethal adverse effects to mollusks. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 64).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the round hickorynut's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality. Additionally, the round hickorynut is a host fish generalist that can use a wide range of host fish species, suggesting that even in situations where sensitive host fish experience high mortality, individuals will likely be able to switch and use other, more abundant host fish species. Therefore, we anticipate a low level of adverse impacts to the non-arthropod PBF.

**Table 64. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (generalist) | Low |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. Additionally, given that the round hickorynut is a fish host generalist can metamorphosize on a wide range of fish species, we anticipate there will still be sufficient host fish resources available even in the rare event where sensitive fish species experience high mortality from carbaryl exposure as the species can likely switch to a more abundant host fish that is available. As such, we anticipate no more than low levels of adverse effects to the non-arthropod PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the round hickorynut.

***References***

U. S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; 12-Month Finding for Purple Lilliput; Threatened Species Status with Section 4(d) Rule for Longsolid and Round Hickorynut and Designation of Critical Habitat. Proposed Rule. Federal Register 85 FR 61384 61458.

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**Longsolid (*Fusconaia subrotunda)***

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Clean, flowing water with appropriate water quality and temperate conditions, such as (but not limited to) dissolved oxygen above 2 to 3 parts per million (ppm), ammonia generally below 0.5 ppm total ammonia-nitrogen, temperatures generally below 86 degrees Fahrenheit (°F) (30 degrees Celsius (°C)), and (ideally) an absence of excessive total suspended solids and other pollutants.

- Natural flow regimes that vary with respect to timing, magnitude, duration, and frequency of river discharge events
- Predominantly silt-free, stable sand, gravel, and cobble substrates
- Suspended food and nutrients in the water column including (but not limited to) phytoplankton, zooplankton, protozoans, detritus, and dissolved organic matter
- presence of host fish species to ensure recruitment

***Effects of the Action***

We expect carbaryl use will impact water quality and fish hosts, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a medium extent of overlap between the action area and the critical habitat (5.5% total overlap) (Table 65). There is a low level of past carbaryl usage (up to 4.8% critical habitat treated annually), suggesting that a moderate portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 65. Overlap and past usage data for the critical habitat of the longsolid.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 5.5 | 4.8 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54.8-785.6 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Based on available toxicity data, we do not anticipate water quality will be degraded for the species by the presence of carbaryl as estimated environmental concentrations of carbaryl are not likely to cause mortality or sublethal adverse effects to mollusks. As such, we do not expect any adverse effects to the water quality PBF will occur (Table 66).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair fish host resources for individuals of the species. However, we expect the longsolid's host fish are not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality. Additionally, the longsolid is a host fish generalist that can use a wide range of host fish species, suggesting that even in situations where sensitive host fish experience high mortality, individuals will likely be able to switch and use other, more abundant host fish species. Therefore, we anticipate a low level of adverse impact to the non-arthropod PBF.

**Table 66. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impacts to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | X | Presence of fish hosts (generalist) | Low |
| water quality | X | High flow waterbodies, Low flow/Low volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between critical habitat and agricultural use areas and a high level of past agricultural usage within critical habitat, we do not anticipate more than low levels of adverse effects to relevant critical habitat PBFs. Estimated environmental concentrations of carbaryl within critical habitat are not likely to cause any adverse effects to individuals, indicating no more than low levels of adverse effects to the water quality PBF. Similarly, we expect no more than low levels of host fish mortality are likely to occur at estimated environmental concentrations of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, these uses are expected to result in no more than low levels of adverse effects as well. Additionally, given that the longsolid is a fish host generalist can metamorphosize on a wide range of fish species, we anticipate there will still be sufficient host fish resources available even in the rare event where sensitive fish species experience high mortality from carbaryl exposure as the species can likely switch to a more abundant host fish that is available. As such, we anticipate no more than low levels of adverse effects to the non-arthropod PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the longsolid.

***References***

U. S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; 12-Month Finding for Purple Lilliput; Threatened Species Status with Section 4(d) Rule for Longsolid and Round Hickorynut and Designation of Critical Habitat. Proposed Rule. Federal Register 85 FR 61384 61458.

## *Crustaceans*

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**Brawleys Fork crayfish (*Cambarus williamsi*)**

***Conclusion:*** Likely to destroy or adversely modify proposed critical habitat

***Physical & Biological Features:***

- Moderate to fast-flowing stream with unembedded cherty-gravel and cobble substrate within an unobstructed stream continuum (i.e., riffle, run, pool complexes) of perennial, small- to moderate-sized (generally third order or smaller) streams and rivers (up to the ordinary high-water mark as defined at 33 CFR 329.11)
- Stream banks with intact riparian cover to maintain stream morphology and reduce erosion and sediment inputs that may reduce availability of substrate interstitial spaces.
- Water quality characterized by seasonally moderated, or spring influenced, water temperatures and physical and chemical parameters (e.g., pH, conductivity, dissolved oxygen) sufficient for the normal behavior, growth, reproduction, and viability of all life stages.
- Adequate food base, indicated by a healthy aquatic community structure including native benthic macroinvertebrates, fishes, and plant matter (e.g., leaf litter, algae, detritus).
- An interconnected network of streams and rivers that have the physical and biological features described in paragraphs (2)(i) through (iv) of this entry that allow for the movement of individual crayfish in response to environmental, physiological, or behavioral drivers. The connectivity of the stream network should be sufficient to allow for gene flow within and among watersheds.

***Effects of the Action***

We expect carbaryl use will impact water quality, arthropod prey, and non-arthropod prey, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats proposed for aquatic species, rather than using the proposed critical habitat units, the EPA uses the HUC-12 watersheds that contain the proposed critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat proposed for aquatic species will experience.

There is a high extent of overlap between the action area and the critical habitat (10.4% total overlap) (Table 67). There is a high level of past carbaryl usage (up to 10.3% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 67. Overlap and past usage data for the critical habitat of the Brawleys Fork crayfish.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 10.4 | 10.3 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. EPA's environmental fate modeling predicts maximum carbaryl concentrations within the Brawley Forks crayfish's habitat will range from 26-50 µg/L depending on the specific habitat characteristics (e.g., flow rate, water volume). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies.

Available toxicity data indicate that crustaceans are sensitive to carbaryl exposure and are likely to experience high levels of mortality, even at low exposure concentrations. As such, we expect the presence of carbaryl will reduce water quality to a level where individuals may not be able to use areas of critical habitat exposed to carbaryl. Similarly, we anticipate carbaryl residues in critical habitat will also result in high levels of adverse effects to the Brawleys Fork crayfish's arthropod prey (Table 68).

In contrast, non-arthropod prey, such as fish, are not likely to experience more than low levels of mortality or sublethal adverse effects to growth or reproduction as estimated environmental concentrations of carbaryl within critical habitat are lower than levels where toxicity studies in fish have observed adverse effects. As such, we do not anticipate there will be more than low levels of impacts to the non-arthropod prey PBF.

**Table 68. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Benthic macroinvertebrates | High |
| non-arthropods (as prey or hosts) | X | Fish | Low |
| water quality | X | High flow waterbodies | High |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

There is a high extent of overlap between the action area and the critical habitat, and usage is anticipated to be high. While impacts to the non-arthropod PBF would be low, impacts to the water quality and arthropod prey PBFs would have high impacts to the species, preventing individuals from occupying sites and leading to high levels of mortality where exposure occurs. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Brawleys Fork crayfish.

***References***

U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Brawleys Fork Crayfish and Designation of Critical Habitat. Proposed Rule. Federal Register: 88

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**Panama City crayfish (*Procambarus econfinae*)**

***Conclusion:*** Not likely to destroy or adversely modify proposed critical habitat

***Physical & Biological Features:***

- Undeveloped lands, including cropland, utilities rights-of-way, timberlands, or grazing lands, that support open wet pine flatwoods and wet prairie habitats that contain appropriate herbaceous groundcover vegetation; permanent or temporary pools of shallow (usually less than 1 foot) freshwater locations; and gently sloped ground level swales with a 3:1 or shallower slope ratio along ecotonal or transitional areas.
- Soil types within undeveloped lands that provide sediment structure needed for burrow construction and that support some native herbaceous vegetation and the likelihood of native seed bank that with management will provide vegetation needed for additional food and cover, and where the ground water is always within 3 feet of the ground surface and surface waters occur on occasion.
- Undeveloped lands that contain surface and groundwater of sufficient quality to support all life stages of the Panama City crayfish and the herbaceous vegetation on which they rely. This includes surface waters with oxygen levels, pH levels and temperatures within specific ranges.

Additionally, special management concerns highlighted in the final critical habitat rule state that the release of pollutants into surface water could “alter water conditions to levels that are beyond the tolerances of the crayfish”.

***Effects of the Action***

We expect carbaryl use will impact water quality, which is a critical habitat PBFs that is essential for the conservation of the species.

For critical habitats proposed for aquatic species, rather than using the proposed critical habitat units, the EPA uses the HUC-12 watersheds that contain the proposed critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat proposed for aquatic species will experience.

There is a low extent of overlap between agricultural use sites and the watersheds containing the species' critical habitat (0.7% total overlap) (Table 67). There is a low level of past carbaryl usage (up to 0.7% critical habitat treated annually), suggesting that a small portion of the critical habitat is likely to be exposed over the duration of the proposed action from agricultural uses.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl, particularly in managed forests and rights of ways as these areas are specifically noted as being used by the species in the critical habitat PBF descriptions. Additionally, given the proximity of designated critical habitat to urban areas, we anticipate the potential for exposure to carbaryl through developed and open space developed uses (excluding golf courses as a visual inspection of satellite imagery did not identify any golf courses in proximity to designated critical habitat). Available usage data from the U.S. Forest Service indicate that no carbaryl has been used in managed forests within the states containing designated critical habitat from 2016-2020, suggesting that there is a low likelihood that critical habitat will be exposed to carbaryl through use on managed forests. Similarly, available usage data in rights of ways show that only small amounts of carbaryl (up to 500 pounds) are used each year nationally. While this may represent high exposure if all treatments were made in a single critical habitat, we anticipate this is unlikely to occur as rights of way usage is likely to be sporadic across the national landscape. While much of the designated critical habitat is in close proximity to developed and open space developed use sites, we anticipate existing conservation measures, such as restrictions to most residential uses to spot, crack-and-crevice, or narrow perimeter band treatments using hand-held equipment and mandatory 25-foot buffers on all uses will substantially reduce the treatment footprint within developed and open space developed use sites and minimize off-site transport into critical habitat through spray drift or runoff. As such, we do not anticipate more than low levels of exposure are likely to occur through non-agricultural uses.

**Table 69. Overlap and past usage data for the critical habitat of the Panama City crayfish.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
| ---: | ---: |
| 0.7 | 0.7 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. EPA's environmental fate modeling predicts maximum carbaryl concentrations within the Brawley Forks crayfish's habitat will range from 41.8-785.6 µg/L depending on the specific habitat characteristics (e.g., flow rate, water volume). These estimated environmental concentrations incorporate relevant existing conservation measures on product labels, which include a 48-hour rain restriction and application buffers to waterbodies.

Available toxicity data indicate that crustaceans are sensitive to carbaryl exposure and are likely to experience high levels of mortality, even at low exposure concentrations. As such, we expect the presence of carbaryl will reduce water quality to a level where individuals may not be able to use areas of critical habitat exposed to carbaryl, resulting in high levels of impacts to the water quality PBF (Table 68).

**Table 70. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
| --- | --- | --- | --- |
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | Low flow/Low volume waterbodies | High |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

We anticipate a high level of impact to the water quality PBF will occur with exposure to carbaryl as available toxicity data indicate that crustacean species are likely highly sensitive to carbaryl. However, we expect only a small portion of critical habitat is likely to be exposed to carbaryl as there is very little agriculture within the watershed containing the crayfish's critical habitat. Similarly, available usage data indicate that exposure through use in managed forests and rights of way uses are not likely to occur. Additionally, while there is a large presence of developed and open space developed areas in the vicinity of designated critical habitat, existing conservation measures (including restrictions to hand-held equipment, rain restrictions, and mandatory buffers to waterbodies) will minimize off-site transport and exposure to critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Panama City crayfish.

***References***

U.S. Fish and Wildlife Service. 2022. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Panama City Crayfish and Designation of Critical Habitat. Final Rule. Federal Register 87.

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**Vernal pool fairy shrimp (*Branchinecta lynchi*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

Critical habitat units are designated for Jackson County, Oregon, and Alameda, Amador, Butte, Contra Costa, Fresno, Kings, Madera, Mariposa, Merced, Monterey, Napa, Placer, Sacramento, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Solano, Stanislaus, Tehama, Tulare, Ventura, and Yuba Counties, California. The primary constituent elements of critical habitat for vernal pool fairy shrimp (*Branchinecta lynchi*) are the habitat components that provide:

- Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;
- Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding; and
- Structure within the pools described above in paragraph (3)(ii), consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

Existing manmade features and structures, such as buildings, roads, railroads, airports, runways, other paved areas, lawns, and other urban landscaped areas do not contain one or more of the primary constituent elements. Federal actions limited to those areas, therefore, would not trigger a consultation under section 7 of the Act unless they may affect the species and/ or primary constituent elements in adjacent critical habitat.

***Effects of the Action***

We expect carbaryl use will impact water quality, which is a critical habitat PBF that is essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural uses of carbaryl and the critical habitat (38.2% total overlap) (Table 71). While some of the vernal pool fairy shrimp's critical habitat units occur in Oregon, the majority of its designated critical habitat units occur in California (i.e., 28 out of 32 units are located entirely in California). As such, we include California specific past usage data as an additional line of evidence for our analysis of this critical habitat. Mandatory reporting data from the state of California indicates that, on average, between 2013-2022, only 0.3% of the critical habitat has been treated with carbaryl annually. Thus, while there is a high level of overlap between the species' designated critical habitat and agricultural use areas, we anticipate only a low level of exposure is likely to occur as mandatory usage records indicate very little carbaryl has been used within the sections in California where the majority of the species' critical habitat units occur.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl, including use in developed, open space developed, managed forests, and rights of way areas. Our review of the specific PBF requirements listed above indicates that rangeland and nursery use sites are not likely to contain or produce many of the PBF requirements, indicating that these non-agricultural uses of carbaryl are not likely to significantly contribute to the exposure of critical habitat. U.S Forest Service usage data indicate that 322 acres of managed forests within the general regions overlapping the vernal pool fairy shrimp's range have been treated with carbaryl over a 5-year period (2016-2020). We do not anticipate all treated acres of managed forests occur in a single location or are all concentrated within the fairy shrimp's range. Furthermore, treatments are made using ground-based sprayers directed to lower parts of the tree (i.e., the trunk) (which will limit the extent of off-site transport and exposure to critical habitat) and are made to protect plantings of oak trees in Southern California (which would limit exposure to only the southern most critical habitat units). Available data on open space developed uses of carbaryl (such as turf or golf course applications) indicate that less than 2.5% of open space developed areas have been treated with carbaryl while only 500 pounds of carbaryl are used nationally on rights of ways annually. While this open space developed and rights of way usage may result in a large treatment footprint if all treated areas were concentrated in a single critical habitat, we expect this is highly unlikely to occur. Rather, we expect open space developed and rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within a particular critical habitat. As such, we anticipate that non-agricultural uses of carbaryl are not likely to contribute significantly to the overall exposure of critical habitat and do not further consider these uses in our analysis. For most residential and developed uses, current product labels limit applications to spot, crack-and-crevice, or narrow perimeter bands around urban structures (from 1 inch to 6 feet wide) using handheld equipment, which we anticipate will greatly reduce the extent of area that can be treated and will prevent most off-target exposures. As such, we anticipate that non-agricultural uses of carbaryl are not likely to contribute significantly to the overall exposure of critical habitat and do not further consider these uses in our analysis.

**Table 71. Overlap and past usage data for the critical habitat of the vernal pool fairy shrimp.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 38.2 | 0.3 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. Available toxicity data indicate that crustaceans are sensitive to insecticide exposure and are likely to experience high levels of mortality, even at low exposure concentrations. As such, we expect the presence of carbaryl residues will reduce water quality to a level where individuals may not be able to use areas of critical habitat exposed to carbaryl (Table 72).

**Table 72. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | High |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While impacts to the water quality PBF would have high impacts to the species, we expect these adverse effects will be limited to only small areas of critical habitat. Based on spatially refined mandatory pesticide usage reporting in the state of California, which encompasses the vast majority of the designated critical habitat units for the vernal pool fairy shrimp, we anticipate only small portions of critical habitat are likely to be exposed to carbaryl. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the vernal pool fairy shrimp.

**References**

U.S. Fish and Wildlife Service. 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants. Final Rule. Federal Register: 71.

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**Noel's Amphipod (*Gammarus desperatus*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- The PBFs of critical habitat for Noel's amphipod is springs and spring-fed wetland systems that:
    - Have permanent, flowing water with no or no more than low levels of pollutants;
    - Have slow to moderate water velocities;
    - Have substrates including limestone cobble and aquatic vegetation;
    - Have stable water levels with natural diurnal (daily) and seasonal variations;
    - Consist of fresh to moderately saline water;
    - Have minimal sedimentation;
    - Vary in temperature between 50– 68 °F (10–20 °C) with natural seasonal and diurnal variations slightly above and below that range; and
    - Provide abundant food, consisting of: (A) Submergent vegetation and decaying organic matter; (B) A surface film of algae, diatoms, bacteria, and fungi; and (C) Microbial foods, such as algae and bacteria, associated with aquatic plants, algae, bacteria, and decaying organic material.

Threats to the species include reducing or eliminating water in suitable or occupied habitat through drought or pumping; introducing pollutants to levels unsuitable for the species from urban areas, agriculture, release of chemicals, and oil and gas operations; fires that reduce or eliminate available habitat; and introducing non-native species into the species inhabited spring systems such that suitable habitat is reduced or eliminated.

***Effects of the Action***

We expect carbaryl use will impact water quality, which is a critical habitat PBF that is essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

We anticipate exposure is unlikely to occur to any significant degree as all units of the species' critical habitat occurs on the Bitter Lake National Wildlife Refuge. Pesticide usage records from the U.S. Fish and Wildlife Service indicate that no carbaryl has been previously applied to national wildlife refuges. As such, we do not anticipate any areas of critical habitat are likely to be treated with carbaryl (Table 73). Visual inspection of areas surrounding the national wildlife refuge indicate no agricultural areas are in the vicinity of the refuge at this time, suggesting that off-site transport of carbaryl from adjacent use sites into the species' critical habitat is also unlikely to occur to any significant degree.

**Table 73. Overlap and past usage data for the critical habitat of the Noel's amphipod.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 0[1] | 0 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect carbaryl use (including all non-agricultural uses of carbaryl) will result in maximum estimated environmental concentrations will reach 54-76 µg/L. Available toxicity data indicate that crustaceans are sensitive to carbaryl exposure and are likely to experience high levels of mortality, even at low

[1] Overlaps for this critical habitat were determined by reviewing satellite imagery of designated critical habitat units and surrounding areas rather than using overlap data provided by the EPA.

exposure concentrations. As such, we expect the presence of carbaryl will reduce water quality to a level where individuals may not be able to use areas of critical habitat exposed to carbaryl (Table 74).

**Table 74. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | Low flow waterbodies | High |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

Impacts to the water quality PBF would be high if exposed, but there is an extremely low likelihood that critical habitat would be exposed to carbaryl as all critical habitat units occur in a national wildlife refuge with no recorded instances of carbaryl usage. As such, usage is anticipated to be extremely low over the project duration. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Noel's amphipod.

### *References*

U.S. Fish and Wildlife Service. 2011. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Roswell Springsnail, Koster's Springsnail, Noel's Amphipod, and Pecos Assiminea. Final Rule. Federal Register 76: 33036-3306

## *Fishes*

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**Peppered chub (*Macrhybopsis tetranema*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Unobstructed river segments greater than 127 river miles in length that are characterized by a complex braided channel and substrates of predominantly sand, with some patches of silt, gravel, and cobble.
- Flowing water with adequate depths to support all life stages and episodes of elevated discharge to facilitate successful reproduction, channel and floodplain maintenance, and sediment transportation.
- Water of sufficient quality to support survival and reproduction, which includes, but is not limited to, the following conditions:
    - Water temperatures generally less than 98.2 degrees Fahrenheit (36.8 degrees Celsius);
    - Dissolved oxygen concentrations generally greater than 3.7 parts per million;
    - Conductivity generally less than 16.2 millisiemens per centimeter;
    - pH generally ranging from 5.6 to 9.0; and
    - sufficiently low petroleum and other pollutant concentrations such that reproduction and/or growth is not impaired.
- Native riparian vegetation capable of maintaining river water quality, providing a terrestrial prey base, and maintaining a healthy riparian ecosystem.
- A level of predatory or competitive, native or nonnative fish present such that any peppered chub population's resiliency is not affected.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a moderate extent of overlap between the action area and the critical habitat (8.6% total overlap) (Table 75). There is a low level of past carbaryl usage (up to 3.7% critical habitat treated annually), suggesting that a moderate portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 75. Overlap and past usage data for the critical habitat of the peppered chub.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 8.6 | 3.7 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54.8-1397.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the peppered chub consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 76).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for the species. We expect high levels of mortality are likely to occur at high end estimates as these concentrations exceed the $HC_{05}$ calculated by the EPA in the BE for fish species, suggesting that the peppered chub is likely to experience high levels of mortality at these exposures. However, high-end exposure estimates are only associated with carbaryl treatments to crops in the "other grains" UDL and for individuals exposed in low flow or low water volume habitats within the species' range. 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 carbaryl ranging from 54.8-76.4 µg/L. These exposure concentrations are well below levels where available toxicity studies in fish have observed any adverse effects to survival, growth, or reproduction. As such, given that water quality impairments will vary depending on the area of critical habitat, we anticipate there will be an overall moderate adverse impact to the water quality PBF. Maximum estimated environmental concentrations resulting from non-agricultural uses are below the fish mortality $HC_{05}$, indicating that non-agricultural uses are not likely to cause more than low levels of adverse impacts to the water quality PBF.

**Table 76. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Larval insects, small crustaceans | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | Low flow/low volume waterbodies, high flow waterbodies | Medium |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

There is a moderate extent of overlap between the action area and the critical habitat, and usage is anticipated to be low. While we anticipate sensitive arthropod prey will experience high levels of mortality with exposure to carbaryl, we do not anticipate all arthropod prey species are equally sensitive to carbaryl and, as invertivore generalists, expect the peppered chub will have sufficient arthropod prey resources in the form of less sensitive arthropods. Additionally, we anticipate the prey community will recover once carbaryl residues degrade (which occurs rapidly in natural environments). As such, we anticipate there will be moderate levels of adverse effects to the arthropod prey PBF. Similarly, while some uses of carbaryl (i.e., “other grains” type crops) can result in high estimated environmental concentrations of carbaryl in certain parts of critical habitat (i.e., low flow shallow areas), resulting in high levels of mortality, we do not anticipate more than low levels of mortality in other areas of critical habitat or with other uses of carbaryl. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating that these uses are expected to result in no more than low levels of adverse effects to water quality as well. As such, we also anticipate a moderate level of impacts to the water quality PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for 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, with appendices. October 2018. Albuquerque, NM. 172 pp

U.S. Fish and Wildlife Service. 2022. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Peppered Chub and Designation of Critical Habitat. Final Rule. Federal Register 87

**Maryland darter (*Etheostoma sellare*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Continuity and sufficiency of streamflow.
- Permanence of riffle habitat (shallower, swifter segments of streams).
- High oxygen in swift waters (i.e., pollution sensitivity).
- Presence and quality of cover (i.e., crevices among stones, smaller pebbles, vegetation, or trapped wood flotsam) from predators and for spawning.

Maryland darters feed primarily on small riffle insects, snails, and invertebrates. As stated in the critical habitat (see *Critical Habitat* section), "darters [are] among the first fishes to show respiratory stress and failure with any reduction of oxygen availability" and "selective mortality of darters in habitats subjected to various other kinds of pollution is also documented."

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (16.9% total overlap) (Table 77). There is a high level of past carbaryl usage (up to 15.8% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 77. Overlap and past usage data for the critical habitat of the Maryland darter.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 16.9 | 15.8 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the Maryland darter consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 78).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for individuals of the species. However, we expect the Maryland darter is not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate no more than low levels of water quality impairment as carbaryl residues are not likely to cause mortality to individuals occupying critical habitat. As such, we anticipate only low levels of adverse impacts to the water quality PBF are likely.

**Table 78. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

There is a high extent of overlap between agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high. We anticipate impacts to the arthropod prey PBF that would moderately reduce their function where exposed but anticipate no more than low levels of impacts to the water quality PBF throughout the designated critical habitat. However, in the Service's 2021 5-year status review for the Maryland darter, we recommended delisting due to extinction. Because the available information indicates this species is no longer extant in the wild, we do not anticipate the application of carbaryl, as proposed, will adversely impact critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Maryland darter.

***References***

U.S. Fish and Wildlife Service. 1984. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Endangered Maryland Darter. Final Rule. Federal Register 49: 34228-34232.

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**Alabama cavefish (*Speoplatyrhinus poulsoni*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

The final critical habitat rule does not describe PBFs for the critical habitat. The species forages on isopods, copepods, amphipods, and small crayfish. Groundwater degradation caused by fertilizers, pesticides, herbicides, animal wastes, petroleum, and other toxins is a threat to the species habitat and its prey source. Therefore, we have identified arthropod prey, non-arthropod prey, and water quality as relevant PBFs.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

The species' critical habitat occurs within Key Cave National Wildlife Refuge. There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (27.2% total overlap) (Table 79). U.S. Fish and Wildlife Service pesticide usage records indicate that, from 2013-2023, no carbaryl has been applied within Key Cave National Wildlife Refuge. As such, we do not anticipate any areas of critical habitat are likely to be treated with carbaryl. However, off-site transport of carbaryl used in adjacent agricultural areas may result in critical habitat exposure.

**Table 79. Overlap and past usage data for the critical habitat of the Alabama cavefish.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 27.2 | 0[2] |

Carbaryl may reach the Alabama cavefish's habitat through sinkholes, groundwater recharge areas, and percolation through the soil. However, we expect recharge of karst cave systems, or the process of aboveground water reaching the groundwater supply, will often take weeks to months, at which point we expect carbaryl to be degraded and no longer present in the water as it enters the cave due to its low persistence in the environment.

Available toxicity data indicate that arthropods are highly sensitive to carbaryl and are likely to experience high levels of mortality when exposed to carbaryl. However, given that we anticipate carbaryl residues will degrade before reaching the Alabama cavefish's subterranean habitat, we anticipate arthropod prey are likely to experience no more than low levels of adverse effects and are likely to recover quickly once carbaryl residues degrade. Therefore, we anticipate no more than low levels of adverse effects to the arthropod prey PBF (Table 80).

Similarly, we do not anticipate levels of carbaryl that enter the Alabama cavefish's critical habitat are likely below levels where toxicity studies have observed adverse effects to test fish

[2] Low usage indicated by available Pesticide Use Proposal records maintained by the Fish and Wildlife Service

species. As such, we expect no more than low levels of adverse effects to the non-arthropod prey PBF and the water quality PBF are likely to occur.

**Table 80. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | High |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

The species' critical habitat occurs within Key Cave National Wildlife Refuge. Available pesticide usage data on national wildlife refuges show no carbaryl has been previously used in Key Cave National Wildlife Refuge. As such, we do not anticipate any part of critical habitat will be directly treated with carbaryl. However, there are high levels of usage in adjacent agricultural areas that may result in off-site transport. While carbaryl could be transported into critical habitat areas, we anticipate very little carbaryl is likely to enter the species' cave habitats given the long transport time required for surface water to enter the cave systems and carbaryl's rapid degradation rate. Recharge of karst cave systems, or the process of aboveground water reaching the groundwater supply, will often take weeks to months, at which point we expect carbaryl to be degraded and no longer present in the water as it enters the cave due to its low persistence in the environment. We expect carbaryl that enters the cave system where the cavefish occurs will be degraded and diluted, resulting in very low-level impacts to the arthropod prey, non-arthropod prey, and water quality PBFs of the critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Alabama cavefish.

### *References*

U.S. Fish and Wildlife Service. 1977. Final Threatened Status and Critical Habitat for Five Species of Southeastern Fishes. Final Rule. Federal Register 42: 45526-45530.

**Slackwater darter (*Etheostoma boschungi*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

The final critical habitat rule does not describe PBFs for the critical habitat. Based on information in the 2024 5-Year Status Review, the species occurs in two required habitat types: nonbreeding habitat and breeding habitat. For the-majority-of the year, they 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. As the name suggests, slackwater darters prefer streams with slow current or "slack" water. 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. Slackwater darter populations are entirely dependent upon connectivity between these two habitat types for successful recruitment. The slackwater darter primarily forages on crustaceans and insects. Pesticides are known to degrade surface water and groundwater and are listed as threats to the species. Therefore, we have identified arthropods and water quality as relevant PBFs.

In the 2024 5-Year Status Review, we state "[d]egradation 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."

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (13.5% total overlap) (Table 81). There is a high level of

past carbaryl usage (up to 13.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 81. Overlap and past usage data for the critical habitat of the slackwater darter.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 13.5 | 13.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the slackwater darter consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 82).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for individuals of the species. However, we expect the slackwater darter is not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate no more than low levels of water quality impairment as carbaryl residues are not likely to cause mortality to individuals occupying critical habitat. As such, we anticipate only low levels of adverse impacts to the water quality PBF are likely.

**Table 82. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between the agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high, we do not anticipate more than low levels of impacts to the water quality PBF as estimated environmental concentrations of carbaryl within critical habitat that are not likely to cause more than low levels of adverse effects to fish. While there will be temporary impacts to arthropod prey availability, we do not anticipate the entire prey community will die with exposure to carbaryl as we expect different species will exhibit different sensitivity to insecticides. Given that the slackwater darter is an opportunistic invertivore, we anticipate individuals will be able to rely on alternative prey species when sensitive prey species die from carbaryl exposure. Furthermore, given that the prey community will recover after carbaryl residues degrade (which will occur rapidly in natural environments), we expect these impacts to arthropod prey will only be temporary. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating that these uses are expected to result in no more than low levels of adverse effects to water quality as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the slackwater darter.

***References***

U.S. Fish and Wildlife Service. 1977. Final Threatened Status and Critical Habitat for Five Species of Southeastern Fishes. Final Rule. Federal Register 42: 45526-45530.

U.S. Fish and Wildlife Service. 1977. Final Correction and Augmentation of Critical Habitat Reorganization. Final Rule. Federal Register 42: 47840-47845.

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

**Arkansas River shiner (*Notropis girardi*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Natural, unregulated hydrologic regime with episodes of flood and drought or, if flows are modified or regulated, a hydrologic regime characterized by the duration, magnitude, and frequency of flow events capable of forming and maintaining channel and instream habitat.
- A complex, braided channel with pool, riffle (shallow area in a streambed causing ripples), run, and backwater components.
- Unimpounded stretches of flowing water of sufficient length to allow hatching and development of the larvae.
- Substrates of predominantly sand, with some patches of silt, gravel, and cobble
- Water quality characterized by low concentrations of contaminants and natural, daily, and seasonally variable temperature, turbidity, conductivity, dissolved oxygen, and pH.
- Suitable reaches of aquatic habitat and adjacent riparian habitat sufficient to support abundant terrestrial, semiaquatic, and aquatic invertebrates.
- Few or no predatory or competitive non-native fish species present

The critical habitat final rule (see *Effects of Critical Habitat Designation*) states that activities that may adversely affect critical habitat for the Arkansas River shiner include, "[a]ctions that significantly and detrimentally alter the water chemistry in any of the designated stream segments. Possible actions would include intentional or unintentional release of chemical lor biological pollutants into the surface water or connected groundwater as a point source or by dispersed release (non-point)."

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (17.6% total overlap) (Table 83). There is a high level of past carbaryl usage (up to 9.8% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 83. Overlap and past usage data for the critical habitat of the Arkansas River shiner.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 17.6 | 9.8 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-1397 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the Arkansas River shiner consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 84).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for the species. We expect high levels of mortality are likely to occur at high end estimates as these concentrations exceed the $HC_{05}$ calculated by the EPA in the BE for fish species, suggesting that the Arkansas River shiner is likely to experience high levels of mortality at these exposures. However, high-end exposure estimates are only associated with carbaryl treatments to crops in the "other grains" UDL and for individuals exposed in low flow or low water volume habitats within the species' range. 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 carbaryl ranging from 60.89-115.3 µg/L. These exposure concentrations are well below levels where available toxicity studies in fish have observed any adverse effects to survival, growth, or reproduction. As such, given that water quality impairments will vary depending on the area of critical habitat, we anticipate there will be an overall moderate adverse effect to the water quality PBF. Maximum estimated environmental concentrations resulting from non-agricultural uses are below the fish mortality $HC_{05}$, indicating that non-agricultural uses are not likely to cause more than low levels of adverse impacts to the water quality PBF.

**Table 84. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Medium |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

There is a high extent of overlap between agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high. While we anticipate sensitive arthropod prey will experience high levels of mortality with exposure to carbaryl, we do not anticipate all arthropod prey species are equally sensitive to carbaryl and, as invertivore generalists, expect the Arkansas River shiner will have sufficient arthropod prey resources in the form of less sensitive arthropods. Additionally, we anticipate the prey community will recover once carbaryl residues degrade (which occurs rapidly in natural environments). As such, we anticipate there will be moderate levels of adverse effects to the arthropod prey PBF. Similarly, while some uses of carbaryl (i.e., "other grains" type crops) can result in high estimated environmental concentrations of carbaryl in certain parts of critical habitat (i.e., low flow shallow areas), resulting in high levels of mortality, we do not anticipate more than low levels of mortality in other areas of critical habitat or with other uses of carbaryl. In contrast, we expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating that these uses are expected to result in no more than low levels of adverse effects to water quality. As such, we also anticipate a moderate level of impacts to the water quality PBF. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Arkansas River shiner.

***References***

U.S. Fish and Wildlife Service. 2005. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Arkansas River Basin Population of the Arkansas River Shiner (*Notropis girardi*). Final Rule. Federal Register 70: 59808-59846.

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**Topeka shiner (*Notropis topeka (=tristis)*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Streams most often with permanent flow, but that can become intermittent during dry periods.
- Side-channel pools and oxbows either seasonally connected to a stream or maintained by groundwater inputs, at a surface elevation equal to or lower than the bankfull discharge stream elevation.
- Water quality including temperature (1 to 30° C), total suspended solids (0 to 2000 ppm), conductivity (100 to 800 mhos), dissolved oxygen (4 ppm or greater), pH (7.0 to 9.0), and other chemical characteristics that may change seasonally.
- Pools or runs with water velocities less than 0.5 m/sec (20 in/sec) and depths between 0.1 to 2.0 m (4 to 80 in).
- Medium amounts of instream aquatic cover, such as woody debris, overhanging terrestrial vegetation, and aquatic plants.
- Sand, gravel, cobble, and silt substrates with amounts of fine sediment and substrate embeddedness that allows for nest building and maintenance of nests and eggs.
- Adequate terrestrial, semiaquatic, and aquatic invertebrate populations.
- A hydrologic regime capable of forming, maintaining, or restoring the flow periodicity, channel morphology, fish community composition, off-channel habitats, and habitat components.
- Few or no nonnative predatory or nonnative competitive species present.

In the critical habitat rule (see *Effects of Critical Habitat Designation*), "release of chemical or biological pollutants into the surface water or connected groundwater at a point source or by dispersed release (non-point)" is listed as an action that would "[s]ignificantly and detrimentally [alter] the water chemistry" of Topeka shiner critical habitat.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites and the critical habitat (87.7% total overlap) (Table 85). There is a high level of past carbaryl usage (up to 76.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 85. Overlap and past usage data for the critical habitat of the Topeka shiner.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 87.7 | 76.6 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the Topeka shiner consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 86).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for individuals of the species. However, we expect the Topeka shiner is not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations).

We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate no more than low levels of water quality impairment as carbaryl residues are not likely to cause mortality to individuals occupying critical habitat. As such, we anticipate only low levels of adverse impacts to the water quality PBF are likely.

**Table 86. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBFs |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between the agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high, we do not anticipate more than low levels of impacts to the water quality PBF as estimated environmental concentrations of carbaryl within critical habitat are not likely to cause more than low levels of adverse effects to fish. While there will be temporary impacts to arthropod prey availability, we do not anticipate the entire prey community will die with exposure to carbaryl as we expect different species will exhibit different sensitivity to insecticides. Given that the Topeka shiner is able to rely on alternative prey species when sensitive prey species die from carbaryl exposure, we anticipate there will be sufficient prey available for the species even in cases of high carbaryl exposure. Furthermore, given that the prey community will recover after carbaryl residues degrade (which will occur rapidly in natural environments), we expect these impacts to arthropod prey will only be temporary. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating these uses are expected to result in no more than low levels of adverse effects to water quality as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Topeka shiner.

***References***

U.S. Fish and Wildlife Service. 2004. Endangered and Threatened Wildlife and Plants Final Designation of Critical Habitat for the Topeka Shiner. Final Rule. Federal Register 69: 44736-44770.

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**Carolina madtom (*Noturus furiosus*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Suitable substrates and connected instream habitats, characterized by geomorphically stable stream channels and banks (i.e., channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater native fish (such as stable riffle-run-pool habitats that provide flow refuges consisting of silt-free gravel, small cobble, coarse sand, and leaf litter substrates) as well as abundant cover used for nesting.
- Adequate flows, or a hydrologic flow regime (which includes the severity, frequency, duration, and seasonality of discharge over time), necessary to maintain instream habitats where the species is found and to maintain connectivity of streams with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the fish's habitat, food availability, and ample oxygenated flow for spawning and nesting habitat.
- Water quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
- Aquatic macroinvertebrate prey items, which are typically dominated by larval midges, mayflies, caddisflies, dragonflies, and beetle larvae.

The features essential to the conservation of the Carolina madtom and Neuse River waterdog may require special management considerations or protections to reduce the following threats: (1) Urbanization of the landscape, including (but not limited to) land conversion for urban and commercial use, infrastructure (roads, bridges, utilities), and urban water uses (water supply reservoirs, wastewater treatment, etc.); (2) nutrient pollution and sedimentation from agricultural activities that impact water quantity and quality; (3) significant alteration of water quality; (4) improper forest management or clearcuts in riparian areas; (5) culvert and pipe installation that create barriers to movement; (6) impacts from invasive species; (7) changes and shifts in seasonal precipitation patterns as a result of climate change; and (8) other watershed and floodplain disturbances that release sediments or nutrients into the water.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites and the critical habitat (31% total overlap) (Table 87). There is a high level of past carbaryl usage (up to 30.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 87. Overlap and past usage data for the critical habitat of the Carolina madtom.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 31 | 30.2 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the Carolina madtom consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 88).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for individuals of the species. However, we expect the Carolina madtom is not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate no more than low levels of water quality impairment as carbaryl residues are not likely to cause mortality to individuals occupying critical habitat. As such, we anticipate only low levels of adverse impacts to the water quality PBF are likely.

**Table 88. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBFs |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | X | low flow/low volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between the agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high, we do not anticipate more than low levels of impacts to the water quality PBF as estimated environmental concentrations of carbaryl within critical habitat are not likely to cause more than low levels of adverse effects to fish. While there will be temporary impacts to arthropod prey availability, we do not anticipate the entire prey community will die with exposure to carbaryl as we expect different species will exhibit different sensitivity to insecticides. Given that the Carolina madtom is an opportunistic invertivore, we anticipate individuals will be able to rely on alternative prey species when sensitive prey species die from carbaryl exposure. Furthermore, given that the prey community will recover after carbaryl residues degrade (which will occur rapidly in natural environments), we expect these impacts to arthropod prey will only be temporary. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating these uses are expected to result in no more than low levels of adverse effects to water quality as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Carolina madtom.

***References***

U. S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Neuse River Waterdog, Endangered Species Status for Carolina Madtom, and Designations of Critical Habitat. Final Rule. Federal Register 86.

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**Diamond Darter (*Crystallaria cincotta*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

Primary constituent elements (PCEs) are the physical and biological features of critical habitat essential to a species' conservation. The PCEs of *Crystallaria cincotta* critical habitat consists of five components in West Virginia and Kentucky (78 FR 52364-52387):

(i) A series of connected riffle-pool complexes with moderate velocities in moderate- to large-sized (fourth- to eighth-order), geomorphically stable streams within the Ohio River watershed.

(ii) Stable, undisturbed sand and gravel stream substrates that are relatively free of and not embedded with silts and clays.

(iii) An instream flow regime (magnitude, frequency, duration, and seasonality of discharge over time) that is relatively unimpeded by impoundment or diversions such that there is minimal departure from a natural hydrograph.

(iv) Adequate water quality characterized by seasonally moderated temperatures, high dissolved oxygen levels, and moderate pH, and low levels of pollutants and siltation. Adequate water quality is defined as the quality necessary for normal behavior, growth, and viability of all life stages of the diamond darter.

(v) A prey base of other fish larvae and benthic invertebrates including midge, caddisfly, and mayfly larvae.

***Effects of the Action***

We expect carbaryl use will impact water quality, arthropod prey, and non-arthropod prey, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural uses of carbaryl and the critical habitat (13.1% total overlap) (Table 89). There is a high level of past carbaryl usage (up to 12.8% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed Action.

**Table 89. Overlap and past usage data for the critical habitat of the diamond darter.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 13.1 | 12.8 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use (including all non-agricultural uses of carbaryl) will result in maximum estimated environmental concentrations will reach 54-862.8 μg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 μg/L.

Available toxicity data indicate that arthropods, such as the insect prey that the diamond darter consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 90).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for individuals of the species. However, we expect the diamond darter is not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate no more than low levels of water quality impairment as carbaryl residues are not likely to cause mortality to individuals occupying critical habitat. As such, we anticipate only low levels of impacts to the water quality PBF are likely. Similarly, we do not anticipate the use of carbaryl will result in substantial decreases in the availability of fish prey. As such, we anticipate only low levels of adverse impacts to the non-arthropod prey PBF are likely.

**Table 90. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | Fish prey | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While there is a high extent of overlap between agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high, we do not anticipate more than low levels of impacts to the water quality PBF as estimated environmental concentrations of carbaryl within critical habitat are not likely to cause more than low levels of adverse effects to fish. Similarly, we do not anticipate more than low levels of adverse effects to the non-arthropod prey PBF as we expect there will not be any substantial decreases in the abundance of fish prey. While there will be temporary impacts to arthropod prey availability, we do not anticipate the entire prey community will die with exposure to carbaryl as we expect different species will exhibit different sensitivity to insecticides. Given that the diamond darter is an opportunistic forager than can rely on alternative food resources when insect prey species are not available, we anticipate individuals will have sufficient food resources even in scenarios where sensitive insect prey experience high levels of mortality. Furthermore, given that the prey community will recover after carbaryl residues degrade (which will occur rapidly in natural environments), we expect these impacts to arthropod prey will only be temporary. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating these uses are expected to result in no more than low levels of adverse effects to water quality as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the diamond darter.

***References***

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Diamond Darter (Crystallaria cincotta). Final Rule. Federal Register: 78

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**Spring pygmy sunfish (*Elassoma alabamae*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Springs and connecting spring-fed reaches and wetlands that are geomorphically stable and relatively low-gradient
- Yearly averages of water quality with optimal temperatures of 57.2 to 68°F (14 to 20°C), pH 6.0 to 7.7, dissolved oxygen of 6.0 parts per million (ppm) or greater, low concentrations of free or suspended solids with turbidity measuring less than 15 NTU and 20 mg/l TSS
- Hydrologic flow regime (magnitude, frequency, duration, and seasonality of discharge over time) necessary to maintain spring habitats
- Macroinvertebrates, including Daphnia spp., amphipods, chironomids, or small snails
- Aquatic, emergent, and semi-emergent vegetation

Activities that may affect critical habitat that are described in the "Application of the "Adverse Modification" Standard section of the final rule include, "Actions that would significantly alter water chemistry or water quality (e.g., temperature, pH, contaminants, and excess nutrients). Such activities could include, but are not limited to, the unsustainable use or release of chemicals, such as pesticides and fertilizers and biological pollutants, into surface water or groundwater. These activities could alter water conditions that are beyond the tolerances of this species and result in direct or cumulative adverse effects to the species and its life cycle." Adequate water quality is essential for normal behavior, growth, and viability during all life stages of the spring pygmy sunfish.

The large majority of occupied habitat for this species remains on privately owned lands enrolled under three Candidate Conservation Agreements with Assurances (CCAAs). We determined that the benefits of excluding areas covered by these CCAA outweighed the benefits of including them in the critical habitat designation, thus the designated critical habitat does not include these areas. The total area designated as critical habitat is 538 ha (1,330 ac). Critical habitat in Unit 1, Subunit A is a small, narrow strip of wetlands in an area of 7.2 ha (17.9 ac) that has been acquired for protection of the species by the Land Trust of North Alabama. Site restrictions on this site include no use of pesticides or herbicides.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey, non-arthropod prey, and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

For critical habitats designated for aquatic species, rather than using the designated critical habitat units, the EPA uses the HUC-12 watersheds that contain the designated critical habitat units to calculate the extent of overlap and past carbaryl usage. Given this expansion of area considered for overlap and usage, we only use on-field overlap to characterize potential exposure as we anticipate all residues that leave use sites will be collected in the waterbodies within the critical habitat regardless of how residues leave treated sites or where in the watershed they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that critical habitat designated for aquatic species will experience.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (33.5% total overlap) (Table 91). There is a high level of past carbaryl usage (up to 25.4% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

**Table 91. Overlap and past usage data for the critical habitat of the spring pygmy sunfish.**

| % Total Critical Habitat Overlap | % Critical Habitat Treated Annually |
|---:|---:|
| 33.5 | 25.4 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl 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. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Based on the specific carbaryl uses that we anticipate are most prevalent within critical habitat (i.e., the uses with the highest overlap with critical habitat), we expect agricultural carbaryl use will result in maximum estimated environmental concentrations will reach 54-862.8 µg/L. We anticipate non-agricultural uses of carbaryl will result in maximum estimated environmental concentrations up to 958.7 µg/L.

Available toxicity data indicate that arthropods, such as the insect and crustacean prey that the spring pygmy sunfish consumes, are highly sensitive to insecticides and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies, behaviors, and life histories will result in some species experiencing lower levels of mortality than others. Additionally, we anticipate arthropod prey communities will recover over time once carbaryl residues have degraded (which should occur within days to weeks of exposure). Thus, we anticipate medium levels of adverse effects to the arthropod PBF are likely to occur (Table 92).

Available toxicity data indicate that fish can experience adverse effects from carbaryl exposure, suggesting that the presence of carbaryl in critical habitat can impair water quality for individuals of the species. However, we expect the spring pygmy sunfish is not likely to experience more than low levels of mortality as maximum estimated environmental concentrations of carbaryl are well below the $HC_{05}$ for fish mortality calculated by EPA in the BE (i.e., more than 95% of tested fish species would not experience high levels of mortality at predicted environmental concentrations). We consider the $HC_{05}$ a conservative threshold for qualitatively estimating anticipated mortality to listed fish as data representing a wide diversity of fish species are used to generate $HC_{05}$ estimates. Since the maximum estimated environmental concentrations are well below the level where we anticipate 95% of fish species will not experience high levels of mortality, we anticipate no more than low levels of water quality impairment as carbaryl residues are not likely to cause mortality to individuals occupying critical habitat. As such, we anticipate only low levels of adverse impacts to the water quality PBF are likely.

**Table 92. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBFs |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | X | presence of snail prey | Low |
| water quality | X | low flow/low volume waterbodies, high flow/high volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While there is a high extent of overlap between agricultural uses of carbaryl and the critical habitat, and usage is anticipated to be high, we do not anticipate more than low levels of impacts to the water quality PBF as estimated environmental concentrations of carbaryl within critical habitat are not likely to cause more than low levels of adverse effects to fish. While there will be temporary impacts to arthropod prey availability, we do not anticipate the entire prey community will die with exposure to carbaryl as we expect different species will exhibit different sensitivity to insecticides. Given that the spring pygmy sunfish is an opportunistic invertivore, we anticipate individuals will be able to rely on alternative prey species when sensitive prey species die from carbaryl exposure. Furthermore, given that the prey community will recover after carbaryl residues degrade (which will occur rapidly in natural environments), we expect these impacts to arthropod prey will only be temporary. We expect any non-agricultural use of carbaryl will result in exposure concentrations below the fish mortality $HC_{05}$, indicating these uses are expected to result in no more than low levels of adverse effects to water quality as well. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the spring pygmy sunfish.

***References***

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

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

## *Flowering Plants*

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### Sand dune phacelia (*Phacelia argentea*)

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***
- Sandy coastal dune habitat above the high tide line that provides a high light environment, room for growth, and adequate moisture; and
- A sufficiently abundant pollinator community (which may include leafcutter bees and bumble bees) for pollination and reproduction.

***Effects of the Action***

We expect carbaryl use will impact arthropod pollinators, which is a critical habitat PBF that is essential for the conservation of the species.

There is a moderate extent of overlap between the action area and the critical habitat (9.8% total overlap) (Table 93). There is a medium level of past carbaryl usage (up to 9.8% critical habitat treated annually), suggesting that a moderate portion of the critical habitat is likely to be exposed over the duration of the proposed action. In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may cause additional exposure to critical habitat. Visual inspection of critical habitat units indicate that rights of way are the only likely non-agricultural use sites located in or near critical habitat. Available usage data on rights of way usage indicate that very little rights of way areas are treated with carbaryl nationwide, with only about 500 pounds of carbaryl applied to rights of way areas (including roadways) nationally every year. While this may represent a large exposure if all treatments were made within a single critical habitat, we anticipate this is unlikely to occur and expect rights of way usage will be sporadic across the national landscape and limited to only small treatment areas. As such, we do not anticipate non-agricultural uses of carbaryl are likely to expose more than a small portion of critical habitat, if at all.

**Table 93. Overlap and past usage data for the critical habitat of the sand dune phacelia.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 2.3 | 7.5 | 9.8 | 2.3 | 7.5 | 9.8 |

Our analysis of potential impacts to critical habitat PBFs (Table 94) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Available toxicity data indicate that insect species are generally sensitive to carbaryl and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all insect species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies and behaviors will result in different responses to carbaryl exposure. As such, we anticipate some pollinators are likely to still be available within critical habitat after carbaryl exposure. Additionally, we anticipate impacted pollinator species, especially those that are less sensitive and more common, will recover over time once carbaryl residues have degraded (which should occur over days to weeks). As such, we anticipate temporary, episodic reductions of insect pollinator species should exposure to carbaryl occur.

**Table 94. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Presence of insect pollinators | High |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

While the sand dune phacelia may be able to use a variety of insect pollinator species, it needs a robust pollinator community within critical habitat to reproduce and maintain genetic diversity and viable populations over time. As such, we anticipate individual plants will experience a moderate decrease in their reproductive output due to carbaryl-caused insect pollinator mortality and will lose the ability to use a substantial portion (9.8%) of critical habitat for recovery. Given that only a small portion of critical habitat, if any, will be exposed by non-agricultural uses of carbaryl, we anticipate no more than minor adverse effects to critical habitat PBFs are likely from these uses. In summary, we expect temporary, but episodic losses of a large portion of the most sensitive species of the pollinator community within a large portion of the critical habitat. We expect the proposed action will result in moderate reductions in the pollinator PBF in a large portion of the critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the sand dune phacelia.

### *References*

U.S. Fish and Wildlife Service. 2023. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Sand Dune Phacelia and Designation of Critical Habitat. Final Rule. Federal Register: 88.

## Wright's marsh thistle (*Cirsium wrightii*)

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Water-saturated soils with surface or subsurface water flow that allows permanent root saturation and seed germination;
- Alkaline soils;
- Full sunlight; and
- Diverse floral communities to attract pollinators.

***Effects of the Action***

We expect carbaryl use will impact insect pollinators, which is a critical habitat PBF that is essential for the conservation of the species.

There is a high extent of overlap between agricultural use areas and the critical habitat (33.9% total overlap). There is a high level of past carbaryl usage (up to 33.9% critical habitat treated annually). However, a visual assessment of the designated critical habitat unit using satellite imagery revealed no identifiable agricultural use sites within or near critical habitat, suggesting that the agricultural area overlap and usage metrics reported in **Table 95** are likely overestimates. However, visual assessment of critical habitat units did identify possible non-agricultural use sites within or near critical habitat units, including roadways, development (including commercial, industrial, and residential areas), and forests. However, we do not anticipate exposure to critical habitat through these potential non-agricultural use sites is likely either. Available usage data from the U.S. Forest Service indicate, between 2016-2020, no carbaryl has been used within managed forests within New Mexico, suggesting that there is a low probability that critical habitat will be exposed through this use type. Similarly, available usage data in rights of ways (including roadways) indicate very low levels of usage are likely, with only about 500 pounds of carbaryl applied nationally every year. While this may result in a large treatment footprint if all usage was concentrated within a single critical habitat, we anticipate this is unlikely to occur as treatments are likely to be sporadic across that nation and limited to small treatment areas within any critical habitat. As such, we anticipate no more than low levels of exposure through usage on rights of way use sites as well. Existing conservation measures for most developed uses (including residential, commercial, and industrial sites) restrict applications to spot, crack-and-crevice, and narrow perimeter band treatments using hand-held equipment, which we anticipate will substantially reduce the treatment footprint of any applications and render off-site transport through drift and runoff unlikely. As such, we anticipate very small areas, if any, are likely to be exposed to carbaryl through non-agricultural uses. In summary, based on a visual assessment of critical habitat units, available usage data, and existing conservation measures, we expect non-agricultural uses of carbaryl will expose more than a small portion of critical habitat, if at all.

**Table 95. Overlap and past usage data for the critical habitat of the Wright's marsh thistle.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---|---|---|---|---|---|
| 11.2 | 22.7 | 33.9 | 11.2 | 22.7 | 33.9 |

Our analysis of potential impacts to critical habitat PBFs (Table 96) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. Available toxicity data indicate that insect species are generally sensitive to carbaryl and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all insect species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies and behaviors will result in different responses to carbaryl exposure. As such, we anticipate some pollinators are likely to still be available within critical habitat after carbaryl exposure. Additionally, we anticipate impacted pollinator species, especially those that are less sensitive and more common, will recover over time once carbaryl residues have degraded (which should occur over days to weeks). As such, we anticipate temporary, episodic reductions of insect pollinator species should exposure to carbaryl occur.

**Table 96. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Presence of insect pollinators | High |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

While the Wright's marsh thistle relies on insect pollinators that are highly sensitive and susceptible to carbaryl exposure, we do not anticipate more than low levels of adverse effects are likely to occur. A visual assessment of designated critical habitat units indicate that agricultural use sites are not located within or near designated critical habitat. While potential non-agricultural use sites are in the general vicinity of designated critical habitat (including roadways, commercial, residential, and managed forest use sites), available usage data and existing conservation measures suggest that exposure to critical habitat from these uses is not likely. Given that only a small portion of critical habitat, if any, will be exposed by non-agricultural uses of carbaryl, we anticipate no more than minor adverse effects to critical habitat PBFs are likely from these uses. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Wright's marsh thistle.

***References***

U.S. Fish and Wildlife Service. 2023. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Wright's Marsh Thistle with a Section 4(d) Rule and Designation of Critical Habitat. Final Rule. Federal Register: 88

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**Florida brickell-bush (*Brickellia mosieri*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Areas of pine rockland habitat that contain:
    - Open canopy, semi-open subcanopy, understory.
    - Substrate of oolitic limestone.
    - Plant community of predominantly native vegetation.
- Disturbance regime that naturally or artificially duplicates natural ecological processes and maintains pine rockland habitat.
- Habitats that are connected and of sufficient area to sustain viable populations.
    - Availability of pollinators of appropriate type and in sufficient numbers.

Pollen dispersal for this species is provided mainly by insect pollinators, which are listed as a PCE in the critical habitat final rule. Because the specific type(s) and number of pollinators of *B. mosieri* are unknown and may include non-generalist species closely tied to pine rockland habitats, preserving and restoring connectivity of pine rockland habitat fragments is essential to the long- term conservation of the species. Sufficient connectivity of pine rockland habitat is necessary to support establishment of new populations through seed dispersal, and to preserve and enhance genetic diversity. Therefore, habitat connectivity of sufficient size and suitability that supports the species' growth, distribution, and population expansion is included as a PCE for *B. mosieri.*

***Effects of the Action***

We expect carbaryl use will impact insect pollinators, which is a critical habitat PBF that are essential for the conservation of the species. The Florida brickell-bush is an insect pollinator generalist that can use a variety of insect species for successful reproduction.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (58.2% total overlap) (Table 97). There is a high level of

past carbaryl usage (up to 58.2% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action. In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may cause exposure of critical habitat. Critical habitat for the Florida brickell-bush occurs almost exclusively within pine rockland habitats in Miami-Dade County. As such, we do not expect carbaryl use on managed forests, rangeland, nursery, and rights of way use sites are likely to contain or produce the PBF requirements. However, in the final critical habitat designation, units are described as small, fragmented, and in most cases, surrounded by urban development. We expect existing conservation measures that apply to most residential treatments (e.g., limitations to spot, crack-and-crevice, or narrow perimeter band treatments using hand-held equipment) will reduce treatment area sizes and render spray drift unlikely for most residential uses. However, we anticipate carbaryl uses on lawns, turf, or other open space developed areas (such as golf courses) may still result in exposure to critical habitat. Given that designated critical habitat units are known to be in very close proximity to urban development, we anticipate exposure to some developed and open space developed uses is expected to occur. As such, we expect developed and open space developed uses of carbaryl are likely to expose critical habitat.

**Table 97. Overlap and past usage data for the critical habitat of the Florida brickell-bush.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 29 | 29.3 | 58.2 | 29 | 29.3 | 58.2 |

Our analysis of potential impacts to critical habitat PBFs (Table 98) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Available toxicity data indicate that insect species are generally sensitive to carbaryl and are likely to experience high levels of mortality when exposed to carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all insect species will be equally sensitive to carbaryl as natural variations in species' physiologies, life histories, and behaviors will result in different responses to carbaryl exposure. As such, we anticipate there will likely be some pollinators available in critical habitat after carbaryl exposure for individuals to use. Additionally, we anticipate impacted pollinator species, especially those that are less sensitive and more common, will recover over time once carbaryl residues have degraded (which should occur over days to weeks). As such, we anticipate temporary, episodic reductions of insect pollinator species in most of the areas within designated critical habitat.

**Table 98. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as pollinators | High |

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

There is a high degree of overlap between the agricultural use sites and designated critical habitat, indicating a high level of exposure to critical habitat. Furthermore, while existing conservation measures on most residential uses will reduce exposure resulting from developed uses, these measures do not apply to all developed or open space developed uses. Given the close proximity of designated critical habitat units to developed areas, we anticipate additional exposure to carbaryl through non-agricultural uses is reasonably certain to occur. While the Florida brickell-bush can use a variety of insect species for pollination, outcrossing by insect pollinators is essential to its reproductive success. As such, we anticipate individual plants will experience an appreciable decrease in their reproductive output due to carbaryl-caused insect pollinator mortality (Table 98) and will lose the ability to use a substantial portion of critical habitat for recovery. As a result, we expect the proposed action will result in substantial reductions in the pollinator PBF, to the extent that it would affect the conservation value of the designated critical habitat as a whole. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Florida brickell-bush.

***References***

U.S. Fish and Wildlife Service. 2015. Designation of Critical Habitat for *Brickellia mosieri* (Florida Brickell-bush) and *Linum carteri* var. *carteri* (Carter's Small-flowered Flax). Final Rule. Federal Register 80: 49846-49886.

U.S. Fish and Wildlife Service. 2013. Proposed Designation of Critical Habitat for *Brickellia mosieri* (Florida Brickell-bush) and *Linum carteri* var. *carteri* (Carter's Small-flowered Flax). Proposed Rule. Federal Register 78 61293-61320.

**White Bluffs bladderpod (*Physaria douglasii ssp. tuplashensis*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

(i) Weathered alkaline paleosols and mixed soils overlying the Ringold Formation. These soils occur within and around the exposed caliche-like cap deposits associated with the White Bluffs of the Ringold Formation, which contain a high percentage of calcium carbonate. These features occur between 210–275 m (700–900 ft) in elevation.

(ii) Sparsely vegetated habitat (less than 10–15 percent total cover), containing low amounts of nonnative or invasive plant species (less than 1 percent cover).

(iii) The presence of insect pollinator species.

(iv) The presence of native shrub steppe habitat within the effective pollinator distance (300 m (approximately 980 ft)).

(v) The presence of stable bluff formations with minimal landslide occurrence.

***Effects of the Action***

We expect carbaryl use will impact insect pollinators, which is a critical habitat PBF that is essential for the conservation of the species. Little information is available on the White Bluffs bladderpod's specific pollinators, though they are insects, and the species likely uses outcrossing similar to many other species in the genus *Physaria*. Given the lack of information, we assume the species is an insect pollinator specialist that can only rely on a small number of species for successful pollination.

There is a high extent of overlap between agricultural uses of carbaryl and the critical habitat (51.6% total overlap) (Table 99). There is a high level of past carbaryl usage (up to 51.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action, though most exposure is anticipated to be through spray drift (from off-field overlap).

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may cause exposure of critical habitat. Critical habitat for the White Bluffs bladderpod occurs exclusively within undeveloped areas of the Hanford Reach National Monument. As such, we do not expect carbaryl use on managed forests, rangeland, nursery, developed, open space developed, and rights of way use sites to occur within or adjacent to critical habitat. As such, we expect non-agricultural uses of carbaryl will not expose critical habitat.

**Table 99. Overlap and past usage data for the critical habitat of the White Bluffs bladderpod.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---|---|---|---|---|---|
| 21.2 | 30.4 | 51.6 | 21.2 | 30.4 | 51.6 |

Our analysis of potential impacts to critical habitat PBFs assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. The White Bluffs bladderpod requires insect pollinators as a component of its critical habitat. Available toxicity data show that insect species are sensitive to insecticide exposure and are likely to die when exposed to carbaryl. As such, we anticipate there will be a large reduction in the abundance of insect pollinators within critical habitat areas if they are exposed to carbaryl (Table 100).

**Table 100. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as pollinators | High |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

In summary, while we anticipate a large portion of critical habitat has the potential to be exposed to carbaryl over the duration of the proposed action, we anticipate low adverse effects to the pollinator PBF for the following reasons. First, the species is known to produce abundant seed, indicating that pollinators are available in the range and there is no pre-existing pollinator deficit. Second, almost all individuals occur within designated critical habitat and within the Hanford Reach National Monument where exposure to pollinators from agricultural and non-agricultural uses of carbaryl are not expected to occur (USFWS 2022). In addition, the final listing rule determined pesticide use on agricultural fields adjacent to the range of the species is not a threat to the species or its pollinators (USFWS 2013). Lastly, when critical habitat was designated, a built-in 300-350m ‘buffer’ was added to the designated area, so drift of carbaryl from adjacent agricultural fields (or non-agricultural use areas) is unlikely to reach key habitat areas. As such, we do not anticipate agricultural use of carbaryl will result in an appreciable reduction in the pollinator PBF and the species will continue to be able to use all portions of the critical habitat for recovery, such that carbaryl exposure to pollinators will not affect the conservation value of the designated critical habitat as a whole. We do not anticipate non-agricultural uses of carbaryl will expose critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the White Bluffs bladderpod.

***References***

U.S. Fish and Wildlife Service. 2022. Recovery Plan for White Bluffs bladderpod (*Physaria douglasii* subsp. *Tuplashensis*). Portland, Oregon. 31 pp.

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Threatened Status for *Eriogonum codium* (Umtanum Desert Buckwheat) and *Physaria douglasii* subsp. *tuplashensis* (White Bluffs Bladderpod) and Designation of Critical Habitat. Final Rule. Federal Register 78: 76995-77005.

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Threatened Status for *Eriogonum codium* (Umtanum Desert Buckwheat) and *Physaria douglasii* subsp. *tuplashensis* (White Bluffs Bladderpod) and Designation of Critical Habitat. Final Rule. Federal Register 78: 24008-24032.

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**Carter's small-flowered flax (*Linum carteri carteri*)**

***Conclusion:*** Likely to destroy or adverse modify designated critical habitat

***Physical & Biological Features:***

- Areas of pine rockland habitat that contain:
  - Open canopy, semi-open subcanopy, and understory;
  - Substrate of oolitic limestone rock; and
  - A plant community of predominately native vegetation
- A disturbance regime that naturally or artificially duplicates natural ecological processes (e.g., fire, hurricanes, or other weather events) and that maintains the pine rockland habitat
- Habitats that are connected and of sufficient area to sustain viable populations of *Brickellia mosieri* and *Linum carteri* var. *carteri* in the pine rockland habitat

Additionally, the critical habitat designation emphasizes that sufficient connectivity of pine rockland habitat will contribute to the availability of pollinators of appropriate type and sufficient numbers to allow the species to reproduce and ensure sustainable populations, and to allow for population expansion through seed dispersal. As such, we include the presence of arthropod pollinators as a relevant PBF for this critical habitat.

***Effects of the Action***

We expect carbaryl use will impact insect pollinators, which is a critical habitat PBF that is essential for the conservation of the species. Little information is available on the Carter's small-flowered flax's specific pollinators, but flower morphology suggests the species may be pollinated by butterflies, bees, or both and is likely a pollinator generalist species.

There is a high extent of overlap between the agricultural uses of carbaryl and the critical habitat (58% total overlap) (Table 101). There is a high level of past carbaryl usage (up to 58% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action, though most exposure is anticipated to be through spray drift (from off-field overlap).

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may expose critical habitat to carbaryl. Critical habitat for the Carter's small-flowered flax occurs almost exclusively within pine rockland habitats in Miami-Dade County. As such, we do not expect carbaryl use on managed forests, rangeland, nursery, and rights of way use sites are likely to contain or produce many of the PBF requirements. However, in the final critical habitat designation, units are described as small, fragmented, and in most cases, surrounded by urban development. We expect existing conservation measures that apply to most residential treatments (e.g., limitations to spot, crack-and-crevice, or narrow perimeter band treatments using hand-held equipment) will reduce treatment area sizes and render spray drift unlikely for most residential uses. However, we anticipate carbaryl uses on lawns, turf, or other open space developed areas (such as golf courses) may still result in exposure to critical habitat. Given that designated critical habitat units are known to be in very close proximity to urban development, we anticipate exposure to some developed and open space developed uses is expected to occur. As such, we expect developed and open space developed uses of carbaryl are likely to expose critical habitat.

**Table 101. Overlap and past usage data for the critical habitat of the Carter's small-flowered flax.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 28.6 | 29.4 | 58 | 28.6 | 29.4 | 58 |

Our analysis of potential impacts to critical habitat PBFs (Table 102) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Available toxicity data indicate that insect species are generally sensitive to insecticides and are likely to experience high levels of mortality when exposed to carbaryl within critical habitat, regardless of the exposure level. However, we do not anticipate all insect species will be equally sensitive to carbaryl as natural variations in species' physiologies, life histories, and behaviors will result in different responses to carbaryl exposure. As such, we anticipate there will likely be some pollinators available in critical habitat after carbaryl exposure for individuals to use. Additionally, we anticipate impacted pollinator species, especially those that are less sensitive and more common, will recover over time once carbaryl residues have degraded (which should occur over days to weeks). As such, we anticipate temporary, episodic reductions of insect pollinator species in most of the areas within designated critical habitat.

**Table 102. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as pollinators | High |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

There is a high degree of overlap between the agricultural use sites and designated critical habitat, indicating a high level of exposure to critical habitat. Furthermore, while existing conservation measures on most residential uses will reduce exposure resulting from developed uses, these measures do not apply to all developed or open space developed uses. Given the close proximity of designated critical habitat units to developed areas, we anticipate additional exposure to carbaryl through non-agricultural uses is reasonably certain to occur. While the Carter's small-flowered flax can presumably use a variety of insect species for pollination, outcrossing by insect pollinators is essential to its reproductive success. As such, we anticipate individual plants will experience an appreciable decrease in their reproductive output due to carbaryl-caused insect pollinator mortality and will lose the ability to use a substantial portion of critical habitat for recovery (up to 58% of critical habitat). After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Carter's small-flowered flax.

***References***

U.S. Fish and Wildlife Service. 2015. Designation of Critical Habitat for *Brickellia mosieri* (Florida Brickell-bush) and *Linum carteri* var. *carteri* (Carter's Small-flowered Flax). Final Rule. Federal Register 80: 49846-49886.

U.S. Fish and Wildlife Service. 2013. Proposed Designation of Critical Habitat for *Brickellia mosieri* (Florida Brickell-bush) and *Linum carteri* var. *carteri* (Carter's Small-flowered Flax). Proposed Rule. Federal Register 78: 61293 - 61320.

## *Insects*

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**Salt Creek Tiger beetle (*Cicindela nevadica lincolniana*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Exposed mudflats associated with saline wetlands or the exposed banks and islands of streams and seeps that contain adequate soil moisture and soil salinity are essential core habitats. The "Salmo" soil series is the only soil type that currently supports occupied habitat; "Saltillo" has adequate soil moisture and salinity and can provide suitable habitat.
- Vegetated wetlands adjacent to core habitats that provide shade for subspecies thermoregulation, support a source of prey for adults and larval forms of Salt Creek tiger beetles, and protect core habitats.

The PBFs specific to the Salt Creek tiger beetle pertain to saline barrens and seeps found within saline wetland habitat in Little Salt, Rock, Oak and Haines Branch Creeks. The PBFs focus on maintaining suitable habitat that contains specific soil dynamics and wetlands that support a source of prey and other requirements for the species to complete its life cycle. Salt Creek tiger beetle prey species include insects belonging to the orders Coleoptera (beetles), Orthoptera (grasshoppers and crickets), Hemiptera (true bugs), Hymenoptera (ants, bees, and wasps), Odonata (dragonflies), Diptera (flies), and Lepidoptera (moths and butterflies). Ants appear to be the most commonly observed prey of adult tiger beetles.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey, which is a critical habitat PBF that is essential for the conservation of the species.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (67.6% total overlap) (Table 103). There is a high level of past carbaryl usage (up to 67.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl. Our review of the specific PBF requirements listed above indicates that most managed forests, developed, open space developed, nursery, and rights of way use sites are not likely to contain or produce many of the PBF requirements. As such, we do not expect these non-agricultural uses will expose critical habitat. In contrast, rangeland use sites could contain at least some of the PBFs required to support the species. However, available usage data from USDA APHIS indicate no carbaryl has been used in rangeland habitats within the states containing the Salt Creek tiger beetle's critical habitat, suggesting that there is a low likelihood that critical habitat will be exposed through this use. In addition, we anticipate all rangeland applications of carbaryl will be carried out in association with USDA APHIS as part of their grasshopper and Mormon cricket suppression program (USFWS 2024), which includes many conservation measures that are meant to protect listed species and their critical habitats from exposure. As such, we anticipate that non-agricultural uses of carbaryl are not likely to expose more than a small portion of critical habitat, if at all.

**Table 103. Overlap and past usage data for the critical habitat of the Salt Creek tiger beetle.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 51.8 | 15.8 | 67.6 | 51.8 | 15.8 | 67.6 |

Our analysis of potential impacts to critical habitat PBFs (Table 104) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Available toxicity data indicate that insect species are generally sensitive to carbaryl and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level. We anticipate many impacted prey species will recover over time once carbaryl residues have degraded after applications (which should occur within days to weeks of exposure). However, critical habitat is likely to experience repeated exposures to carbaryl over the duration of the proposed action based on the high levels of past usage in the critical habitat. As such, while we do not expect the entire arthropod prey community will experience complete mortality and that some species in the community will recover after carbaryl exposure, we anticipate high, episodic impacts to the arthropod prey PBF.

**Table 104. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | High |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

In summary, a large portion of critical habitat is likely to be exposed to carbaryl over the proposed action's duration. We do not anticipate non-agricultural uses will expose more than a small portion of critical habitat, if at all. In areas exposed, we anticipate a high level of impacts to arthropod prey resources as insect prey species are likely to experience high levels of mortality, reducing the abundance of insect prey for the salt creek tiger beetle. While we expect these impacts are temporary during periods after applications, given carbaryl's rapid degradation rate, we anticipate these adverse effects will result in substantial impacts to the critical habitat PBFs. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Salt Creek tiger beetle.

***References***

U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Revision of Critical Habitat for Salt Creek Tiger Beetle. Final Rule. Federal Register 79: 26013-26038.

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**Poweshiek skipperling (*Oarisma poweshiek*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Wet-mesic to dry tallgrass remnant untilled prairies or remnant moist meadows containing:
    - Predominantly native grasses and native flowering forbs.
    - Undisturbed (untilled) glacial soil types including, but not limited to, loam, sandy loam, loamy sand, gravel, organic soils (peat), or marl that provide the edaphic features necessary.
    - If present, depressional wetlands or low wet areas, within or adjacent to prairies.
    - If present, trees or large shrub cover <5% of area in dry prairies and <25% in wet-mesic prairies and prairie fens.
    - If present, nonnative invasive plant species occurring in <5% of the area.
- Prairie fen habitats containing:
    - Predominantly native grasses and native flowering forbs.
    - Undisturbed (untilled) glacial soil types including, but not limited to, organic soils (peat), or marl that provide the edaphic features necessary.
    - Depressional wetlands or low wet areas, within or adjacent to prairies.
    - Hydraulic features necessary to maintain prairie fen groundwater flow and prairie fen plant communities.
    - If present, trees or large shrub cover <25% of the unit.
    - If present, nonnative invasive plant species occurring in <25% of area.
- Native grasses and native flowering forbs for larval and adult food and shelter, specifically;

  - Native grasses to provide larval food and shelter sources: Prairie dropseed (Sporobolus heterolepis), little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), or mat muhly (Muhlenbergia richardsonis).
  - Forbs in bloom to provide nectar and water sources: Purple coneflower (Echinacea angustifolia), black-eyed Susan (Rudbeckia hirta), smooth ox-eye (Heliopsis helianthoides), stiff tickseed (Coreopsis palmata), palespike lobelia (Lobelia spicata), sticky tofieldia (Triantha glutinosa), or shrubby cinquefoil (Dasiphora fruticosa ssp. floribunda).
- Dispersal grassland habitat that is within 1 km (0.6 mi) of native high-quality remnant prairie that connects high quality wet-mesic to dry tallgrass prairies, moist meadows, or prairie fen habitats.
  - Undeveloped open areas dominated by perennial grassland with limited or no barriers to dispersal including tree or shrub cover <25% of the area and no row crops such as corn, beans, potatoes, or sunflowers.

***Effects of the Action***

We expect carbaryl use will impact habitat function, which is a critical habitat PBF that are essential for the conservation of the species.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (18.6% total overlap) (Table 105). There is a high level of past carbaryl usage (up to 18.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl. Our review of the specific PBF requirements listed above indicates that managed forests, developed, open space developed, nursery, and rights of way use sites are not likely to contain or produce many of the PBF requirements. As such, we do not expect these non-agricultural uses of carbaryl are not likely to significantly contribute to the exposure of critical habitat. In contrast, rangeland use sites could contain at least some of the PBFs required to support the species. However, available usage data from USDA APHIS indicate no carbaryl has been used in rangeland habitats within the states containing the Poweshiek skipperling's critical habitat, suggesting that there is a low likelihood that critical habitat will be exposed through this use. In addition, we anticipate all rangeland applications of carbaryl will be carried out in association with USDA APHIS as part of their grasshopper and Mormon cricket suppression program (USFWS 2024), which include many conservation measures that are meant to protect listed species and their critical habitats from exposure. As such, we do not expect non-agricultural uses will expose critical habitat.

**Table 105. Overlap and past usage data for the critical habitat of the Poweshiek skipperling.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---|---|---|---|---|---|
| 5.6 | 12.9 | 18.6 | 5.6 | 12.9 | 18.6 |

Our analysis of potential impacts to critical habitat PBFs (Table 106) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Based on available toxicity data, we anticipate insect species are sensitive to carbaryl and are likely to experience high levels of mortality with exposure. Critical habitat exposed to carbaryl through direct application or through spray drift is likely not able to function as critical habitat as the presence of aerosolized compound or residues on surfaces are likely high enough to cause mortality to insects, precluding its use for individuals of the species. Given that individuals occupying critical habitat will die if exposed to carbaryl, we expect, even with carbaryl's rapid degradation rate, that repeated exposures will further result in high levels of impacts to critical habitat function.

**Table 106. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | -- | -- | -- |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | X | -- | High |

***Rationale for Conclusion***

In summary, a large portion of critical habitat is likely to be exposed to carbaryl over the proposed action's duration. We do not anticipate non-agricultural uses of carbaryl will expose critical habitat. In areas exposed, we anticipate high levels of impacts to the critical habitat's function as individuals exposed to carbaryl residues in critical habitat are likely to die. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Poweshiek skipperling.

***References***

U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Dakota Skipper and Poweshiek Skipperling. Final Rule. Federal Register 80: 59247-59384.

Appendix D-A1. Animals and Plants Critical Habitat Determinations and Rationales

## *Mammals*

**Indiana bat (*Myotis sodalis*)**

***Conclusion:*** Not likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

The final critical habitat rule does not describe PBFs for the critical habitat. Critical habitat units designated include 13 hibernacula (winter habitat), including 11 caves and two mines in six states (Indiana, Kentucky, Missouri, Tennessee, and West Virginia). The species feeds on flying insects and occasionally spiders. Therefore, we have identified arthropod prey as the relevant PBF.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey, which is a critical habitat PBF that is essential for the conservation of the species. While we do not anticipate carbaryl residues are likely to enter the caves and mines that serve as hibernacula for the species, we focus our evaluation of effects to critical habitat on the areas immediately surrounding hibernacula in the periods of seasonal swarming prior to hibernation.

There is a high extent of overlap between agricultural use sites (and their associated off-site transport areas) and the critical habitat (23.5% total overlap) (Table 107). There is a high level of past carbaryl usage (up to 15.7% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action.

In addition to agricultural uses, we anticipate non-agricultural uses of carbaryl may also expose critical habitat to carbaryl, including uses in developed, open space developed, nursery, managed forests, rangeland, and rights of way areas. Given that the designated critical habitat is focused on the bat's winter hibernacula, which consists of caves and abandoned mines, we expect developed, open space developed, nurseries, managed forests, rangelands, and rights of way use sites are not likely to contain or produce many of the PBF requirements. As such, we do not expect non-agricultural uses of carbaryl will expose critical habitat.

**Table 107. Overlap and past usage data for the critical habitat of the Indiana bat.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---:|---:|---:|---:|---:|---:|
| 17.8 | 5.7 | 23.5 | 11.6 | 4.1 | 15.7 |

Our analysis of potential impacts to critical habitat PBFs (Table 108) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Available toxicity data indicate that insect species are generally sensitive to carbaryl and are likely to experience high levels of mortality when exposed to predicted levels of carbaryl within critical habitat, regardless of the exposure level.

Given that individuals do not feed while they are hibernating, we anticipate arthropod prey impacts would be limited to periods of seasonal swarming pre-hibernation in the fall. However, while we anticipate high levels of mortality to sensitive arthropod prey species, we anticipate there will still be sufficient prey availability within critical habitat. We do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies and behaviors will result in different responses to insecticides. Thus, we anticipate there will still be some food resources available in critical habitat even in scenarios where carbaryl is used in the areas surrounding the hibernacula in the periods preceding hibernation. Additionally, we anticipate most impacted prey species will recover over time once carbaryl residues have degraded after applications (which we expect to occur on the order of days to weeks). The Indiana bat is also highly mobile and would likely find adequate prey availability at alternative foraging sites not exposed to carbaryl. As such, we expect some arthropod prey will still be available after exposure and any losses will likely only be temporary, resulting in episodic, moderate levels of impacts to the arthropod prey PBF.

**Table 108. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBFs |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | Medium |
| non-arthropods (as prey or hosts) | -- | -- | -- |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

In summary, we expect episodic losses of prey in a large portion of the critical habitat (primarily in the areas surrounding the hibernacula). However, the Indiana bat is a generalist insectivore that forages on a variety of insect prey items. We do not anticipate all prey will be lost in the areas surrounding the species' hibernacula at the same time or for long periods. In addition, the bat is highly mobile, and we expect individuals would be able to move to alternative foraging sites as needed during pre-hibernation periods of feeding. We do not anticipate non-agricultural uses of carbaryl will expose critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the Indiana bat.

***References***

U.S. Fish and Wildlife Service. 1977. Endangered and Threatened Wildlife and Plants; Correction and Augmentation of Published Rulemaking. Final Rule. Federal Register 42: 47840-47845.

U.S. Fish and Wildlife Service. 1976. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for American Crocodile, California Condor, Indiana Bat, and Florida Manatee. Final Rule. Federal Register 41: 41914-41916.

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**Buena Vista Lake ornate Shrew (*Sorex ornatus relictus*)**

***Conclusion:*** Likely to destroy or adversely modify designated critical habitat

***Physical & Biological Features:***

- Permanent and intermittent riparian or wetland communities that contain:
    - Consistent and diverse supply of prey. Although the specific prey species used by the Buena Vista Lake ornate shrew have not been identified, ornate shrews are known to eat a variety of terrestrial and aquatic invertebrates, including amphipods, slugs, and insects.

These PBFs discuss the importance of riparian and wetland habitats to provide the Buena Vista Lake ornate shrew's food sources. Buena Vista Lake ornate shrew's critical habitat is surrounded by agriculture in the South San Joaquin Valley of California. In the critical habitat final rule (see *Application of the "Adverse Modification" Standard*), activities "that could affect water quality within critical habitat" may adversely modify critical habitat.

***Effects of the Action***

We expect carbaryl use will impact arthropod prey, non-arthropod prey, and water quality, which are critical habitat PBFs that are essential for the conservation of the species.

Mandatory reporting data from the state of California indicates that, between 2013-2022, the maximum yearly overlap between the critical habitat and agricultural areas reporting any pesticide usage was 24.2% (Table 109). Of those areas reporting pesticide usage, up to 18.3% reported use of any insecticide. Based on this reporting data, we expect 2.1% of the critical habitat is likely to be treated with carbaryl, specifically. However, on average, only 13.8 growers within the species' critical habitat report pesticide usage information to the state, which we consider to be a small sample size. This suggests that, despite a low level of annual carbaryl usage, there may be high variability across years as even a small number of applicators changing their pesticide usage can dramatically alter the overall exposure to critical habitat year-to-year. To account for this variability, we use the percent range treated with any insecticide to represent the past level of carbaryl usage within critical habitat. As such, we anticipate there is a high level of past usage, suggesting that a large portion of critical habitat is likely to be exposed to carbaryl.

While non-agricultural uses of carbaryl could also contribute to the overall exposure of critical habitat, given available information on the locations of designated critical habitat units, we do not anticipate non-agricultural uses are likely to occur on or near critical habitat. Available descriptions of critical habitat units indicate that most units are completely surrounded by agricultural development and are not located on or near developed, open space developed, nursery, managed forests, or rangeland use sites, suggesting that there is a low likelihood that the shrew's critical habitat will be exposed to carbaryl through these uses. While rights of way do occur on or near critical habitat units, we also expect exposure is unlikely to occur through this use pattern as we anticipate low usage rates in rights of way. Available usage data indicate that only 500 pounds of carbaryl are used nationally on rights of ways annually. While this level of usage may result in a large treatment footprint if all treated areas were concentrated in a single critical habitat, we expect this is highly unlikely to occur. Rather, we expect rights of way usage is likely to be sporadic across the national landscape and only small amounts of carbaryl will be used within the Buena Vista Lake ornate shrew's critical habitat, if any. As such, we anticipate that non-agricultural uses of carbaryl are not likely to expose critical habitat.

**Table 109. Past usage data for the Buena Vista Lake ornate shrew.**

| % range treated with any pesticide | % range treated with any insecticide | % range treated with carbaryl |
|---:|---:|---:|
| 24.2 | 18.3 | 2.1 |

Our analysis of potential impacts to critical habitat PBFs (Table 110) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Available toxicity data indicate that arthropod species, like the crustaceans and insects the shrew consumes, are generally sensitive to insecticides and are likely to experience high levels of mortality when exposed carbaryl, regardless of the predicted exposure concentration. However, we do not anticipate all arthropod species will be equally sensitive to insecticides as natural variations in species' physiologies and behaviors will result in different responses to carbaryl exposure. Thus, we anticipate there will still be some food resources available in critical habitat despite a reduction in the abundance of sensitive species. Additionally, we anticipate impacted prey species will recover over time once carbaryl residues have degraded (which should occur over days to weeks). However, the species requires a consistent and diverse supply of prey, and we expect adverse effects to arthropod prey are likely to repeatedly occur over the duration of the proposed action. As such, while we expect some arthropod prey will still be available after exposure and any losses will likely only be temporary, we anticipate episodic, moderate to high levels of impacts to the arthropod prey PBF.

In contrast, available toxicity data indicate that the non-arthropod species that the shrew consumes, including snails, slugs, and earthworms, are not likely to experience more than low levels of adverse effects to survival, growth, or reproduction predicted environmental concentrations of carbaryl. As such, we expect there will be no more than low levels of impacts to non-arthropod prey availability and no adverse effects to the non-arthropod PBF.

Carbaryl is not likely to bioaccumulate. As such, while the aquatic habitats within the shrew's critical habitat are likely to contain carbaryl residues, EPA's exposure modeling indicate that individuals are not likely to accumulate more than low levels of carbaryl through exposure to contaminated water. We do not anticipate this exposure through water will result in more than low levels of adverse effects to individual shrews. As such, we expect carbaryl will not cause water quality impairments that prevent individuals from using critical habitat, indicating no more than low levels of adverse effects to the water quality PBF.

**Table 110. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impacts to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Arthropods as prey | High |
| non-arthropods (as prey or hosts) | X | presence of soil invertebrates, benthic invertebrate prey | Low |
| water quality | X | low flow/low volume waterbodies | Low |
| habitat function | -- | -- | -- |

### *Rationale for Conclusion*

In summary, there is a large portion of critical habitat likely to be exposed over the duration of the proposed action. While we anticipate low levels of effects to the non-arthropod and water quality PBFs, we expect a high level of impact to the arthropod prey PBF. While arthropod prey communities would likely recover over time after exposure, losses would likely be repeated throughout the project duration from repeated applications over the duration of the proposed action. We do not anticipate non-agricultural uses of carbaryl will expose critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species and is likely to result in the destruction or adverse modification of the designated critical habitat for the Buena Vista Lake ornate shrew.

### *References*

U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Buena Vista Lake Shrew. Final Rule. Federal Register 77: 39835-39867.

## *Reptiles*

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### Rim rock crowned snake (*Tantilla oolitica*)

***Conclusion:*** Not likely to destroy or adversely modify proposed critical habitat

***Physical & Biological Features:***

- Pine rocklands habitat that contains:
  - Refugia consisting of limestone rock substrate with holes, crevices, and shallow depressions; piles of rock rubble; and pockets of organic matter accumulating in solution holes;
  - Suitable prey;
  - Warm, moist microhabitats to maintain homeostasis; and
  - A natural or prescribed fire regime at 5- and 7-year intervals that maintains the pine rocklands habitat and associated plant community.
- Rockland hammock habitat that contains:
  - Refugia consisting of limestone rock substrate with holes, crevices, and shallow depressions; piles of rock rubble; and pockets of organic matter accumulating in solution holes;
  - Suitable prey;
  - Warm, moist microhabitats to maintain homeostasis; and
  - Little to no maintenance

***Effects of the Action***

We expect carbaryl use will impact arthropod and non-arthropod prey, which are critical habitat PBFs that are essential for the conservation of the species.

There is a high extent of overlap between the action area and the critical habitat (11.6% total overlap) (Table 111). There is a high level of past carbaryl usage (up to 11.6% critical habitat treated annually), suggesting that a large portion of the critical habitat is likely to be exposed over the duration of the proposed action. Our review of the specific PBF requirements listed above indicates that managed forests, nursery, rangeland, and rights of way use sites are not likely to contain or produce many of the PBF requirements. While, proposed designated critical habitat units are described as surrounded by urban development, including commercial and residential areas, we anticipate existing conservation measures that apply to most residential uses (e.g., limitations to spot, crack-and-crevice, or narrow perimeter band treatments using hand-held equipment) will reduce treatment area sizes and render spray drift and runoff unlikely for most of these uses. As such, we do not expect non-agricultural uses will expose critical habitat.

**Table 111. Overlap and past usage data for the critical habitat of the rim rock crowned snake.**

| % Total On-Field Overlap | % Total Off-field Overlap | % Total Overlap | % On-field Treated Annually | % Off-field Treated Annually | % Treated Annually |
|---|---|---|---|---|---|
| 5.6 | 6 | 11.6 | 5.6 | 6 | 11.6 |

Our analysis of potential impacts to critical habitat PBFs (Table 112) assumes critical habitats are exposed to carbaryl and is focused on determining the level of adverse effect expected to occur once exposure has taken place. We integrate species' specific factors and considerations in the "Rationale for Conclusion" section below. The rim rock crowned snake's exact diet is unknown, but prey probably consists of centipedes, insects, and other small invertebrates such as earthworms, snails, cutworms, wireworms, and insect larvae. Available toxicity data indicate that arthropod species, such as the insect species the snake consumes, are generally sensitive to carbaryl and are likely to experience high levels of mortality when exposed to carbaryl within critical habitat, regardless of the exposure concentration. However, we do not anticipate all arthropod species will be equally sensitive to carbaryl exposure as natural variations in species' physiologies and behaviors will result in different responses to carbaryl exposure. Furthermore, the rim rock crowned snake is primarily fossorial and lives underground, where we expect its prey species are less likely to be exposed to carbaryl. Thus, we anticipate there will still be some food resources available in critical habitat despite a reduction in the abundance of sensitive species. Additionally, we anticipate impacted prey species will recover over time once carbaryl residues have degraded (which should occur over days to weeks). As such, while we expect arthropod prey will still be available after exposure and any losses will likely only be temporary, suggesting only low levels of adverse effects to the arthropod prey PBF.

In contrast to arthropod prey, available toxicity data indicate that the non-arthropod invertebrate species that the snake consumes, including snails, slugs, and worms, are not as sensitive to carbaryl as arthropod invertebrates. While these invertebrate species may experience sublethal adverse effects to growth or reproduction, we do not anticipate this will result in more than minor levels of adverse effects to the non-arthropod prey PBF. As such, we expect there will be no more than low levels of impacts to non-arthropod prey availability and no adverse effects to the non-arthropod PBF.

**Table 112. Summary of relevant physical and biological features (PBFs), feature characteristics, and potential impact to each PBF.**

| Physical/Biological Feature Category | Feature of Critical Habitat | Feature Characteristics | Potential Impact to PBF |
|---|---|---|---|
| arthropods (as prey or pollinators) | X | Insect prey | Medium |
| non-arthropods (as prey or hosts) | X | Mollusks, annelids | Low |
| water quality | -- | -- | -- |
| habitat function | -- | -- | -- |

***Rationale for Conclusion***

In summary, there is a high level of overlap between agricultural use areas and the proposed critical habitat, as well as a high level of anticipated usage, indicating a high level of exposure. We anticipate arthropod prey will experience high levels of mortality with carbaryl exposure. However, based on the species' life history, we do not anticipate this level of mortality to arthropod prey will result in more than medium level impacts to the arthropod prey PBF as the species is an invertebrate generalist and can likely switch to more abundant prey when sensitive arthropod species die. While non-arthropod prey species are likely to experience some sublethal adverse effects, we do not anticipate this will result in significant decreases in the abundance of non-arthropod prey. As such we anticipate only low impacts to the non-arthropod prey PBF. We do not anticipate non-agricultural uses of carbaryl will expose critical habitat. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the critical habitat, we have determined that the proposed action will not appreciably diminish the value of critical habitat as a whole for the conservation of the species and is not likely to result in the destruction or adverse modification of the designated critical habitat for the rim rock crowned snake.

***References***

U.S. Fish and Wildlife Service. 2020. Species status assessment report for the Rim rock crowned snake (*Tantilla oolitica*). Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2022. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Rim Rock Crowned Snake and Key Ring-Necked Snake and Designation of Critical Habitat. Proposed Rule. Federal Register: 87