Integration and Synthesis Summary for Reptiles

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

Vulnerability

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

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

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

Exposure

While we anticipate reptiles will be exposed to carbaryl through inhalation and dermal contact with residues on surfaces or in the air, we anticipate that the main route of exposure for reptiles is dietary, through the consumption of contaminated food items. Carbaryl degrades quickly in natural environments (i.e., within a few days) and as such is not likely to persist in species' habitats for long periods of time.

Exposure to Agricultural Uses

We characterize the expected level of exposure using overlaps between the species' ranges and agricultural areas where carbaryl is registered for use (i.e., overlap data), past carbaryl usage data (when available; the amount and location where carbaryl has been used in the past), any species-specific considerations such as life history information (e.g., habitat preferences, dispersal behavior), and existing protections or conservation actions (e.g., existing label measures, conservation measures from the action agency). Species with greater than 10% overlap between their range and agricultural carbaryl use sites are assigned a high overlap score, species with 5-10% overlap are assigned a medium overlap score, and species with less than 5% total overlap are assigned a low overlap score. In addition to range overlaps with carbaryl use sites, we considered past carbaryl usage data within a species' range to determine how much of a species' range we expect to be treated with carbaryl each year of the proposed action. Except where otherwise noted, usage data is provided by EPA applying data from their National and State Summary Use and Usage Matrix, as described in the Usage Analysis section of this biological opinion. Species that data indicate will have a large portion of their range (>10%) treated with carbaryl each year are assigned a high usage score. Species with 5-10% total usage are assigned a medium usage score, and species with less than 5% total usage are assigned a low usage score. Agricultural uses of carbaryl in the state of Hawai‘i are no longer registered; however, agricultural uses are still registered for other island territories.

We determine the overall exposure ranking by qualitatively considering both the total overlap and total usage, as well as any additional exposure considerations that might modify the level of exposure likely to occur. When overlap and usage scores are the same, we assign the overall exposure ranking the same score (e.g., if both overlap and usage is high, the overall exposure ranking is high). In cases where overlap is high and usage is medium or when overlap is medium and usage is low, we use the overlap score as the overall exposure ranking to maintain conservative exposure assumptions. (As usage is a subset of overlap, the overlap score will always be greater than the usage score). In cases where overlap is high, but usage is low, we anticipate a large portion of the range may be treated over the duration of the proposed action even if only a small portion of the range is treated in any given year (particularly if the areas treated occur in different locations each year), leading to an overall exposure ranking of medium. Past usage data for carbaryl is not available for species located on Pacific or Caribbean islands, including the Commonwealth of the Northern Mariana Islands, Guam, American Sāmoa, U.S. Virgin Islands, and Puerto Rico. Thus, in the absence of any additional exposure considerations

for these species, our ranking is based on total overlap of carbaryl use sites for species that occur in these areas. For all species, where there are additional exposure considerations, we adjust the overall exposure ranking to reflect this additional information, as appropriate.

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). Rights of way includes roadsides, and we refer to roadsides when applicable. 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 species to non-agricultural uses of carbaryl in a qualitative manner, considering the life history of species, methods of application, carbaryl usage, and any existing conservation measures to reduce drift and runoff or otherwise limit exposure to species. To facilitate this analysis, for every species in this Appendix, we reviewed species' documents (e.g., 5-Year Reviews, recovery plans, listing rules) to determine if the species and their pollinators and seed dispersers could occur on non-agricultural carbaryl use sites (i.e., managed forests, rights of way, developed, open space developed, nurseries, or rangelands) and the manner in which they may rely on these sites.

For most species, 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 of this Opinion. Briefly, we expect listed species are generally not likely to be exposed to non-agricultural uses of carbaryl as there are low levels of past usage and several existing mitigation measures that are protective of listed species. 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 across the country). Some use patterns, like rights of way, have particularly low usage, with less than 500 lbs. of carbaryl applied nationally each year.

Based on application information, we anticipate carbaryl use in these UDLs are 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 U.S. 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 as 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 attract mammal species or result in spray drift or contact exposure.

Additionally, there are several existing conservation and mitigation measures for non-agricultural uses of carbaryl that will reduce the likelihood of exposure to listed species. For example, from the 2022 FIFRA Proposed Interim Decision and the 2024 NMFS biological opinion for carbaryl, residential treatments are limited to spot and crack 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 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, known occurrences, relevant life history traits or behaviors, as well as relevant available usage data (summarized in the above sections). For species whose habitat is known or presumed to occur in or adjacent to non-agricultural use sites, we consider, individually and qualitatively, the extent and manner of non-agricultural carbaryl usage within the species' range to generally determine whether a small, moderate, or large number of individuals are likely to be exposed and the expected level of adverse effects from non-agricultural exposure of carbaryl.

Conservation Measures

As part of the 2022 proposed interim decision for carbaryl, the technical registrants committed to a number of conservation measures for the protection of listed species, including a 48-hour rain restriction and mandatory 25-foot and 150-foot application buffers from aquatic habitats for all outdoor ground and aerial applications, respectively. We anticipate these measures will contribute to the protection of listed reptile species by reducing the amount of carbaryl residue that is transported off use sites and into the habitat of listed species.

Additionally, an existing letter of concurrence issued by the Service to USDA APHIS regarding carbaryl use in their rangeland grasshopper and Mormon cricket suppression program requires the implementation of numerous conservation measures for the protection of listed species. The USDA APHIS BA considered grasshopper and Mormon cricket program activities in states where their program is active, which includes the implementation of conservation measures, and as a surrogate for usage in states where no programs exist greatly reducing the likelihood of exposure to the species from rangeland uses of carbaryl. Reptile mitigations from the USDA-APHIS grasshopper and Mormon cricket consultation are the following: a 2,500-foot buffer for all ultra-low volume applications of carbaryl and a 300-foot buffer for all ground applications of carbaryl. For carbaryl bait aerial applications all reptiles are protected by a 750-foot buffer and a 100-foot ground buffer. These specific buffers apply for the following species that fall in the action area for the USDA-APHIS consultation: alligator snapping turtle, desert tortoise, dunes sagebrush lizard, giant garter snake, narrow-headed garter snake, northern Mexican gartersnake, and northwestern pond turtle. For the remaining reptiles in this biological opinion that are outside the action area for the grasshopper and Mormon cricket program, we anticipate there is a low likelihood of the need to apply these program measures as grasshopper and Mormon cricket populations do not reach the level where they would need to be suppressed in these areas. However, we anticipate the standard aquatic habitat buffers (500-foot buffer for aerial sprays, 200-foot buffer for ground sprays, and a 50-foot buffer for bait application) and other mitigation measures outlined in the biological assessment would be applied, if there were a need to use carbaryl applications to control crickets and grasshoppers within the remaining reptile species' habitats.

Toxicity

We characterize the expected toxic effect to species based on the anticipated level of direct and indirect[1] adverse effects to individuals. Our analysis of toxicity assumes individuals are exposed to 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. Direct effects are based on the anticipated level of mortality and sublethal effects (e.g., reduced growth) likely to occur in exposed individuals. Indirect effects are based on the impact a listed species is likely to experience when the organisms they rely on, such as those that act as food or habitat resources, are exposed to carbaryl and experience adverse effects.

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

We consider estimated concentrations of carbaryl on the landscape or within the environment and effects reported in available toxicity studies to determine the level of direct and indirect adverse effects to listed species or critical habitat. Concentrations of carbaryl on food items can vary greatly depending on the particular item and whether exposure to carbaryl occurs on- or off-field. Based on available toxicity data, we do not expect reptiles to die from exposure to carbaryl at estimated environmental concentrations from either exposure on or adjacent to use sites.

We anticipate species that only rely on plant-based resources, such for food or habitat, are not likely to experience any indirect adverse effects, as available toxicity data in plants indicate no reductions in plant survival or growth are likely to occur with carbaryl exposure. In contrast, species that rely on arthropods for food resources may experience high levels of indirect adverse effects as carbaryl exposure will likely reduce the abundance and availability of prey. We do not expect species that rely on other vertebrates like birds, terrestrial phase amphibians, or reptiles for food resources to experience adverse indirect effects as available toxicity data indicate that adverse effects will not great enough to reduce abundance of these species at estimated environmental concentration. In contrast, we anticipate mammalian prey will experience high levels of mortality when foraging on carbaryl use sites but are not likely to experience any mortality off-field.

We determine the overall toxicity ranking for reptiles by qualitatively assessing both the expected levels of direct adverse effects and indirect effects (e.g., prey loss). As mentioned previously, available toxicity data indicate reptiles are not likely to die or experience other direct adverse effects from carbaryl at estimated environmental concentrations. Ranking for indirect effects will be variable based upon effects to food resources.

Summary of Reptiles Conclusions

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the registration of carbaryl, as proposed, is not likely to jeopardize the continued existence of the 40 reptile species in this Appendix.

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

individual species. On the contrary, our process and analysis for each species remained the same, regardless of the format of the discussion presented below.

Species with low concern of adverse effects

We group species together that have low concern of adverse effects due to low exposure and low toxicity with high vulnerability (Table 1). For reptiles, only one species, the sand skink, meets the criteria for this group based on its low vulnerability, low exposure, and low toxicity rankings. While we present some specific information about the species in Table 1 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 1. Listed reptile species recommended for delisting.

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	Change in listing status	Determination
Neoseps reynoldsi	Sand skink	Low	Low	Low	Recommended for delisting	No Jeopardy

The sand skink has low vulnerability, exposure, and toxicity rankings. Based on the toxicity of carbaryl, we do not expect any direct adverse effects to the sand skink following consumption of contaminated prey, though we expect loss of prey through impacts to the invertebrate prey base where exposure occur. Total overlap of the species' range with agricultural carbaryl use sites is 3.0% and agricultural usage data indicate that only up 1.3% of the species' range has been treated annually in the past. Because this species has a low agricultural overlap and low annual agricultural usage within its range, we anticipate only a small number of individuals, at most, are likely to experience exposure to carbaryl from agricultural uses.

Sand skinks may occur on non-agricultural use sites, including developed and open space developed, where their habitat conditions are met (e.g., open sandy patches with shrubs and other cover, moist sand, invertebrate prey). Based on application information, we anticipate carbaryl uses in developed and open space developed areas are restricted to small treatment areas that are treated infrequently over long periods of time. Therefore, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals.

In addition, we recommended the species for delisting in the most recent 5-year review because a large portion of its habitat is protected from development and managed for conservation (USFWS 2023, p. 53) and the sand skink is not likely to go extinct within the next 50 years. Modeling predictions indicate that it is unlikely that conditions between 50-100 years in the future will change in such a way that the species becomes at high risk of extinction (USFWS 2023, Ch 5.).

In summary, the sand skink has low vulnerability and toxicity rankings. We anticipate only small numbers of individuals are likely to be exposed and those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of

individuals of these species. In addition, the sand skink has been recommended for delisting based on recovery goals and is likely to persist for many years into the future based on habitat protections, modeling projections, and resiliency trends. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the likelihood of the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the sand skink.

References:

U.S. Fish and Wildlife Service. 2023. Species Status Assessment Report for the Sand skink (*Neoseps reynoldsi*) Version 1.0. Atlanta, Georgia. 102 pp.

Species with low exposure (informed by low overlap with agriculture)

The species in Table 2 are grouped together as they have low concern of adverse effects due to low exposure as informed by low overlap between the species' range and agricultural land uses where carbaryl is registered for use. While we present some specific information about the species in Table 2 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 2. Species with low baseline exposure as informed by low overlap between the species' range and agricultural land uses.

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	Total Agricultural Use Overlap (% range)	Determination
Ameiva polops	St. Croix ground lizard	High	Low	Low	0.0	No Jeopardy
Anolis roosevelti	Culebra Island giant anole	High	Low	Low	0.0	No Jeopardy
Chilabothrus granti	Virgin Islands tree boa	High	Low	Low	0.3	No Jeopardy
Chilabothrus inornatus	Puerto Rican boa	Medium	Low	Low	0.4	No Jeopardy
Crocodylus acutus	American crocodile	Medium	Low	Low	1.9	No Jeopardy
Crotalus willardi obscurus	New Mexican ridge-nosed rattlesnake	High	Low	Low	0.1	No Jeopardy
Diadophis punctatus acricus	Key ring-necked snake	High	Low	Low	NA[2]	No Jeopardy
Emoia slevini	Slevin's skink	High	Low	Low	0.5	No Jeopardy
Gopherus polyphemus	Gopher tortoise	Medium	Low	Low	2.0	No Jeopardy
Graptemys flavimaculata	Yellow-blotched map turtle	High	Low	Low	1.7	No Jeopardy

[2] NA: Not Available; the species' range shapefile is unavailable. Based on its habitat needs, we expect overlap with agricultural lands to be, at most, low.

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	Total Agricultural Use Overlap (% range)	Determination
Graptemys oculifera	Ringed map turtle	Medium	Low	Low	1.7	No Jeopardy
Graptemys pearlensis	Pearl River map turtle	Medium	Low	Low	NA[2]	No Jeopardy
Nerodia clarkii taeniata	Atlantic salt marsh snake	Medium	Low	Low	1.9	No Jeopardy
Pituophis melanoleucus lodingi	Black pinesnake	High	Low	Low	2.6	No Jeopardy
Pituophis ruthveni	Louisiana pinesnake	High	Low	Low	1.0	No Jeopardy
Plestiodon egregius egregius	Florida Keys mole skink	High	Low	Low	0.0	No Jeopardy
Plestiodon egregius insularis	Cedar Key mole skink	High	Low	Low	0.0	No Jeopardy
Pseudemys alabamensis	Alabama red-bellied turtle	High	Low	Low	3.6	No Jeopardy
Sceloporus arenicolus	Dunes sagebrush lizard	High	Low	Low	0.7	No Jeopardy
Sternotherus depressus	Flattened musk turtle	High	Low	Low	3.1	No Jeopardy
Tantilla oolitica	Rim rock crowned snake	High	Low	Low	NA[3]	No Jeopardy
Thamnophis rufipunctatus	Narrow-headed gartersnake	High	Low	Low	3.9	No Jeopardy

All species in Table 2 have a medium or high vulnerability ranking, indicating that the species are likely less robust to any adverse effects that might occur to individuals than species with low vulnerability. However, all species in this group have a low toxicity ranking. EPA's exposure modeling indicates that the species in Table 2 are not likely to accumulate more than low levels of carbaryl from exposure resulting from either agricultural or non-agricultural uses. Available toxicity data in birds (which we use as a surrogate for reptile species), indicate that no direct

[3] NA: Not Available; the species' range shapefile is unavailable for the rim rock crowned snake. Based on its habitat needs, we expect overlap with agricultural lands to be, at most, low.

adverse effects to survival, growth, or reproduction are likely to occur at any predicted exposure levels. We anticipate some species, particularly those that rely on arthropod prey as a food resource, will experience some indirect effects as arthropod species will likely die with carbaryl exposure, but we do not anticipate the entire prey community will die as we expect natural variation in physiology, behavior, and life histories will result in some arthropod prey being less sensitive and more robust to carbaryl exposure. We anticipate there will be some arthropod prey available for species like the St. Croix ground lizard, flattened musk turtle, ringed map turtle, yellow-blotched map turtle, dunes sagebrush lizard, and Slevin's skink after low levels of exposure to carbaryl.

In addition, all species in this group have a low exposure ranking. They have low total overlap between their ranges and agricultural carbaryl use areas (up to 3.9%, including application sites and adjacent spray drift and runoff areas). The total overlap metric we use does not fully account for redundancy between use site layers, assumes exposure is occurring in all possible overlapping areas, and does not consider information on past carbaryl usage (which we expect would only further decrease the likelihood of exposure). Given that exposure is unlikely to occur without considering any additional factors that would further reduce the extent of exposure reasonably certain to occur, we have high confidence that, at most, only small numbers of individuals of each of these species are likely to experience exposure to carbaryl through agricultural uses.

The Florida Keys mole skink species' range does not overlap the action area (0% overlap). Though the Key ring-necked snake, Pearl River map turtle, and rim rock crowned snake do not have range maps available, we do not expect overlap with the action area. These four species occur in areas where we do not expect carbaryl use to occur (e.g., Florida Key beaches, pine rockland, rivers, or large creeks; USFWS 2020a, 2021, 2022a, 2023). The rim rock crowned snake also occurs in Miami-Dade County, Florida in protected areas (e.g., Barnacle Historic State Park, Zoo Miami pineland preserve). We do not expect these species will be exposed to carbaryl. The ranges of the St. Croix ground lizard and Culebra Island giant anole do not overlap with areas where carbaryl may be used. As we do not expect that any individuals of the above species will be exposed to carbaryl, we do not anticipate take for these species.

We proposed the Puerto Rican boa for delisting in 2022 due to recovery (USFWS 2022b), and agricultural carbaryl use sites overlap only 0.4% of the species' range. Several species occur on habitats where we do not expect carbaryl use to occur (i.e., Slevin's skink in complex forests (USFWS 2020b), Virgin Islands tree boa in subtropical forests (USFWS 2022c), and New Mexican ridge-nosed rattlesnake in mountainous areas of the U.S. southwest). Some species, including the Louisiana pinesnake, occur primarily on public lands (e.g., Department of Defense and U.S. National Forests; USFWS 2022d) where we expect minimal carbaryl use. Although carbaryl use sites in these areas are expected to overlap with no more than 0.5% of these species' ranges, a very small number of organisms could die or experience sublethal effects due to reductions in prey abundance.

In addition to agricultural uses, reptiles may be exposed to carbaryl through non-agricultural uses. We anticipate nine out of the 21 reptiles in Table 2 are not likely to occur in or near non-agricultural carbaryl use sites and are not likely to be exposed to carbaryl through these uses. The Puerto Rican boa, gopher tortoise, black pinesnake, Louisiana pinesnake, and narrow-headed gartersnake can occur in, disperse through, or forage on managed forests; the American crocodile, gopher tortoise, Louisiana pinesnake, and narrow-headed gartersnake can occur in open space developed areas; and the gopher tortoise, Alabama red-bellied turtle, and rim rock crowned snake can occur in rights of way. While it is possible individuals on these non-agricultural use sites may be exposed to carbaryl, we anticipate that exposure is unlikely to occur given low levels of non-agricultural carbaryl usage. Available usage data from the U.S. Forest Service indicate that no carbaryl has been used in managed forests within the ranges of these species, indicating that there is a low risk of exposure to carbaryl in these areas. Where applications have taken place, the majority of treatments have involved small areas (<1 acre), such as if usage did occur, exposure to species would be minimal. 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 way annually. While open space developed and rights of way usage may result in a large treatment footprint if all treated areas were concentrated in one location or within one species' range, 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 species' range. As such, we anticipate that non-agricultural uses of carbaryl will not expose more than small numbers of individuals of each of the species in Table 2.

Given that we anticipate small numbers of individuals are likely to be exposed and that most exposed individuals will not experience mortality, sublethal adverse effects, or loss of food resources, we expect the proposed action will result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce survival and recovery of these species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the species listed in Table 2.

References:

U.S. Fish and Wildlife Service. 2023. Species status assessment report for the Pearl River map turtle (*Graptemys pearlensis*). Atlanta, Georgia. 141 pp.

U.S. Fish and Wildlife Service. 2022a. Species status assessment report for the Florida Keys mole skink (*Plestiodon egregius egregius*). Version 2.0. Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2022b. Puerto Rican Boa (*Chilabothrus inornatus*) Species Status Assessment. Atlanta, Georgia. 86 pp.

U.S. Fish and Wildlife Service. 2022c. Virgin Islands tree boa (*Chilabothrus granti*) Species Status Assessment version 1.1. Atlanta, Georgia. 46 pp.

U.S. Fish and Wildlife Service. 2022d. Species Status Assessment Report for the Louisiana pine snake (*Pituophis ruthveni*) version 1.0. Atlanta, Georgia. 86 pp.

U.S. Fish and Wildlife Service. 2021. Species status assessment report for the Key ring-necked snake (*Diadophis punctatus acricus*). February 11, 2021. Vero Beach, Florida. 39 pp.

U.S. Fish and Wildlife Service. 2020a. Species status assessment report for the Rim rock crowned snake (*Tantilla oolitica*). Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2020b. Slevin's skinkor or gualiik halumtanu (*Emoia slevini*) 5-Year Review: Summary and Evaluation. Honolulu, Hawai'i. 20 pp.

Species with low past usage informed by low past usage from California Department of Pesticide Regulation data

The species in Table 3 are grouped together because they occur completely within California and have low exposure confirmed by low levels of past carbaryl usage within their ranges (% range treated), as informed by the California Department of Pesticide Regulation Pesticide Use Reporting (CalPUR) data. While we present some specific information about the species in **Table 3** below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 3. Reptiles with low exposure (confirmed by low last usage from California Department of Pesticide Regulation (CalPUR) data).

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	% Range Treated (CalPUR)	Determination
Actinemys pallida	Southwestern pond turtle	High	Low	Low	0.1	No Jeopardy
Gambelia silus	Blunt-nosed leopard lizard	High	Low	Low	1.0	No Jeopardy
Masticophis lateralis euryxanthus	Alameda whipsnake (=striped racer)	High	Low	Low	0.0	No Jeopardy
Thamnophis gigas	Giant garter snake	High	Low	Low	1.2	No Jeopardy
Thamnophis sirtalis tetrataenia	San Francisco garter snake	High	Low	Low	0.1	No Jeopardy
Uma inornata	Coachella Valley fringe-toed lizard	High	Low	Low	0.0	No Jeopardy

All species listed in Table 3 have high vulnerability rankings, indicating that they may not be able to withstand additional stressors in their environment, including mortality of individuals from carbaryl exposure. However, all species in this group have a low toxicity ranking. EPA's exposure modeling indicates that all the species in the above table are not likely to accumulate more than low levels of carbaryl with exposed from agricultural or non-agricultural uses. These concentrations are not likely to result in any direct adverse effects to survival, growth, or reproduction. We anticipate some species, particularly those that rely on arthropod prey as a food resource, will experience some indirect effects as arthropod species will likely die with carbaryl exposure, we do not anticipate the entire prey community will die as we expect natural variation in physiology, behavior, and life histories will result in some arthropod prey being less sensitive and more robust to carbaryl exposure. As such, we anticipate there will still be some arthropod

prey species left for species like the blunt-nosed leopard lizard and Coachella Valley fringe-toed lizard.

In addition, while these species may be more vulnerable to adverse effects from pesticides, all species in this group have a low exposure ranking. Mandatory pesticide usage reporting data collected by the state of California indicates very little carbaryl has been used in the agricultural areas where these species' ranges occur, ranging from 0 to 1.2% of each range treated annually with carbaryl from 2013-2022. Given that usage reporting is mandated by the state of California and that these data are provided regularly with relatively high spatial resolution, we have high confidence that only a small percent of the species' ranges are likely to be exposed to carbaryl from the proposed action. As such, we anticipate that only small numbers of individuals, at most, are likely to be exposed to carbaryl.

In addition to agricultural uses, reptiles may be exposed to carbaryl through non-agricultural uses. While CalPUR data include all agricultural usage, it is also inclusive of certain non-agricultural uses, such as those performed by professional commercial applicators in areas like rights of way and golf course. While these data no not capture all non-agricultural usage, such as residential applications by consumers, we do not expect these listed reptiles to be exposed to carbaryl from this use. 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. For example, available usage data from the U.S. Forest Service indicate only 322 acres of managed forests within southern California were treated with carbaryl between 2016-2020. This represents only a small portion of the range of species like the southwestern pond turtle and indicates no usage of carbaryl on managed forests within the range of the Alameda whipsnake, both of which can occur in managed forests. Where applications have taken place, the majority of treatments have involved small areas (<1 acre) such that if usage did occur, exposure to these species would be minimal. As such, we anticipate that non-agricultural uses of carbaryl are not likely to expose more than a small number of individuals of each species in Table 3.

Given that we anticipate small numbers of individuals are likely to be exposed and that most exposed individuals will not experience mortality, sublethal adverse effects, or loss of food resources, we expect the proposed action will result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce survival and recovery of these species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the species listed in Table 3.

Species with low past usage informed by low past usage from USDA Census of Agriculture

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

Table 4. Species with low exposure (confirmed by low past usage from U.S. Department of Agriculture's Census of Agriculture (CoA)).

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	% Range Treated (CoA)	Determination
Caretta caretta	Loggerhead sea turtle (North Pacific Ocean DPS)	Medium	Low	Low	0.2	No Jeopardy
Gopherus agassizii	Desert tortoise	Medium	Low	High	3.1	No Jeopardy
Thamnophis eques megalops	Northern Mexican gartersnake	High	Low	Medium	0.7	No Jeopardy

All the species listed in Table 4 have a medium or high vulnerability ranking, indicating that the species are likely less robust to any adverse effects that might occur to individuals. However, all species in this group have a low toxicity ranking. EPA's exposure modeling indicates that the species in Table 4 are not likely to accumulate more than low levels of carbaryl from exposure to agricultural and non-agricultural uses. These concentrations are not likely to result in any direct adverse effects to survival, growth, or reproduction. We do not anticipate any of the species in the table above are disproportionately reliant on arthropod prey species and are not likely to experience indirect adverse effects.

In addition, all species in this group have a low exposure ranking. We anticipate only a small number of individuals are likely to be exposed to carbaryl given the low insecticide usage in the past across their ranges. Low CoA usage indicates that very little insecticide usage (of any type) occurred in the past in the counties where these species' ranges occur. Given that this reporting broadly includes all insecticide usage, we consider CoA data to be conservative estimates of carbaryl usage that indicate very little of the species' ranges are likely to be treated.

All species in this group occur in areas where we expect carbaryl use to be minimal or unlikely. Over half (58%) of the northern Mexican gartersnake's range is on federal lands (i.e., Coronado National Forest and Buenos Aires National Wildlife Refuge; USFWS 2014) and desert tortoise

occur in desert habitats where carbaryl use is expected to be low (USFWS 2022). The North Pacific Ocean DPS of loggerhead sea turtles primarily occur in the Pacific Ocean and nest on Japanese beaches, so we do not expect carbaryl use to affect nesting loggerhead sea turtles (NMFS and USFWS 2020).

In addition to agricultural uses, reptiles may be exposed to carbaryl through non-agricultural uses. While it is possible individuals in these areas may be exposed to carbaryl, we anticipate that exposure is unlikely to occur given the low level of usage that occurs in these use sites. For instance, both the desert tortoise and northern Mexican gartersnake can occur on open space developed and rangeland areas, the desert tortoise can also occur in rights of ways, and the northern Mexican gartersnake can also occur in managed forests. Available usage data from USDA APHIS indicate that, from 2019-2023, no carbaryl has been used to treat rangeland habitats with these species' ranges. Similarly, usage data from the U.S. Forest Service indicate no carbaryl has been used between 2016-2020 to treat managed forests within the ranges of these species. As such, we anticipate there is a low likelihood of exposure of these species to carbaryl through these uses. 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 in one location or within one species' range, 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 species' range. As such, we anticipate that non-agricultural uses of carbaryl are not likely to expose more than a small number of individuals of each species in Table 4.

Given that we anticipate small numbers of individuals are likely to be exposed and that most exposed individuals will not experience mortality, sublethal adverse effects, or loss of food resources, we expect the proposed action will result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce survival and recovery of these species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the species listed in Table 4.

References:

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service. 2020. Loggerhead Sea Turtle (Caretta caretta) North Pacific Ocean DPS 5-Year Review: Summary and Evaluation. Silver Spring, Maryland and Jacksonville, Florida. 84 pp.

U.S. Fish and Wildlife Service. 2022. Desert tortoise (*Gopherus agasizii*) 5-Year Review: Summary and Evaluation. Las Vegas, Nevada. 55 pp.

U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Threatened Status for the Northern Mexican Gartersnake and Narrow-Headed Gartersnake. Final Rule. Federal Register 79(130):38678-38746.

Species with Individual Integration and Synthesis Summaries

For the species in Table 5, our preliminary exposure and toxicity rankings indicate that the proposed action may result high adverse effects. As such, we discuss each species in more detail in individual Integration and Synthesis summaries below. In some cases, we modified initial exposure and toxicity rankings due to additional information regarding exposure and effects for individual species, as described below.

Additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity can be found in Appendix E. The status of the species accounts can be found in Appendix B.

Table 5. Reptiles with moderate to high adverse effects anticipated from the proposed action. We addressed each species in individual Integration and Synthesis summaries.

Scientific Name	Common Name	Determination
Pseudemys rubriventris bangsi	Plymouth redbelly turtle = Plymouth redbelly cooter	No Jeopardy
Drymarchon couperi	Eastern indigo snake	No Jeopardy
Eumeces egregius lividus	Blue-tailed mole skink	No Jeopardy
Nerodia erythrogaster neglecta	Copperbelly water snake	No Jeopardy
Glyptemys muhlenbergii	Bog turtle	No Jeopardy
Actinemys marmorata	Northwestern pond turtle	No Jeopardy
Macrochelys temminckii	Alligator snapping turtle	No Jeopardy
Sistrurus catenatus	Eastern massasauga (=rattlesnake)	No Jeopardy
Macrochelys suwanniensis	Suwannee alligator snapping turtle	No Jeopardy

Integration and Synthesis Summary: Plymouth redbelly turtle = Plymouth redbelly cooter

Scientific Name:	Common Name:	Entity ID:
Pseudemys rubriventris bangsi	Plymouth redbelly turtle = Plymouth redbelly cooter	170

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range (Figure 1) and medium past usage of carbaryl within the species' range, indicating a high extent of exposure. No exposed individuals are likely to die or experience sublethal adverse effects. We do not anticipate indirect adverse effects from loss of forage plants and expect no more than a low level of indirect adverse effects to aquatic prey. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Plymouth redbelly turtle. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 6/21/2022; Wherever found; *States within the range:* MA

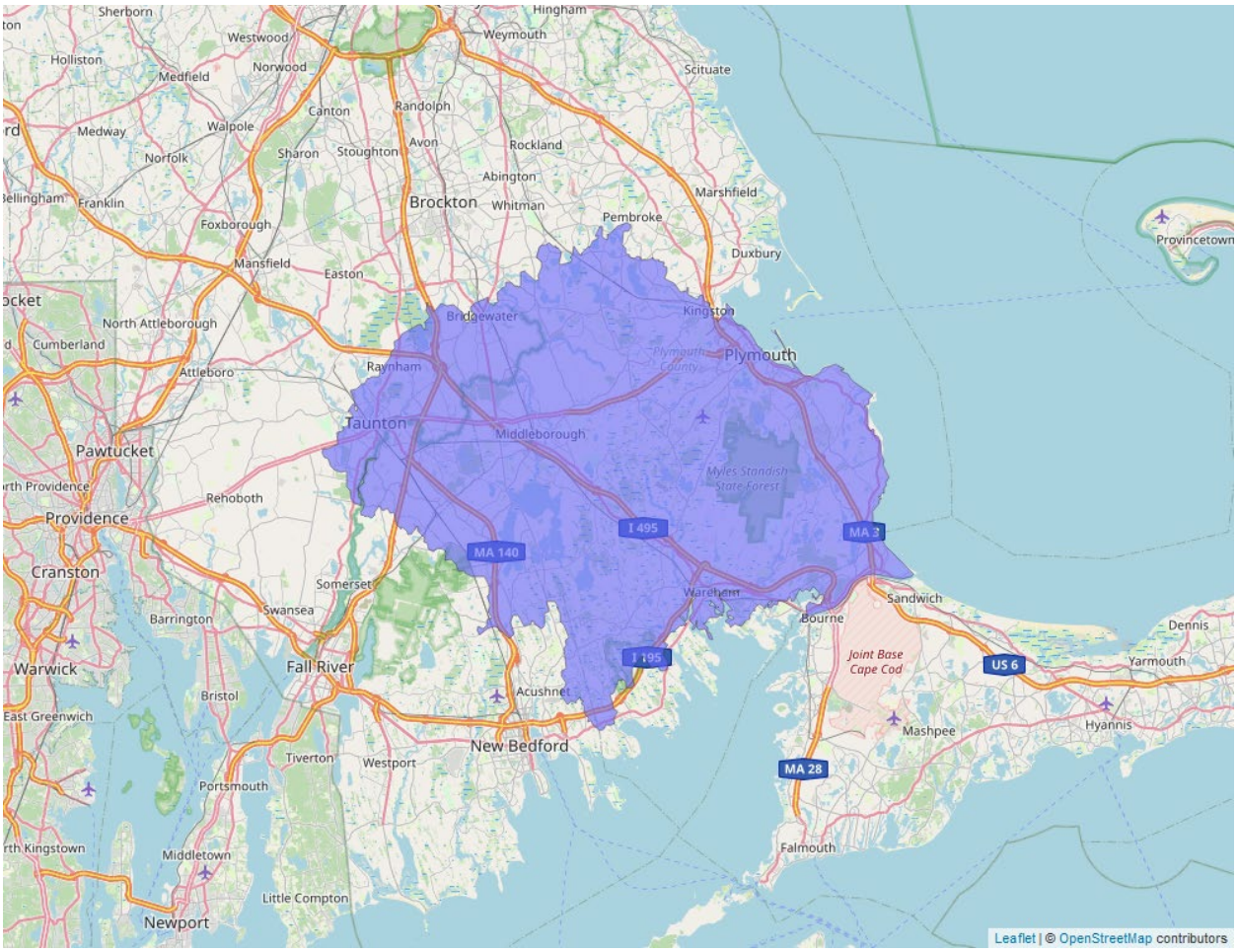

Figure 1. Range map of Plymouth redbelly turtle (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/451.

Vulnerability

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

Summary of status

Listing status: Endangered

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

Most recently completed 5-Year Status Review: 3/25/2022

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

Number of populations: Single population

Species trends: Unknown population trends

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

The Plymouth redbelly turtle is a large basking turtle found in various aquatic habitats in southeastern Massachusetts. They are now known as northern red-bellied cooters (*Pseudemys rubriventris*) and no longer considered a subspecies due to results of genetic testing with red-bellied cooters outside of Massachusetts (e.g., New Jersey). They are found in coastal plain ponds, reservoirs, cranberry bogs, and rivers. They nest in unforested, upland habitats with well-drained soils near aquatic habitat and overwinter submerged in open water. They eat submergent aquatic vegetation, other aquatic plants, snails, fish, tadpoles, and crayfish. Historically, they were found along the coastal plain from North Carolina to New York with one population in Massachusetts. They may have been connected in the past, but historical records cannot confirm. In 1980, there were 12 occupied ponds with an estimated population of around 200 individuals. In 2017, the Massachusetts population estimate was 1,950 cooters. In 2021, the northern red-bellied cooter was known to occupy 26 ponds across 15 pond complexes and two rivers in Plymouth and Bristol Counties, Massachusetts. They have been introduced in two additional locations: (1) the Lakeville Ponds Complex and lower Nemasket River and (2) the Burrage Pond Wildlife Management Area. Based on movement studies, we believe the Massachusetts population acts as a metapopulation. Since 1985, the Massachusetts Division of Fisheries and Wildlife in partnership with the Service has maintained a headstarting program that raises wild-born hatchlings in captivity for nine months before releasing them back into suitable habitat. Over 4,400 wild-born cooters have been headstarted and released across 34 sites in Massachusetts. To meet our recovery goals for this species, headstarting continues to be essential and because future threats are foreseeable, we feel the species meets the definition of threatened (USFWS 2021, 2022).

Primary threats at listing were small population size, restricted range, habitat fragmentation and development of shoreline habitat, and nest predation. They are threatened by decreases in water quality from siltation resulting from land clearing adjacent to ponds, pollution and excess nutrients, pollution of groundwater, and reduction of water levels from pumping. The cranberry (*Vaccinium macrocarpon*) industry, including herbicide use, is a main source of water quality and quantity concerns for the northern red-bellied cooter. (We note that carbaryl is not registered for use on cranberries.) Residential and commercial development could damage coastal plain ponds, including land conversion, unmaintained septic systems, impervious surfaces, and water withdrawals. Their primary predators are raccoons, striped skunks, red foxes, coyotes, crows, owls, small rodents, bullfrogs, predatory non-native sport fish (i.e., smallmouth and largemouth

bass, chain pickerel, brown bullhead, and white perch), snapping turtles, and wading birds. Several invasive plant species, including fanwort and hydrilla, threaten coastal plain pond habitat. Some turtles are at high risk for vehicle or boat mortality. Expected climate changes for Massachusetts may have beneficial (e.g., more basking opportunities) and detrimental effects (e.g., shifts in other species' ranges, competition, predation, winter hibernation changes) on northern red-bellied cooters. The historical threat of intentional human harvest is not believed to be a current threat. It is unknown if historical or present use of pesticides and insecticides affects red-bellied cooters, but high levels of glyphosate-based herbicides may induce stress and exposure to organochlorine pesticides may suppress turtle immune systems (USFWS 2021). The ESA designation of about 10 ponds and 3,269 acres of land in Plymouth County, Massachusetts as critical habitat has allowed for habitat protection. The future of the headstarting program is uncertain and increasing turtle numbers through headstarting alone will not prevent the species from declining in the future if underlying threats remain. We expect the species to continue to face threats from habitat loss, fragmentation, road mortality, predation, and human disturbance into the future (USFWS 2022).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 12.6% of the species' range overlaps with agricultural use sites and 14.9% of the species' range overlaps with areas adjacent to use sites (Table 6) that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 27.5% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 6. Overlap and usage (% range treated annually) for the Plymouth redbelly turtle.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	2.3	3.6	5.9	0.3	0.5	0.8
Citrus	0	0	0	0	0	0
Corn[4]	1	2.3	3.3	0.8	1.8	2.6
Grapes	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other Crops	3.5	5.2	8.7	0	0	0

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

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Other Grains	<0.1	0.1	0.2	0	0	0
Other Orchards	0.1	0.1	0.2	0.1	0.1	0.2
Other Row Crops	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Soybeans	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vegetables and Ground Fruit	5.7	3.5	9.2	5.7	3.5	9.2
Total	**12.6**	**14.9**	**27.5**	**6.9**	**5.9**	**12.8**

Usage

Past usage data indicate that up to 12.8% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

Available information on the Plymouth redbelly turtle indicate that the species avoids agricultural areas as they spend the majority of their lives in aquatic areas. While individuals readily move through overland areas to travel between waterbodies, we do not expect individuals are likely to spend significant time dispersing through or foraging in agricultural use sites. As such, while there is overlap between the species' range and agricultural use sites, we do not anticipate any individuals are likely to be exposed directly on agricultural use sites. To account for this difference in exposure potential, we only consider off-site exposure in our assessment, indicating that total overlap with agricultural areas is 14.9% and up to 5.9% of the range is likely to be treated annually.

Non-agricultural Uses

Given that individuals spend most of their time in aquatic habitats (such as coastal plain ponds, river systems, bogs, and other wetlands), we do not anticipate individuals are likely to enter or forage in non-agricultural carbaryl use sites. As we generally expect non-agricultural uses to have a low potential for off-site transport due to application methods that limit drift and runoff, low usage, and required buffers from aquatic habitats, we do not expect non-agricultural uses will expose more than a small number of individuals over the duration of the proposed action.

Exposure Summary

There is a high extent of overlap between the Plymouth redbelly turtle's range and areas immediately adjacent to agricultural carbaryl use sites (14.9% overlap with off-field areas). We do not expect more than a small number of individuals will experience exposure to carbaryl through non-agricultural uses. There is a moderate level of past carbaryl usage within the species range (up to 5.9% range treated annually), indicating that a moderate portion of the range is likely to be treated with carbaryl over the duration of the proposed action. As such, we anticipate the species has a high exposure ranking.

Overall Exposure Ranking: High

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the Plymouth redbelly turtle.

Effects of the Action: Toxicity

Direct Effects:

We expect reptiles will be directly exposed to carbaryl through dietary exposure by consuming food items that have accumulated carbaryl from direct application of the pesticide on-field or through spray drift off-field. The Plymouth redbelly turtle is omnivorous but primarily consumes submerged aquatic vegetation. However, individuals occasionally consume other dietary items such as snails, fish, tadpoles, and crayfish. Given that these aquatic food items are not likely to occur on use sites and that carbaryl is not likely to bioaccumulate in aquatic food items, we do not anticipate Plymouth redbelly turtles will be exposed to more than low levels of carbaryl. As such, we do not anticipate individuals will experience any mortality or sublethal adverse effects.

Indirect Effects:

Available toxicity data indicate that carbaryl is not likely to cause any toxic effects to aquatic plant species that the Plymouth redbelly turtle primarily feeds on. Individuals occasionally consume other dietary items such as snails, fish, tadpoles, and crayfish. While there may be high levels of mortality of crayfish prey, we anticipate low effects, if any, to the snail, fish, and tadpole species that turtle feeds on. As such, while crayfish prey may experience high levels of mortality, we anticipate overall low indirect adverse effects are likely to occur as most of the food items the turtle relies on will not experience adverse effects from carbaryl exposure.

Toxicity Summary

We anticipate vertebrate species will primarily be exposed to carbaryl through dietary exposures. Given that carbaryl is unlikely to bioaccumulate in the Plymouth redbelly turtle's dietary items, we anticipate individuals will only be exposed to, at most, low levels of carbaryl that will not result in any direct adverse effects to survival, growth, or reproduction. Similarly, as carbaryl is not likely to cause any adverse effects to submerged aquatic plant survival or growth, we do not anticipate more than low level indirect adverse effects. As such, the species has a low toxicity ranking.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The Plymouth redbelly turtle has a high exposure ranking. There is a high extent of overlap between the species' range and off-field areas adjacent to agricultural use sites. There is a moderate level of past carbaryl usage within the species' range, indicating that there is a large number of individuals are likely to be exposed over the duration of the proposed action. We do not anticipate non-agricultural uses of carbaryl will expose more than a small number of individuals.

The Plymouth redbelly turtle has a low toxicity ranking. We do not anticipate individuals will accumulate more than low levels of carbaryl through dietary exposure and are not likely to experience any direct adverse effects. Similarly, carbaryl is not likely to negatively affect plant growth or survival, indicating no more than a low level of indirect adverse effects through exposure to other dietary items.

While we anticipate a large number of individuals will be exposed to carbaryl, we do not anticipate more than a small number of exposed individuals will die or experience sublethal adverse effects or more than a low level of indirect adverse effects. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The Plymouth redbelly turtle is an endangered species found in southeast Massachusetts. Historically, they ranged from North Carolina to New York, with one population in Massachusetts. Red-bellied cooters are basking turtles found in coastal plain ponds, reservoirs, cranberry bogs, and rivers, and they nest in unforested upland habitats. They eat plants, snails, fish, tadpoles, and crayfish. Threats to the species include habitat fragmentation, decreases in water quality (including from herbicides), nest predation, effects of small populations, and restricted range. We determined the species has high vulnerability.

Individuals readily move through overland areas between waterbodies, but we do not expect them to spend significant time dispersing through or foraging on agricultural use sites. Therefore, we focus our analyses on off-field exposure. There is large overlap (14.9%) between the species' range and areas subject to off-field carbaryl exposure (i.e., spray drift and runoff) from nearby agricultural use sites, and past usage data indicates that a moderate portion of the range (5.9%) will be exposed through agricultural carbaryl treatments annually. Because we do not expect the species to occur on developed, open space developed, managed forested, rangelands, or rights of way, and we expect a low extent of off-site transport from these uses within the range of the species, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. We do not expect Plymouth redbelly turtles to die or experience sublethal effects from dietary exposure because their primary food sources are aquatic vegetation and animal prey. We do not expect effects to aquatic vegetation, nor do we expect more than low levels of effects to aquatic animals that may be taken as prey.

Therefore, we expect impacts to the Plymouth redbelly turtle to be low and that only a small number of individuals will die or experience sublethal adverse effects or be adversely affected through loss of aquatic prey. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Plymouth red-bellied turtle.

References

U.S. Fish and Wildlife Service. 2022. Northern Red-bellied Cooter Massachusetts Population (*Pseudemys rubriventris*) 5-Year Review: Summary and Evaluation. Concord, New Hampshire. 13 pp.

U.S. Fish and Wildlife Service. 2021. Species Status Assessment (SSA) Report for the Massachusetts Population of the Northern Red-bellied Cooter (*Pseudemys rubriventris*). Version 1.0. Hadley, Massachusetts. 109 pp.

Integration and Synthesis Summary: Eastern indigo snake

Scientific Name:	Common Name:	Entity ID:
Drymarchon couperi	Eastern indigo snake	173

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range (Figure 2) and medium past usage of carbaryl within the species' range, indicating a high extent of exposure. No exposed individuals are likely to die or experience sublethal adverse effects. We do not anticipate more than low levels of indirect adverse effects are likely from loss of small mammal prey, and they rely on other taxa groups of prey as well (e.g., amphibians, turtles). As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the eastern indigo snake. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 2/3/2022; Wherever found; *States within the range:* AL, FL, GA, MS

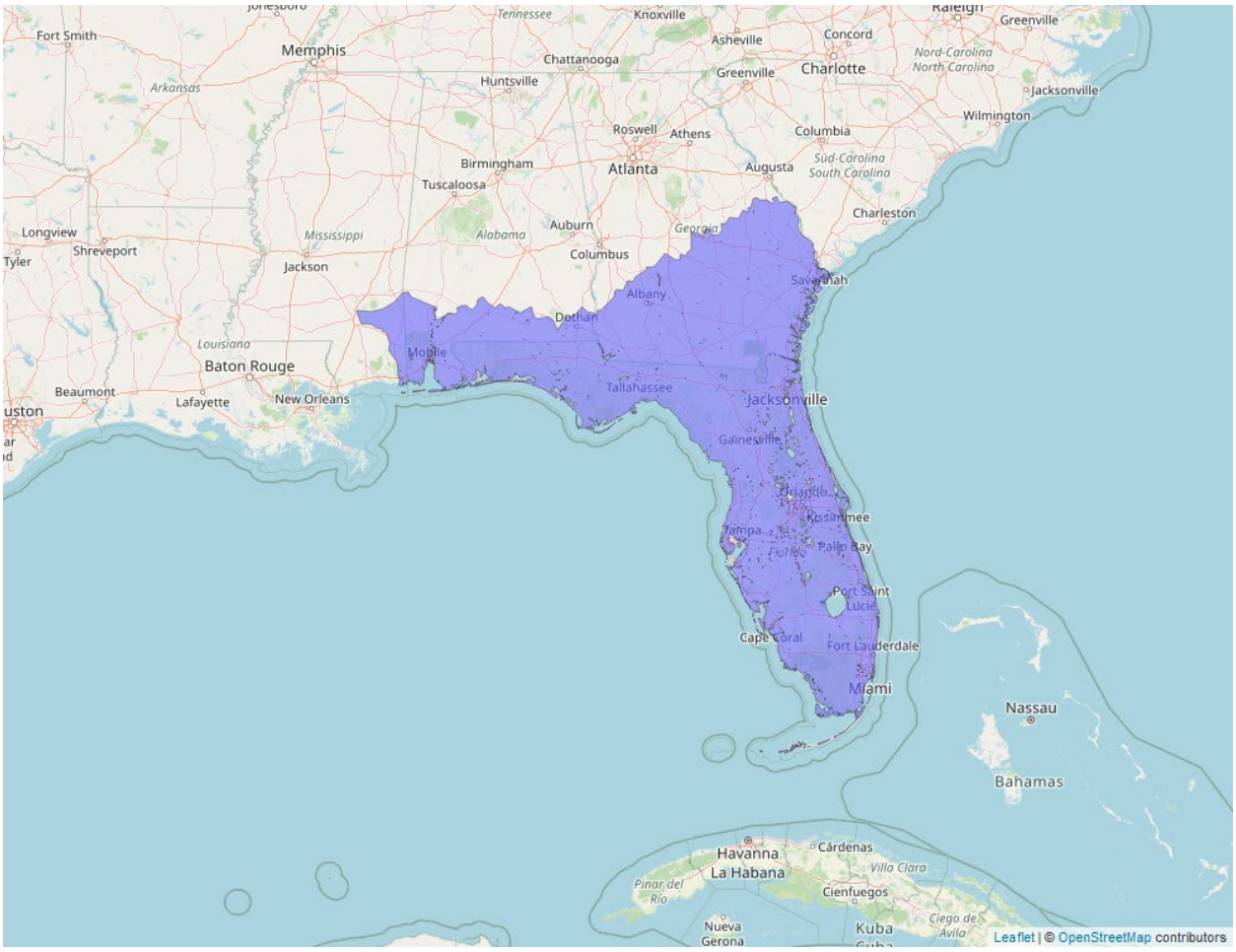

Figure 2. Range map of eastern indigo snake (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/646.

Vulnerability

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

Summary of status

Listing status: Threatened

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

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

Distribution: Population size/Location(s) unknown

Number of populations: Multiple populations (few)

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

Historically, the eastern indigo snake occurred throughout Florida and in the coastal plain of Georgia, Alabama, and Mississippi. The eastern indigo snake has been extirpated in Alabama and Mississippi and, and its distribution has further contracted in other areas, particularly in the Florida Panhandle, due to the decline of gopher tortoise populations. Wild collection of eastern indigo snakes for the pet trade and gassing of gopher tortoise burrows are no longer considered to be substantial threats although they still occur to some extent. Habitat destruction, modification, and curtailment, however, remain significant threats to the species' recovery and long-term viability. Since the last review (USFWS 2008), we've made significant progress in our understanding of the species' distribution, life history and habitat requirements which has supported development and implementation of conservation strategies for the species. This new information was summarized and assessed in the eastern indigo snake's recent species status assessment. Fifty-three (53) potential populations were estimated in the Species Status Assessment (USFWS 2019). Of these populations, resilience was classified based primarily on habitat conditions as follows: eight very low, 28 low to medium-low, 13 medium to medium-high, and four high. The overall current population resiliency is medium to low. Population growth rates are unknown due to the lack of data on this cryptic species. The contemporary distribution of the eastern indigo snake represents the species' known ecological and genetic diversity, but the redundancy of populations has decreased. Most notable is the loss of populations in the Panhandle region (includes parts of Alabama, Florida, Georgia, and Mississippi) and a contraction of the distribution in the southern extent of the Peninsular Florida region, including the Florida Keys. The Panhandle and North Florida regions have zero (0) highly resilient populations, thus limiting overall redundancy (USFWS 2019a, 2019b).

Today, the primary threats to the long-term viability of the species are from habitat fragmentation and loss due to land use changes, especially urbanization. Urbanization includes a variety of negative impacts that remove or alter available habitat or impact snakes directly including residential and commercial development, road construction and expansion, direct mortality (e.g., road mortality, human persecution, domestic pets), invasive species, predation and inadequate fire management. Habitat loss for coastal populations due to sea level rise is also an increasing risk. Snake fungal disease has emerged as an additional negative factor, but impacts to long-term viability remains uncertain, and research is on-going. Pesticides, especially those that bioaccumulate through the food chain, may present a hazard to eastern indigo snakes, but there have been no documented cases of mortality from pesticide use (USFWS 2019a).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 14.7% of the species' range overlaps with agricultural use sites and 10.7% of the species' range overlaps with areas adjacent to use sites (Figure 2) that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 25.4% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 7. Overlap and usage (% range treated annually) data for the eastern indigo snake.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Citrus[5]	1.8	1	2.8	0.2	<0.1	0.3
Corn[6]	2.8	2.3	5.1	0.1	0.1	0.3
Grapes	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other Crops	2	2.1	4.1	1.9	1.9	3.7
Other Grains	1.8	1.3	3.1	<0.1	<0.1	<0.1
Other Orchards	1	1.5	2.5	0.2	0.3	0.5
Other Row Crops	5.6	3.1	8.7	0.2	0.1	0.3
Soybeans	0.7	0.9	1.6	0.2	0.2	0.4
Vegetables and Ground Fruit	0.7	0.9	1.6	<0.1	<0.1	<0.1
Total	**14.7**	**10.7**	**25.4**	**2.5**	**2.6**	**5.1**

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

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

Usage

Past usage data indicate that up to 5.1% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

Throughout their range, eastern indigo snakes may also use below-ground shelter sites for refuge, breeding, feeding, and nesting. Reliance on xeric sandhill habitats throughout the northern portion of the eastern indigo snake's range in Georgia and northern Florida is due to the dependence on gopher tortoise burrows for shelter during winter. Eastern indigo snakes are also known to utilize human-altered habitats. In Florida, agricultural sites, such as sugar cane fields, improved pasture sites, citrus groves, and canal banks created in drained wetland areas are sometimes occupied by eastern indigo snakes (USFWS 2019).

Non-agricultural Uses

In addition to agricultural uses, listed reptile species may be exposed to carbaryl through non-agricultural uses of carbaryl. Given that the eastern indigo snake can be found in nearly all terrestrial habitats except for high intensity developments, we anticipate individuals may occur in managed forest, rangeland, rights of way, and open space developed use sites. While it is possible individuals in these areas may be exposed to carbaryl, we anticipate that exposure is unlikely to occur given the low level of usage that occurs in these use sites. Available usage data from the U.S. Forest Service and USDA APHIS indicate that no carbaryl has been used in federally managed forests or rangelands in the states containing the eastern indigo snake's range since 2014, suggesting that individuals are not likely to be exposed to carbaryl through uses on managed forests or rangelands. Similarly, available usage information indicates that carbaryl is used infrequently in rights of ways, with less than 500 pounds of carbaryl applied to roadways annually. While this may result in a large treatment footprint if all rights of way usage were concentrated in one location or within one species' range, 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 eastern indigo snake's range for rights of way use. Past carbaryl usage data indicate that up to 2.5% of open space developed use sites across the country have been treated annually with carbaryl in the past; we expect very little of this 2.5% will occur in the species' range, indicating a low likelihood of exposure to carbaryl for this particular use. Given these low levels of usage, we do not anticipate non-agricultural uses of carbaryl will expose more than a small number of individuals over the duration of the proposed action.

Exposure Summary

There is a high extent of overlap between the species' range and the action area (25.4% total overlap). While there is only a moderate level of past carbaryl usage within the species range (up to 5.1% range treated annually), we anticipate a large portion of the range is likely to be treated

over time, particularly if the areas treated change each year. As such, we anticipate a large number of individuals are likely to be exposed to carbaryl over the duration of the proposed action. We do not anticipate non-agricultural uses of carbaryl will expose more than a small number of individuals. Based on the high agricultural overlap and moderate level of past agricultural usage, the species has a high exposure ranking.

Overall Exposure Ranking: High

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the eastern indigo snake is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). While the eastern indigo snake can consume a variety of prey items, we expect individuals primarily consume small mammals, amphibians, snakes, and turtles. EPA's exposure modeling indicates maximum dietary exposure to individuals that consume small vertebrate prey on agricultural and non-agricultural use sites recently applied with carbaryl (or consume prey that have fed on use sites recently treated with carbaryl) can accumulate up to 3.8-5.9 mg/kg-bw. We do not anticipate this level of exposure will cause any mortality or sublethal adverse effects to growth and reproduction. We do not expect any direct adverse effects are likely to occur in individuals exposed to carbaryl up to 30 meters off-field as dietary doses are predicted to be well below levels where any adverse effects were observed in toxicity studies.

Indirect Effects:

We expect some of the eastern indigo snake's prey, particularly small mammals, will experience high levels of mortality from exposure to carbaryl on use sites. However, we do not expect small mammal prey will die when exposed to carbaryl in off-field areas and we do not expect any other prey species are likely to die in on- or off-field areas. Given that there will be reduced prey availability on carbaryl use sites and that this reduced prey availability will only be limited to one of the snakes many dietary items, we anticipate the species will only experience low levels of indirect adverse effects.

Toxicity Summary

The eastern indigo snake has a low toxicity ranking. We do not anticipate any dietary exposures (either on- or off-field) will result in exposures at high enough levels to cause any direct adverse effects to survival, growth, or reproduction. While small mammal prey are likely to die on carbaryl use sites, we do not expect this prey loss will result in more than indirect adverse effects to the species as the eastern indigo snake can rely on a variety of alternative prey species that are not likely to experience any exposure on-field.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The eastern indigo snake has a high exposure ranking. Though we do not anticipate more than a small number of individuals will be exposed through non-agricultural uses of carbaryl, there is a high extent of overlap between the species' range and agricultural use areas and a moderate level of past agricultural carbaryl usage within the species' range. As such, we anticipate a large portion of the species' range, and a large number of individuals are likely to be exposed over the duration of the proposed action.

The eastern indigo snake has a low toxicity ranking. Individuals are not likely to accumulate more than low levels of carbaryl through dietary exposure and are not likely to experience and direct adverse effects to survival, growth, or reproduction at predicted levels of exposure. We anticipate only low levels of indirect adverse effects will occur as the species can rely on a number of prey species that are not likely to experience any mortality from carbaryl exposure.

Thus, while a large number of individuals are likely to be exposed, we do not anticipate more than a small number of exposed individuals will die or experience more than low levels of indirect adverse effects. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The eastern indigo snake is a threatened species found in four regions of the southeast: southeast Georgia, the Panhandle (includes portions of Alabama, Florida, and Georgia), north Florida, and peninsular Florida. Thirty (30) of the historical 51 populations are extirpated (59%). Population extent has declined in all regions, with a 48% decline across the species' historical range. The primary threats to the long-term viability of the species are from habitat fragmentation and loss due to land use changes, especially urbanization. Urbanization includes a variety of negative impacts that remove or alter available habitat or impact snakes directly including residential and commercial development, road construction and expansion, direct mortality (e.g., road mortality, human persecution, domestic pets), invasive species, predation, and inadequate fire management. Habitat loss for coastal populations due to sea level rise is also an increasing risk. Snake fungal disease has emerged as an additional negative factor, but impacts to long-term viability remains uncertain, and research is on-going. Thus, we have determined that the species has a high vulnerability.

The eastern indigo snake is a diurnal species and prefers upland habitat types (e.g., longleaf pine sandhills, scrub, pine flatwoods, tropical hardwood hammocks, and coastal dunes), but it also uses a variety of lowland (e.g., freshwater and saltwater marshes and swamps) and human-altered habitats (e.g., agricultural lands). Eastern indigo snakes may move seasonally between upland and lowland habitats, especially in northern portions of their range. Throughout their

range, eastern indigo snakes use below-ground shelter sites for refuge, breeding, feeding, and nesting. Adult eastern indigo snakes move long distances and have very large home ranges from about a hundred to several thousand acres (tens to over a thousand hectares). They consume a wide variety of animals, including other snakes.

There is large overlap (25.4%) between the species' range and agricultural carbaryl use sites, with (14.7%) of the species range overlapping with use sites, and 10.7% susceptible to off-site exposure through spray drift and runoff. Usage data indicates that a moderate amount of the range (5.1%) will be treated with carbaryl annually, which could amount to a large proportion after accounting to changes in treated areas over the duration of the action. The species is known to occur on some agricultural lands, including sugar cane fields, improved pasture sites, and citrus groves. In addition to agricultural use sites, eastern indigo snakes may also occur on non-agricultural use sites including managed forests, rangeland, rights of way, and open space developed areas. However, after considering low usage and conservation measures, we do not anticipate that non-agricultural uses of carbaryl expose more than a small number of individuals over the duration of the proposed action.

Use of burrows and preference for native habitat will generally protect the eastern indigo snake from exposure to carbaryl, however, we cannot rule out that snakes will traverse agricultural fields or other non-agricultural use sites and consume contaminated prey during that time. The eastern indigo snake is an active forager (USFWS 2019b) seeking out its prey rather than sitting and waiting on its prey. While eating contaminated prey cannot be ruled out, the snake is unlikely to consume enough contaminated prey items in a single feeding to induce mortality. Therefore, we do not expect mortality on-field or off-field (within 30 m), and we do not expect sublethal effects from carbaryl exposure. Some of the species' prey (i.e., small mammals) will likely die from exposure to carbaryl on use sites, but we do not expect small mammal mortality off-field, and we expect these indirect effects will amount to a low overall effect to the eastern indigo snake. While prey items for the snake may be reduced, prey items are likely more abundant outside of agricultural areas where carbaryl is applied, and thus, we do not anticipate significant reductions in available prey for the eastern indigo snake throughout its range.

Therefore, we expect impacts to the eastern indigo snake to be low and only a small number of individuals will die or be adversely affected due to loss of mammal prey. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the eastern indigo snake.

References

U.S. Fish and Wildlife Service. 2019a. Eastern Indigo Snake (*Drymarchon corais couperi*) 5-Year Review: Summary and Evaluation. Athens, Georgia. 51 pp.

U.S. Fish and Wildlife Service. 2019b. Species Status Assessment (SSA) Report for the Eastern Indigo Snake (*Drymarchon couperi*). Version 1.1. Athens, Georgia. 160 pp.

Integration and Synthesis Summary: Blue-tailed mole skink

Scientific Name:	Common Name:	Entity ID:
Eumeces egregius lividus	Blue-tailed mole skink	178

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range (Figure 3) and medium past usage of carbaryl within the species' range, indicating a high extent of exposure. No exposed individuals are likely to die or experience sublethal adverse effects. We do not anticipate more than low levels of indirect adverse effects are likely from loss of arthropod prey. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the blue-tailed mole skink. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 2/3/2022; Wherever found; *States within the range:* FL

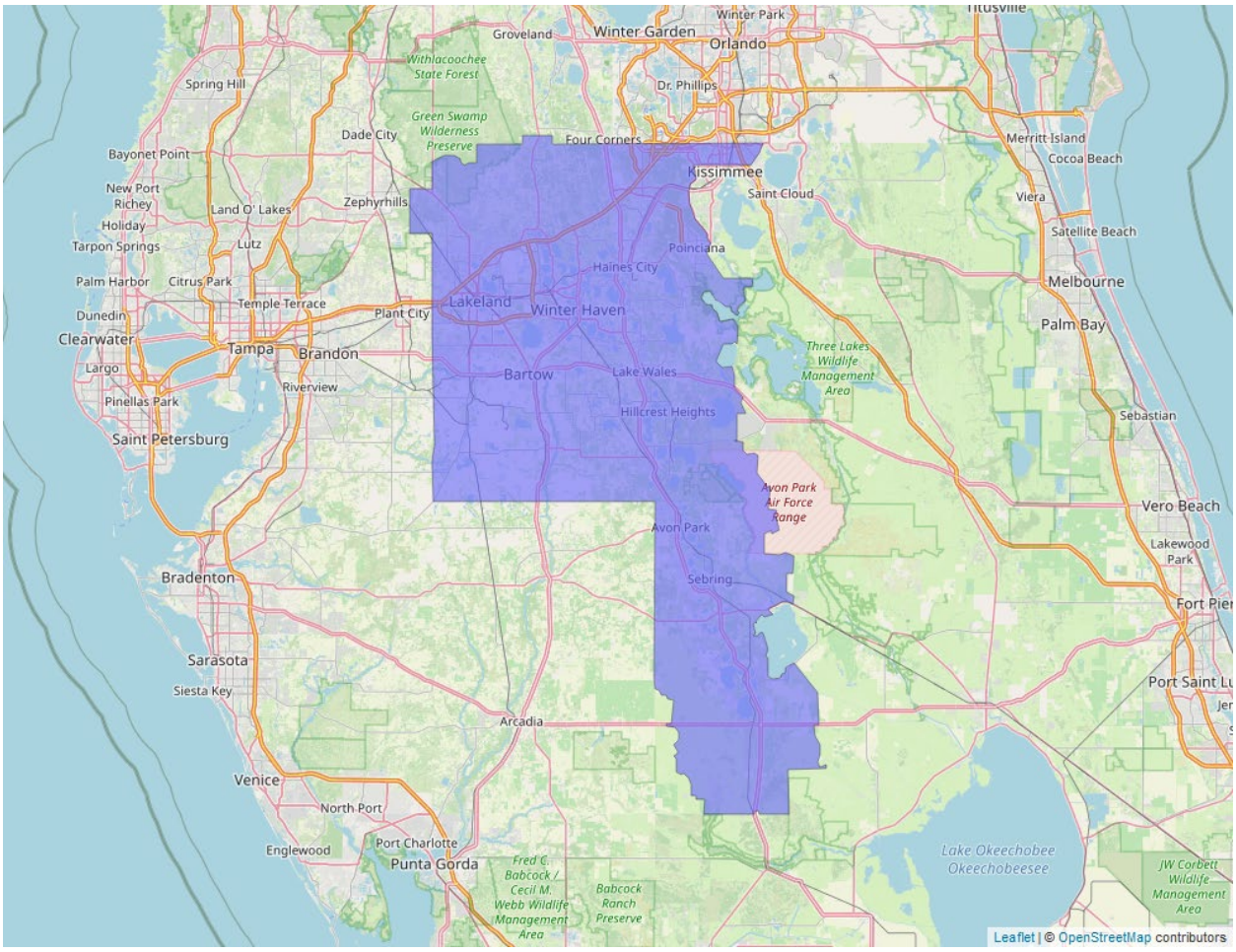

Figure 3. Range map of blue-tailed mole skink (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/2203.

Vulnerability

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

Summary of status

Listing status: Threatened

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

Most recently completed 5-Year Status Review: 7/9/2021

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

Number of populations: Single population

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

Blue-tailed mole skinks are small, slender lizards endemic to the Lake Wales Ridge in central Florida. They occupy xeric upland habitats, with open, sandy patches interspersed with sclerophyllous vegetation in Highlands, Polk, and Osceola Counties. They eat roaches, crickets, and spiders on the soil surface or at depths up to 5 cm (USFWS 1999). It appears that blue-tailed mole skinks are still distributed throughout their historical range, although their numbers have likely declined substantially because 85% of the historical scrub and sandhill habitats on the Lake Wales Ridge have been lost. Based on available information, the blue-tailed mole skink current range contains lands on and off the Lake Wales Ridge, but areas off the Lake Wales Ridge need to be verified. Of the 31 sites on which the blue-tailed mole skink is reported to occur, 18 sites are managed (e.g., for fire) and two more are protected. Much remaining habitat occurs in small, isolated fragments surrounded by residential areas or citrus groves, making them difficult to protect and manage. Many habitat fragments are overgrown and in need of restoration (USFWS 2023).

The blue-tailed mole skink is threatened by habitat loss and degradation, including fragmentation, changes in land use, improper habitat management, invasion by exotic plants, limited geographic range, isolated populations, limited dispersal, and potential effects of climate change factors. If not acquired for conservation, privately-owned sites remain at risk of being developed and management remains a concern. Overutilization for commercial, recreational, scientific, or educational purposes; and disease and predation are not considered to be threats to this species. Development pressures are expected to increase in Florida in the future, which could result in further habitat loss on privately-owned lands. There is a multi-year study on the current status, distribution, and population size for the blue-tailed mole skink, results of which will provide valuable information about the species (USFWS 2023).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 16.1% of the species' range overlaps with agricultural use sites and 10.2% of the species' range overlaps with areas adjacent to use sites (Table 8) that are likely exposed

through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 26.3% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 8. Overlap and usage (% range treated annually) data for the blue-tailed mole skink.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	0	0	0	0	0	0
Citrus[7]	14.4	6.8	21.2	6	2.8	8.9
Corn[8]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Grapes	<0.1	0.1	0.2	<0.1	0.1	0.2
Other Crops	1.4	2.5	3.9	1.4	2.5	3.9
Other Grains	0.2	0.2	0.4	<0.1	<0.1	<0.1
Other Orchards	0.4	0.6	1	0.4	0.6	1
Other Row Crops	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Soybeans	0	0	0	0	0	0
Vegetables and Ground Fruit	0.2	0.6	0.9	0.2	0.6	0.9
Total	**16.1**	**10.2**	**26.3**	**7.7**	**6.1**	**13.7**

Usage

Past usage data indicate that up to 13.7% of the species' range has been treated with carbaryl annually from agricultural uses.

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

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

Additional Exposure Considerations

The blue-tailed mole skink occupies xeric upland habitats of the Central Ridge in peninsular Florida and requires open, sandy patches interspersed with sclerophyllous vegetation. Given this unique habitat requirement, we do not anticipate individuals will occur on agricultural use sites as cultivated land does not likely contain the necessary features to support the skink. As such, while there is overlap between the species' range and agricultural use sites, we do not anticipate any individuals are likely to be exposed directly on agricultural use sites. To account for this difference in exposure potential, we only consider off-site exposure in our assessment, indicating that total overlap with agricultural areas is 10.2% and up to 6.1% of the range is likely to be treated annually.

Non-agricultural Uses

The blue-tailed mole skink occupies a specific habitat that is not likely to coincide with non-agricultural carbaryl use sites, including developed, open space developed, nurseries, managed forests, rangelands, or rights of ways. As we generally expect non-agricultural uses to have low usage, and to have a low potential for off-site transport due to application methods that limit drift and runoff, we do not anticipate more than small numbers of individuals are likely to be exposed to non-agricultural uses over the duration of the proposed action.

Exposure Summary

While we do not anticipate individuals will likely occur on agricultural use sites or any non-agricultural treatment sites, there is still a high extent of overlap between the species' range and areas immediately adjacent to agricultural use sites that are likely to be exposed to carbaryl through spray drift or runoff (10.2% total overlap with off-site areas). Furthermore, there is a moderate level of past agricultural carbaryl usage within the species' range, indicating that a large portion of the species range, and thus a large number of individuals, are likely to be exposed over the duration of the proposed action, particularly if treated areas change each year. As such, the blue-tailed mole skink has a high exposure ranking.

Overall Exposure Ranking: High

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the blue-tailed mole skink is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). As stated in the prior section, we do not anticipate the blue-tailed mole skink will occur on agricultural or non-agricultural use sites of carbaryl. As such, we anticipate exposure will be limited to off-field areas. EPA's exposure modeling indicates maximum dietary exposure to individuals that

consume arthropod prey in off-field (i.e., up to 30 meters off-field) will accumulate up to 0.1 mg/kg-bw. We do not expect any individuals will die at this level of exposure, nor experience any sublethal adverse effects to growth or reproduction.

Indirect Effects:

The blue-tailed mole skink primarily consumes arthropod prey. Based on available toxicity data in insect species, we anticipate there will be a high level of arthropod mortality where exposure occurs. However, we expect the level of mortality will vary across species as a result of natural variability in physiology, exposure, and other factors. We do not expect the entire insect community is likely to experience mortality and that individual skinks will have sufficient food resources available, particularly in areas away from carbaryl use sites where we expect skinks and their prey to be more likely to occur. As such, we do not anticipate more than low levels of indirect adverse effects are likely.

Toxicity Summary

We do not anticipate the blue-tailed mole skink is likely to accumulate more than low levels of carbaryl through dietary exposure as individuals are not likely to forage directly on carbaryl use sites. As such, we do not anticipate individuals will experience direct adverse effects to survival, growth, or reproduction. While we anticipate individuals will experience some indirect adverse effects through the loss of sensitive arthropod prey species, we do not anticipate the entire prey community will die with carbaryl exposure and that there will still be sufficient food resources available for individuals. As such, the blue-tailed mole skink has a low toxicity ranking.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The blue-tailed mole skink has a high exposure ranking. There is a high extent of overlap between the species' range and the action area and a moderate level of past carbaryl usage, indicating that a large portion of the range and a large number of individuals are likely to be exposed over the duration of the proposed action. We anticipate non-agricultural uses of carbaryl will not expose more than a small number of individuals over the duration of the proposed action. The species has a low toxicity ranking as individuals are not likely to accumulate more than low levels of carbaryl, which will not cause mortality or sublethal adverse effects to more than a small number of exposed individuals. While we expect some mortality of arthropod prey, we do not anticipate the entire prey community will die and that there will still be sufficient food resources available for individuals. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The blue-tailed mole skink is a threatened species primarily found in the Lake Wales Ridge of central Florida. They occur in xeric uplands and eat roaches, crickets, and spiders. Two occupied sites are protected, 18 are managed for fire, and an additional 11 are unmanaged for the species or its habitat. Threats to the species include habitat loss and degradation, limited geographic range, isolated populations, and potential effects of climate change.

Individuals prefer upland habitats with open, sandy patches and sclerophyllous vegetation. We do not expect them to occur on carbaryl use sites, therefore, we focus our analyses on off-field exposure. There is large overlap (10.2%) between the species' range and areas subject to runoff and spray drift from nearby agricultural carbaryl use sites, and past usage data indicates that a moderate portion of the range (6.1%) will be exposed through spray drift from agricultural carbaryl treatments annually. As we generally expect non-agricultural uses such as developed, open space developed, and rights of way to have a low potential for off-site transport, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. We do not expect blue-tailed mole skinks to die or experience sublethal effects from dietary exposure after consuming contaminated prey, including in off-field areas. We do not expect more than low indirect effects from loss of prey because they consume diverse invertebrates that are not expected to occur primarily on agricultural areas where carbaryl may be used.

Therefore, we expect impacts to the blue-tailed mole skink to be low and no more than a small number of exposed individuals will die or be adversely affected through loss of terrestrial prey. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the blue-tailed mole skink.

References

U.S. Fish and Wildlife Service. 2021. Blue-tailed Mole Skink (*Eumeces egregius lividus*) 5-Year Review: Summary and Evaluation. Vero Beach, Florida. 20 pp.

U.S. Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan. Vero Beach, Florida.

Integration and Synthesis Summary: Copperbelly water snake

Scientific Name:	Common Name:	Entity ID:
Nerodia erythrogaster neglecta	Copperbelly water snake	180

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range (Figure 4) and high past usage of carbaryl within the species' range, indicating a high extent of exposure. No more than small numbers of exposed individuals are likely to die or experience sublethal adverse effects. The species prey (i.e., amphibians and fish) may experience reductions, but we expect no more than low levels of indirect effects from loss of prey. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the copperbelly water snake. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 12/13/2021; Indiana north of 40 degrees north latitude, Michigan, Ohio; *States within the range:* IN, MI, OH

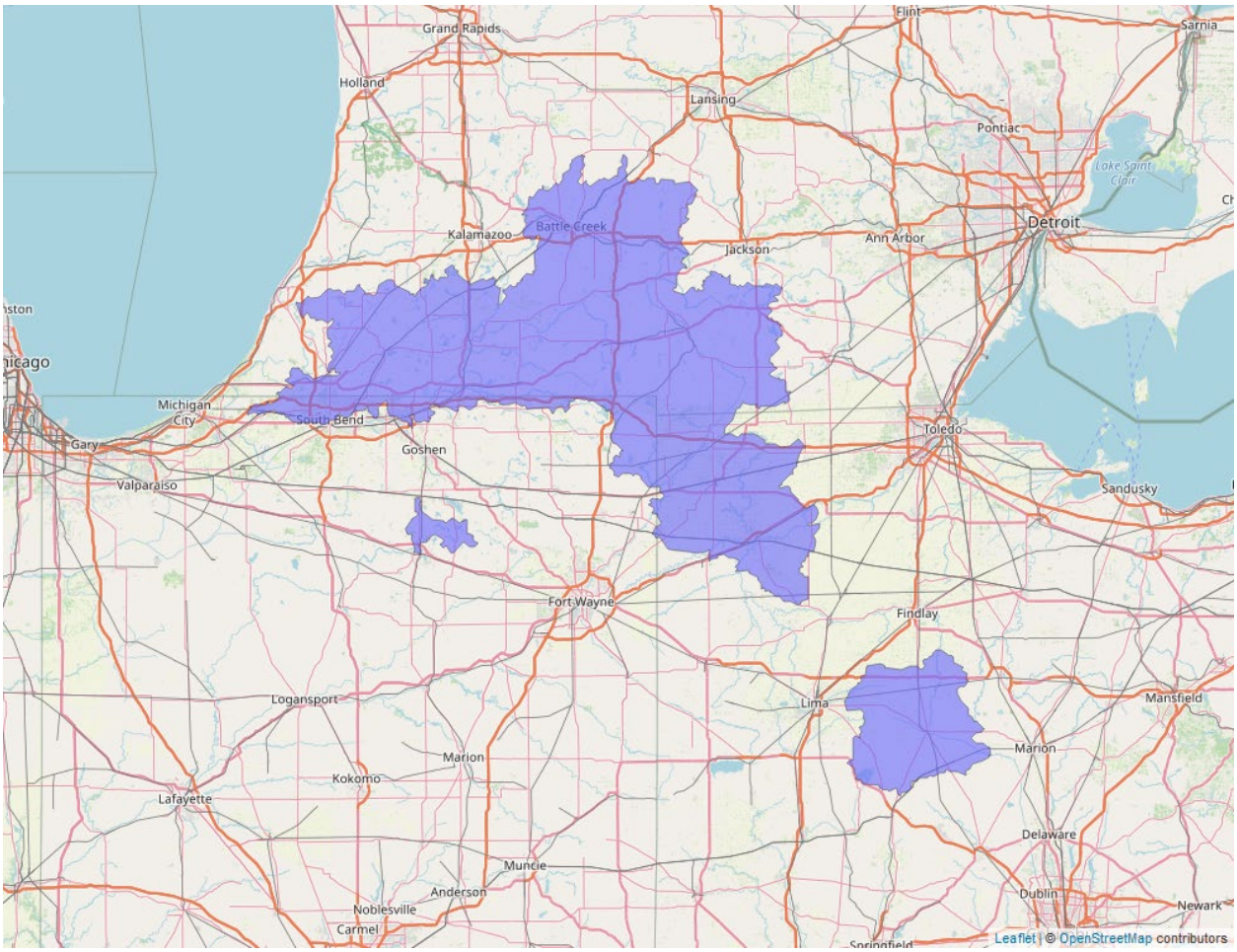

Figure 4. Range map of copperbelly water snake (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/7253.

Vulnerability

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

Summary of status

Listing status: Threatened

Most recent 5 Year Status Review recommendation: Uplist to E

Most recently completed 5 Year Status Review: 9/27/2023

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

Number of populations: Single population

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

The copperbelly water snake is the northern Midwest representative of the plain-bellied water snake. Their diet includes mostly amphibians and fish. Their historical distribution likely included south central Michigan and northwestern Ohio, southwestward through Indiana to extreme southeastern Illinois and Kentucky (USFWS 2008). Genetic studies suggest that the subspecies is found in a single, freely interbreeding population. Subpopulations span from western Kentucky and southern Illinois to northern Indiana and Ohio and southern Michigan. Northern copperbelly water snakes (*Nerodia erythrogaster neglecta*) are listed as a threatened Distinct Population Segment (DPS). The DPS consists of populations north of the 40th Parallel, in Indiana, Michigan, and Ohio. Surveys over the last twenty years have documented an ongoing decline in these populations. Many populations are now extirpated, and the five that remain are very small. Even the largest population, located in Ohio, is in decline with adults likely numbering in the low hundreds or less. Copperbelly water snakes have both wetland and terrestrial habitat requirements but are associated most often with wetland complexes characterized by a preponderance of shallow wetlands, many of which draw down seasonally. Thus, the species needs habitat complexes of isolated wetlands distributed in a forested upland matrix. Many subpopulations are now extirpated, and the few that remain are very small. The species was believed to be declining after the 2018 5-Year Review, in which we stated that the DPS may have had fewer than 100 individuals (USFWS 2018). Further population declines were evidenced by survey results in Indiana, Ohio, and Michigan in 2020 and 2021. They are known to occur in one wetland cluster in Ohio and Michigan; many wetlands previously occupied do not seem to be occupied anymore. In 2022 and 2023, all but one individual observed during surveys (n=10 total) were captured and placed in captivity following the species Captive Rearing Plan. They adapted well to captivity and breeding has been successful (USFWS 2023).

The principal limiting factor for copperbelly water snakes is the availability of wetland/upland habitat complexes of sufficient size. They require many hundreds of hectares of contiguous habitat to persist. Additional threats are disease (e.g., snake fungal disease), human persecution, inadequate habitat management, road crossings, increased sedimentation, and contamination caused by fertilizer runoff. Sedimentation, usually resulting from agricultural activities, but also caused by construction, may change hydrological characteristics, alter plant succession, and reduce the numbers of amphibians and fish used by the snake as food. The species is threatened by climate change, particularly through anticipated changes to ephemeral wetlands and amphibian populations (USFWS 2023). In the 2018 and 2023 5-Year Reviews, the copperbelly

water snake was recommended for uplisting to endangered (USFWS 2018, 2023). The reasoning behind this recommendation is that the recovery criteria have not been met, the known threats have not significantly diminished, climate change represents a new and uncertain threat, and the copperbelly population has declined since listing to its current level (<100 individuals), which meets the criteria for reclassification. The species continues to face a high degree of threat from loss or conversion of forest and wetland habitat, particularly because most of the land in the DPS' range is privately owned. Some restoration, conservation, research, and captive rearing projects continue and create high potential for recovery.

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 76.6% of the species' range overlaps with agricultural use sites and 34.3% of the species' range overlaps with areas adjacent to use sites Table 9 that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 100% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 9. Overlap and usage (% range treated annually) data for the copperbelly water snake.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	5.9	7	13	2.3	2.8	5.1
Citrus	0	0	0	0	0	0
Corn	47.9	12.5	60.5	12.7	3.3	15.9
Grapes	0.2	0.5	0.8	0.2	0.5	0.8
Other Crops	15.1	10.2	25.3	15.1	10.2	25.3
Other Grains	1.4	2.8	4.2	<0.1	<0.1	0.1
Other Orchards	0.4	0.8	1.2	0.4	0.8	1.2
Other Row Crops	<0.1	<0.1	0.1	<0.1	<0.1	0.1

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Soybeans[9]	51.1	11.6	62.8	13.1	2.9	16.1
Vegetables and Ground Fruit	2.5	1.8	4.3	2.5	1.8	4.3
Total	**76.6**	**34.3**	**100**[10]	**33.6**	**18.7**	**52.2**

Usage

Past usage data indicate that up to 52.2% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

Like other water snake species, the copperbelly water snake is generally affiliated with wetland habitats. While individuals can spend significant time in upland habitats to forage, aestivate, and disperse between wetland habitats, individuals do not readily cross expansive agricultural areas. As such, we do not anticipate individuals are likely to occur on-field. While there is overlap between the species' range and agricultural use sites, we do not anticipate any individuals are likely to be exposed directly on agricultural use sites. To account for this difference in exposure potential, we only consider off-site exposure in our assessment, indicating that total overlap with agricultural areas is 34.3% and up to 18.7% of the range is likely to be treated annually.

Non-agricultural Uses

The copperbelly watersnake generally occupies wetland habitats and their associated upland areas, which we do not expect will coincide with non-agricultural carbaryl use sites, including developed, open space developed, nurseries, managed forests, rangelands, or rights of ways. As we generally expect non-agricultural uses to have a low potential for off-site transport due to application methods that limit drift and runoff, low usage, and required buffers from aquatic habitats. We do not anticipate more than small numbers of individuals will be exposed to non-agricultural uses of carbaryl over the duration of the proposed action.

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

[10] Total overlap is capped at 100%.

Exposure Summary

While the copperbelly water snake is not likely to occur on non-agricultural use areas or on agricultural use sites, there is still a high extent of overlap between the species' range and areas adjacent to agricultural use sites that are likely to be exposed to spray drift or runoff (34.3% total overlap with off-field areas). There is also a high level of past agricultural carbaryl usage within the species' range (up to 18.7% range treated annually). As such, we anticipate a large portion of the range, and a large number of individuals, are likely to be exposed over the duration of the proposed action. The copperbelly water snake has a high exposure ranking.

Overall Exposure Ranking: High

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the copperbelly water snake and subsequent risk of direct effects and indirect effects to prey items.

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the copperbelly water snake is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). As stated in the prior section, we do not anticipate the individuals will occur on agricultural use sites. As such, we anticipate exposure will be limited to off-field areas. EPA's exposure modeling indicates maximum dietary exposure to individuals that consume amphibian prey in off-field (i.e., up to 30 meters off-field) will accumulate up to 0.1-2.6 mg/kg-bw. We do not expect any individuals will die at this level of exposure, nor experience any sublethal adverse effects to growth or reproduction.

Indirect Effects:

The copperbelly water snake relies on amphibians, and to a much lesser extent fish, for food resources. Based on available toxicity data, we expect individuals of these prey species will experience low levels of mortality in areas off-field (i.e., there will be a low loss of off-field prey). As such, we expect there may be small reductions in the abundance of prey species throughout the species' range, indicating a low level of indirect adverse effects is likely to occur.

Toxicity Summary

We do not anticipate the copperbelly water snake will accumulate more than low levels of carbaryl through dietary exposure, resulting in no direct adverse effects to survival, growth, or reproduction. There will be, at most, low levels of mortality to amphibian and fish prey species, resulting in no more than low levels of indirect adverse effects to the species. As such, the copperbelly water snake has a low toxicity ranking.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The copperbelly water snake has a high exposure ranking. While non-agricultural uses are not likely to expose more than a small number of individuals, there is a high extent of overlap with off-field agricultural areas and a high level of past agricultural carbaryl usage within the range, indicating a large number of individuals are likely to be exposed. We do not anticipate exposed individuals will accumulate more than low levels of carbaryl no more than small numbers of exposed individuals are likely to die or experience indirect adverse effects through the loss of prey. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The copperbelly water snake is a threatened subspecies (distinct population segment, DPS) that consists of populations north of the 40th parallel in Indiana, Michigan, and Ohio. Populations have been declining for 20+ years, many populations are now extirpated, and the five that remain are very small. Abundance has declined since listing to its current level of less than 100 individuals. We recommended the species for uplisting in 2018 and 2023. Restoration, conservation projects, research, and captive rearing continue and create high potential for recovery. Although several projects (e.g., conservation easements, restoration grants) have resulted in either the protection or restoration of suitable habitat for the copperbelly water snake, the threats of forest and wetland habitat loss and fragmentation remain high. Most of the northern DPS' range is privately owned. The primary form of economic activity in conflict with the copperbelly is agriculture. Row crops do not provide suitable habitat and fragment remaining forest from wetland habitat. Residential development also removes and fragments habitat but is not widespread in the copperbelly range.

Individuals are unlikely to traverse or occur on expansive agricultural fields or non-agricultural use sites of carbaryl, therefore, we focus our analyses on off-field exposure. There is large overlap (34.3%) between the species' range and areas subject to runoff and spray drift from nearby agricultural carbaryl use sites, and past usage data indicates that a large portion of the range (18.7%) will be exposed through spray drift from agricultural carbaryl treatments annually. Because we generally expect non-agricultural uses to have a low potential for off-site transport due to application methods that limit drift and runoff, low usage, and required buffers from aquatic habitats, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. We do not expect copperbelly water snakes to die or experience sublethal effects from dietary exposure after consuming contaminated prey, including in off-field areas. We do not expect more than low indirect effects from loss of prey because their prey items are unlikely to occur on areas where carbaryl may be used, particularly in agricultural fields.

Therefore, we expect impacts to the copperbelly water snake to be low and no more than a small number of exposed individuals will die or be adversely affected through loss of prey. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the copperbelly water snake.

References

U.S. Fish and Wildlife Service. 2023. Copperbelly Water Snake (Northern Population Segment) (*Nerodia erythrogaster neglecta*) 5-Year Review: Summary and Evaluation. Columbus, Ohio. 17 pp.

U.S. Fish and Wildlife Service. 2018. Copperbelly Water Snake (Northern Population Segment) (*Nerodia erythrogaster neglecta*) 5-Year Review: Summary and Evaluation. East Lansing, Michigan. 22 pp.

U.S. Fish and Wildlife Service. 2008. Northern Population Segment of the Copperbelly Water Snake (Nerodia erythrogaster neglecta) Recovery Plan. Fort Snelling, Minnesota. ix + 79 pp.

Integration and Synthesis Summary: Bog turtle

Scientific Name:	Common Name:	Entity ID:
Glyptemys muhlenbergii	Bog turtle	182

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range (Figure 5) and moderate past usage of carbaryl within the species' range, indicating a high extent of exposure. No more than small numbers of exposed individuals are likely to die or experience sublethal adverse effects. While we expect high reductions in insect prey, the species relies on a diverse array of dietary items and individuals will have sufficient food resources available like insect species less sensitive to carbaryl and aquatic plants (which are not likely to be adversely affected by carbaryl). Furthermore, we expect the species and its prey to occur primarily in their preferred habitats (i.e., wetlands) and not in areas where carbaryl is registered for use. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the bog turtle. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 7/1/2024; Wherever found, except GA, NC, SC, TN, VA; *States within the range:* CT, DC, DE, MA, MD, NJ, NY, PA, VA

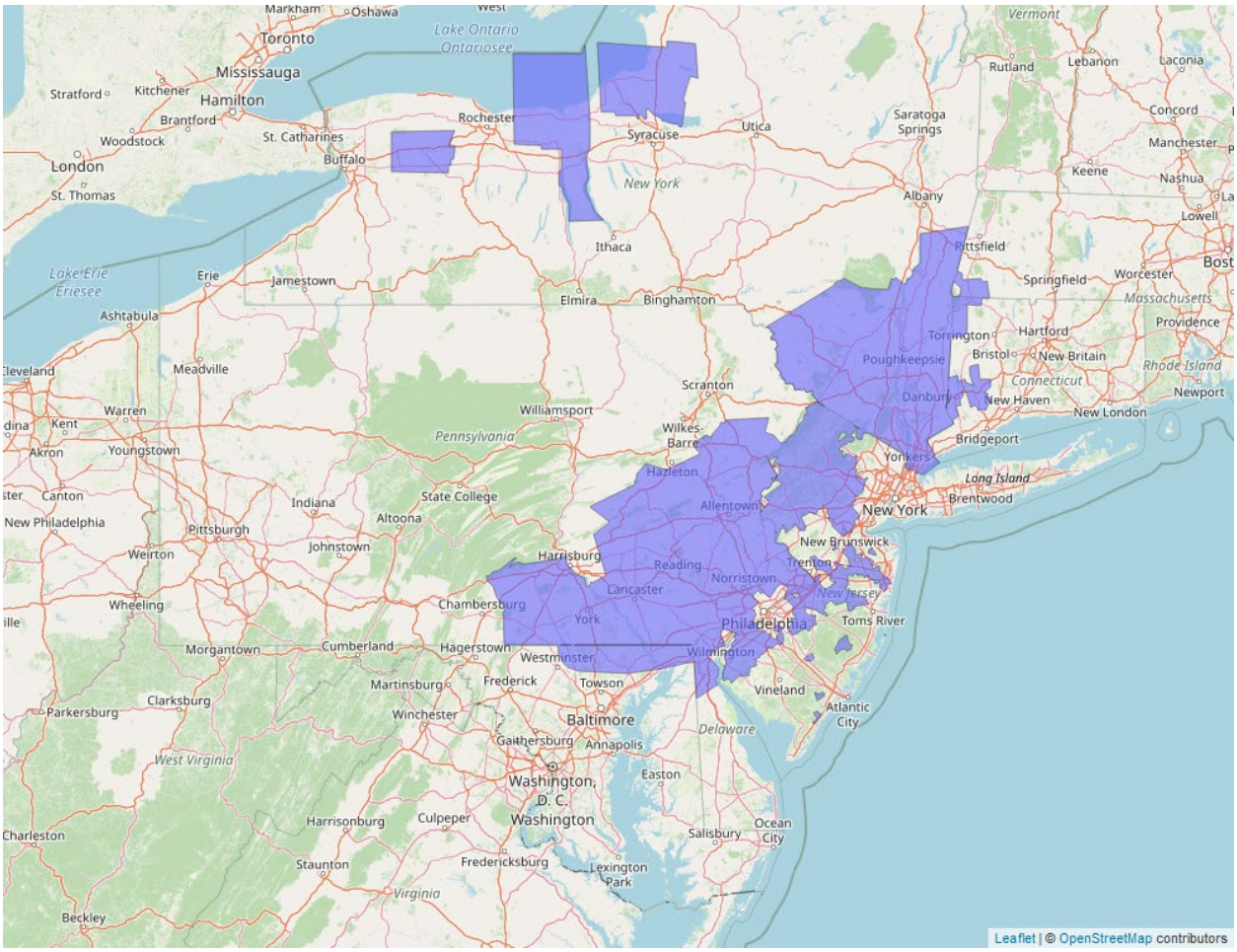

Figure 5. Range map of bog turtle (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/6962.

Vulnerability

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

Summary of status

Listing status: Threatened

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

Most recently completed 5 Year Status Review: 8/29/2022

Distribution: Species/Populations neither constrained nor widespread

Number of populations: Multiple populations (numerous)

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

Bog turtles occur in various wetlands, including shallow, spring-fed fens, sphagnum bogs, swamps, marshy meadows, man-made structures (i.e., pipes, ditches), and pastures. These areas often have soft, muddy bottoms; clear, soft-flowing water; open canopies; and form a network of rivulets. Pedestal vegetation, such as tussock sedge (*C. stricta*) and sphagnum moss, is used for nesting and basking. They hibernate in winter in densely vegetated areas, under water in soft mud, in crevices between rocks, or between tangled roots. Hibernation areas need clean, cool, flowing water to avoid freezing. Bog turtles are able to disperse between habitat patches of changing vegetation within a long-term, stable, wetland complex. They eat slugs, earthworms, spiders, beetles, millipedes, flies, snails, ants, moths, dragonflies, caddisflies, other insects, and plants. We are now aware of 330 extant bog turtle metapopulations (508 individual populations), which includes both connected populations (n=106) and isolated individual populations (i.e., no connectivity to other populations currently, but likely were once part of a metapopulation; n=224). Pennsylvania is the only state in the northern range where new populations are regularly being discovered, and the distribution in the rest of the northern range is stable. There are 37 potentially extirpated populations and 40 confidently extirpated populations due to lack of suitable habitat (USFWS 1995, 2022). While the species also occurs in Georgia, North Carolina, South Carolina, Tennessee, and Virginia, those in the northern states are part of the threatened distinct population segment. The southern populations are listed as “Similarity of Appearance” under the Endangered Species Act (USFWS 2022).

Bog turtles have been found at elevations ranging from near sea level in the north to 1,500 meters in the south. They usually occur in small, discrete populations occupying suitable wetland habitat dispersed along a watershed. These wetlands are a mosaic of micro-habitats that include dry pockets, saturated areas, and areas that are periodically flooded. The turtles depend upon this diversity of micro-habitats for foraging, nesting, basking, hibernation, shelter, and other needs. Bog turtles can disperse between habitat patches of changing vegetation within a long-term, stable, wetland complex. Pedestal vegetation, such as tussock sedge (*C. stricta*) and sphagnum moss, is utilized for nesting and basking. Bog turtles become active in late March to late April, depending upon latitude, elevation, and seasonal weather conditions. Bog turtles generally retreat into more densely vegetated areas to hibernate but have also been found hibernating under water in soft mud, in crevices between rocks, or between tangled roots. The species declined primarily due to loss and degradation of habitat.

Current threats to the bog turtle include habitat loss or alteration from altered hydrology (i.e., due to development, roads, beavers, agriculture) and changes in vegetation (e.g., invasive species encroachment, vegetation succession, incompatible or lack of management); collection for the illegal wildlife trade; predation; and inherent factors (e.g., specialized habitat requirements, limited dispersal ability, small population sizes, delayed sexual maturity, road mortality, contaminants). The greatest threat remains habitat loss or degradation from development. Roads are a source of mortality and barrier to species movement within and between populations. Pollution and contaminants, mainly from oil and gas pipeline projects, threaten the species and its habitat (USFWS 2022). Herbicides, pesticides, and fertilizers can degrade or destroy bog turtle habitat and we recommended avoiding them in bog turtle conservation zones in the recovery plan (USFWS 2001). The primary threat of loss or alteration of habitat has continued, and we expect it to continue into the future, especially on private lands. The early successional vegetation required by bog turtles for successful nesting relies upon habitat management. While the Service, states, NRCS, and other partners have restored many individual wetlands or portions of wetlands, ongoing management is a challenge. The bog turtle is a long-lived species and can tolerate some degree of suboptimal habitat for several years. However, continued degradation results in reduced population size and resiliency, putting populations at greater risk of impacts from stochastic or catastrophic events, such as drought conditions, disease, predation, or illegal collection (USFWS 2022).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 20.3% of the species' range overlaps with agricultural use sites and 15.7% of the species' range overlaps with areas adjacent to use sites (Table 10) that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 36% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 10. Overlap and usage (% range treated) data for the bog turtle.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	2.6	3.7	6.3	0.4	0.6	1.1
Citrus	0	0	0	0	0	0

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Corn[11]	13.1	6.6	19.7	1.4	0.7	2.2
Grapes	0.3	0.1	0.4	0.2	0.1	0.4
Other Crops	1.1	2.0	3.1	1	1.6	2.6
Other Grains	1.0	1.6	2.6	<0.1	<0.1	<0.1
Other Orchards	1.3	0.9	2.2	1.1	0.8	2
Other Row Crops	0.2	0.1	0.3	<0.1	<0.1	<0.1
Soybeans	9.9	5.9	15.9	1.8	1	2.8
Vegetables and Ground Fruit	1.0	0.9	1.8	0.3	0.3	0.6
Total	**20.3**	**15.7**	**36.0**	**4.7**	**4.4**	**9.1**

Usage

Past usage data indicate that up to 9.1% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

While bog turtles have been documented hibernating in agricultural and roadside ditches and dispersing through forests, agricultural lands, and developed areas, the species more typically inhabits a variety of wetland habitats that are generally small, spring/seepage-fed, open-canopy, herbaceous sedge meadows and fens bordered by more thickly vegetated and wooded areas. Individuals use aquatic habitats for nesting, basking, and foraging activities, and use more densely vegetated or sparsely forested upland areas for hibernation.

Non-agricultural Uses

Bog turtles are known hibernate in roadside ditches and disperse through forests, agricultural lands, and developed areas, so we anticipate individuals may be exposed to carbaryl through

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

non-agricultural uses in rights of way, managed forests, and open space developed areas. However, we anticipate that exposure is unlikely to occur given the low level of usage that occurs in these use sites. Available usage data from the U.S. Forest Service and USDA APHIS indicate that no carbaryl has been used in federally managed forests or rangelands within the states containing the bog turtle's range since 2014, suggesting that individuals are not likely to be exposed to carbaryl through uses on managed forests or rangelands.

Similarly, available usage information indicates that carbaryl is used infrequently in rights of ways, with less than 500 pounds of carbaryl applied to roadways nationally annually. While this may result in a large treatment footprint if all rights of way usage were concentrated in one location or within one species' range, 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 bog turtle's range for rights of way use. Past carbaryl usage data indicate that up to 2.5% of open space developed use sites across the country have been treated annually with carbaryl in the past; we expect very little of this 2.5% will occur in the species' range, indicating a low likelihood of exposure to carbaryl for this particular use. Given these low levels of usage, we do not anticipate non-agricultural uses of carbaryl will expose more than a small number of individuals over the duration of the proposed action.

Exposure Summary

While we do not anticipate the bog turtle will experience significant exposure to carbaryl from non-agricultural uses and are not likely to occur on agricultural use sites for significant periods of time, there is still a high extent of overlap between the species' range and the action area (36% overlap with agricultural use areas and those exposed to spray drift and runoff). There is a moderate level of past agricultural usage within the range (up to 9.1% range treated annually), so we expect a large number of individuals are likely to be exposed over the duration of the proposed action. As such, the bog turtle has a high exposure ranking.

Overall Exposure Ranking: High

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the bog turtle and subsequent risk of direct effects and indirect effects to prey items.

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the bog turtle is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). While the bog turtle can consume a variety of food items, we expect individuals primarily consume invertebrates and plant material. EPA's exposure modeling indicates maximum dietary exposure to individuals that consume invertebrate prey on agricultural and non-agricultural use sites (i.e., use sites recently treated with carbaryl) can accumulate up to 3.5-11.6 mg/kg-bw and individuals that consume plant matter on-field will accumulate up to 4.7-15.8 mg/kg-bw. We do not anticipate this level of exposure will cause mortality or sublethal adverse effects to growth or reproduction. We do not expect any direct adverse effects are likely to occur in individuals exposed to carbaryl up to 30 meters off-field as dietary doses are predicted to be well below levels where any adverse effects were observed in toxicity studies.

Indirect Effects:

Bog turtles are opportunistic omnivores and primarily consume insect prey and plant matter. Based on available toxicity data in insect species, we anticipate there will be a high level of arthropod mortality where exposure occurs. However, we expect the level of mortality will vary across insect species as a result of natural variability in physiology, exposure, and other factors. Furthermore, plant food resources are not likely to experience any mortality or sublethal adverse effects from carbaryl exposure, indicating that bog turtles can use alternative food resources when sensitive insect prey species die from carbaryl exposure. As such, we anticipate only moderate levels of indirect adverse effects are likely to occur.

Toxicity Summary

We do not anticipate bog turtles will accumulate more than low levels of carbaryl through dietary exposure and are not likely to experience any direct adverse effects to survival, growth, or reproduction from carbaryl exposure. While we anticipate a high level of impact to insect prey species on- and off-field, we anticipate there will still be sufficient food resources available for the bog turtle because the species is an opportunistic omnivore, and not all insect prey species will die. We expect these effects to occur primarily when dispersing through agricultural or other carbaryl use sites. Also, individuals rely on plant food resources and some insect species that are less sensitive to carbaryl. As such, the bog turtle has a low toxicity ranking.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The bog turtle has a high exposure ranking. While individuals are not likely to spend significant time on agricultural use sites and are not likely to be exposed through non-agricultural uses, there is a high extent of overlap between the species' range and agricultural use sites. There is a moderate level of past agricultural carbaryl usage within the range, and we anticipate a high portion of the range and a large number of individuals will be exposed over the duration of the proposed action. However, we do not anticipate more than small numbers of exposed individuals will die as individuals are not likely to be exposed to more than low levels of carbaryl. We anticipate moderate levels of indirect adverse effects from the loss of invertebrate prey when bog turtles are dispersing on or near carbaryl use sites. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The bog turtle has high vulnerability because of its declining trends and specific habitat requirements. It is listed as threatened and occurs in 508 populations (330 metapopulations) across seven states. They occur in various wetlands and require muddy ground, cool and flowing water, vegetation to burrow under and hibernate, and invertebrates (e.g., slugs, earthworms, spiders, beetles, millipedes, flies, snails, ants, moths, dragonflies, caddisflies, other insects) and plants to eat. Many historical populations are now extirpated, and habitat has been greatly reduced across the range. Bog turtles continue to face threats from habitat loss, altered hydrology, changes to vegetation, collection, predation, and contaminants.

Bog turtles occasionally use agricultural lands for hibernating (i.e., ditches) and dispersing, but we expect them to primarily use non-agricultural lands. There is large overlap (36%) between the species' range and agricultural carbaryl use sites, and past usage data indicates that a moderate portion of the range (9.1%) will be exposed through agricultural carbaryl treatments annually. After considering low carbaryl usage in non-agricultural areas, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. Bog turtles occur on mosaic landscapes made up of wetlands, agricultural lands, and development due to past land use changes and fragmentation. They are known to disperse through agricultural lands between their preferred habitats. However, we expect bog turtles to occur on agricultural fields infrequently and that they primarily feed and occur in their preferred habitat (i.e., wetlands) and in off-field areas. The primary route of exposure for bog turtles is through consuming contaminated prey, and even foraging exclusively in off-field areas subject to spray drift will not result in mortality or sublethal effects. We expect moderate effects from loss of prey in areas where bog turtles may disperse through or adjacent to carbaryl use sites but anticipate that only some insect prey items will decrease in abundance with carbaryl exposure, plant forage will not be affected, and bog turtles and their prey will primarily occur in areas not exposed to carbaryl (i.e., their preferred wetlands).

Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. Therefore, we expect impacts to the bog turtle to be low and no more than a small number of exposed individuals will die or be adversely affected through loss of insect prey. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the bog turtle.

References

U.S. Fish and Wildlife Service. 2022. Bog Turtle (*Glyptemys muhlenbergii*) 5-Year Review: Summary and Evaluation. Cortland, New York. 39 pp.

U.S. Fish and Wildlife Service. 2001. Bog Turtle (*Clemmys muhlenbergii*) Northern Population Recovery Plan. Hadley, Massachusetts. 109 pp.

Integration and Synthesis Summary: Northwestern pond turtle

Scientific Name:	Common Name:	Entity ID:
Actinemys marmorata	Northwestern pond turtle	1686

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range and high past usage of carbaryl within the species' range, indicating a high extent of exposure. No more than small numbers of exposed individuals are likely to die or experience sublethal adverse effects. We expect low adverse effects from loss of insect prey. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the northwestern pond turtle. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 4/8/2024; Wherever found; *States within the range:* CA, NV, OR, WA

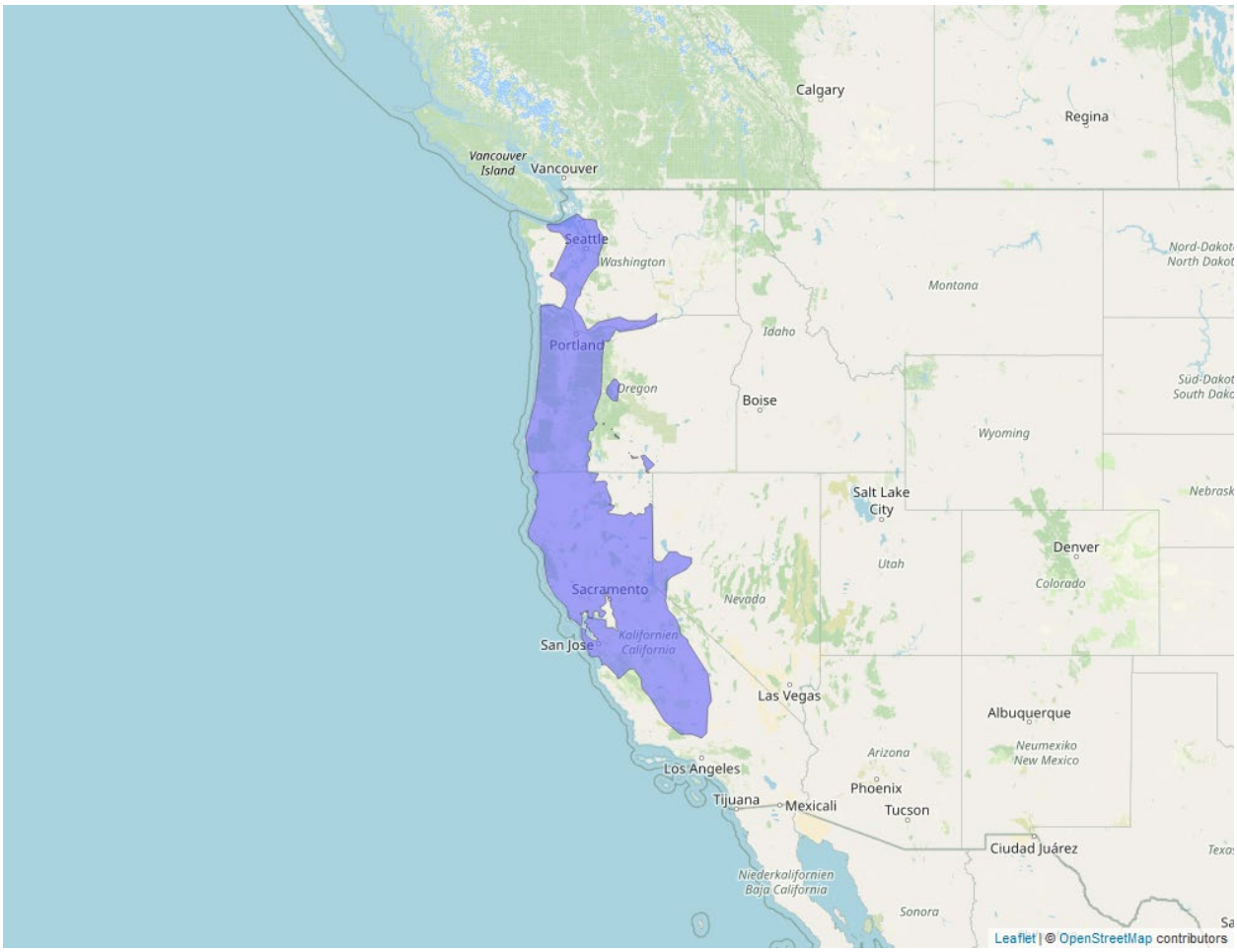

Figure 6. Range map of northwestern pond turtle (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/1111.

Vulnerability

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

Summary of status

Listing status: Proposed Threatened

Most recent 5 Year Status Review recommendation: N/A

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

Distribution: Species/Populations neither constrained nor widespread

Number of populations: Multiple populations (few)

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

The current range of the northwestern pond turtle includes populations from the San Joaquin Valley north through California, the Coastal and Cascade Ranges of Oregon and Washington State, and an outlying population in Nevada. Some populations are conservation reliant (i.e., require headstarting). Historically, they occurred from British Columbia, Canada to Baja California, Mexico, primarily west of the Sierra Nevada and Cascade mountains. They are believed to be extirpated from British Columbia. Western pond turtles are semi-aquatic, with terrestrial and aquatic phases. Eggs are laid in upland terrestrial habitat, and hatchlings, juveniles, and adults use both terrestrial and aquatic habitat. They have been found from brackish estuarine waters from sea level to 2,048 m and in various habitats, permanent and ephemeral aquatic water bodies from remote to urban landscapes, including flowing rivers and streams, lakes, ponds, reservoirs, settling ponds, marshes, vernal pools irrigation ditches, and other wetlands, including some estuaries with tidal influence. Western pond turtles are omnivorous generalists; prey is typically found in water but can be captured or scavenged on land and brought back to water to consume (they appear incapable of swallowing in air). Diets consist of small aquatic invertebrates, fish, tadpoles, frogs, carrion, and some plant material. Western pond turtles migrate between upland and aquatic environments (typically <500 m), and some dispersal between populations has been documented (less than 10% over a 10-year study). Based on conservation efforts, management actions, and genetics, there are 14 analysis units for the northwestern pond turtle across its range (USFWS 2023).

Primary threats are habitat loss and fragmentation, altered hydrology, predation, nonnative species competition, disease, road impacts, collection, contaminants, and climate change. For both northwestern and southwestern pond turtles, predation (by bullfrogs and largemouth bass), drought, and land alteration were top threats. For northwestern pond turtles, pathogens and harvesting were also ranked high in the threat assessment. Pesticides, including mercury, organochlorines, and per- and polyfluoroalkyl substances (PFAS) were mentioned, but definitive links to pond turtle survival or reproduction are not known (USFWS 2023).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 16.5% of the species' range overlaps with agricultural use sites and 9.3% of the species' range overlaps with areas adjacent to use sites that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 25.8% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 11. Overlap and usage (% range treated annually) data for the northwestern pond turtle.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	1.3	1.1	2.3	0.1	0.1	0.3
Citrus	0.4	0.3	0.7	<0.1	<0.1	<0.1
Corn[12]	1.4	1	2.4	0.1	<0.1	0.2
Grapes	1.4	0.5	1.9	0.1	<0.1	0.2
Other Crops	4.8	2.3	7.1	4.8	2.3	7.1
Other Grains	1.5	1.3	2.8	<0.1	<0.1	<0.1
Other Orchards[13]	5.7	2.4	8	1.5	0.6	2.1
Other Row Crops	0.3	0.2	0.6	<0.1	<0.1	<0.1
Soybeans	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vegetables and Ground Fruit	1.5	1	2.6	0.6	0.4	1
Total	**16.5**	**9.3**	**25.8**	**7.1**	**3.6**	**10.7**

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

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

Usage

Past usage data indicate that up to 10.7% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

The northwestern pond turtle is a semi-aquatic species and is a habitat generalist that can occupy and use habitats ranging from remote to urban landscapes, including flowing rivers and streams, lakes, ponds, reservoirs, settling ponds, marshes, vernal pools irrigation ditches, and other wetlands, including estuaries with tidal influence. Connected upland habitat for overwinter, aestivation, and nesting is also a critical feature of the species' habitat. Upland nesting habitat typically consists of sparse vegetation with short grasses, forbs, and little canopy cover. While we anticipate individuals are not likely to occur on agricultural use sites, the species uses a variety of habitat types, and we cannot rule out their use of agricultural areas.

Non-agricultural Uses

Given that the northwestern pond turtle can occur in a wide range of aquatic and terrestrial habitats, we anticipate individuals may occur in non-agricultural use sites, including managed forests, rangelands, rights of ways, and open space developed areas. While it is possible individuals in these areas may be exposed to carbaryl, we anticipate that exposure is unlikely to occur given the low level of usage that occurs in these use sites.

Past usage data from the U.S. Forest Service indicate that only small areas of managed forests within the northwestern pond turtle's range have been treated with carbaryl between 2016-2020. The Forest Service estimates 322 acres of managed forests have been treated with carbaryl over a five-year period within U.S. Forest Service Region 5 (southern California), where part of the northwestern pond turtle's range occurs. Given the expansive range of this species, even if we assume all treated managed forests occurred within the turtle's range (which we do not expect is likely), we anticipate this usage only covers a small portion of the range and will be scattered throughout the landscape as small treatment areas. Given this low level of treatment and sporadic treatment locations, we anticipate there is a low likelihood of individuals being exposed to carbaryl through this specific use. Similarly, available usage data from USDA APHIS indicate that, between 2019 and 2023, rangeland areas in only in a single county in Washington state have been treated with carbaryl, in the form of carbaryl bait. In addition, mitigations from the USDA-APHIS grasshopper and Mormon cricket consultation for the northwestern pond turtle require a 2,500-foot buffer for all ultra-low volume applications of carbaryl and a 300-foot buffer for all ground applications of carbaryl. For carbaryl bait aerial applications all reptiles are protected by a 750-foot buffer and a 100-foot ground buffer.

Similarly, available usage information indicates that carbaryl is used infrequently in rights of ways, with less than 500 pounds of carbaryl applied to roadways nationally annually. While this may result in a large treatment footprint if all rights of way usage were concentrated in one

location or within one species' range, 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 northwestern pond turtle's range for rights of way use. Past carbaryl usage data indicate that up to 2.5% of open space developed use sites across the country have been treated annually with carbaryl in the past; we expect very little of this 2.5% will occur in the species' range, indicating a low likelihood of exposure to carbaryl for this particular use.

In summary, given these low levels of usage and existing conservation measures for some non-agricultural uses, we do not anticipate non-agricultural uses of carbaryl will expose more than a small number of individuals over the duration of the proposed action.

Exposure Summary

While we do not anticipate non-agricultural uses will expose more than a small number of individuals, there is still a high level of overlap between the species' range and agricultural use sites and their off-site transport areas (25.8% total overlap). There is also a high level of past agricultural carbaryl usage within the species' range (10.7% annually). As such, we anticipate a large portion of the species' range, and a large number of individuals are likely to be exposed over the duration of the proposed action. The northwestern pond turtle has a high exposure ranking.

Overall Exposure Ranking: High

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the northwestern pond turtle.

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the northwestern pond turtle is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). While the northwestern pond turtle consumes a variety of prey items, we expect individuals primarily consume invertebrate prey (both terrestrial and aquatic) and plant matter. EPA's exposure modeling indicates maximum dietary exposure to individuals that consume arthropod prey and plant matter on agricultural and non-agricultural use sites recently applied with carbaryl (or consume prey that have fed on use sites recently treated with carbaryl) can accumulate up to 8.1 mg/kg-bw. We do not anticipate this level of exposure will cause any mortality or sublethal adverse effects to growth and reproduction. We do not expect any direct adverse effects are likely to occur in individuals exposed to carbaryl up to 30 meters off-field either as dietary doses are predicted to be well below levels where any adverse effects were observed in toxicity studies.

Indirect Effects:

Northwestern pond turtles are opportunistic omnivores and primarily consume insect prey and plant matter. Based on available toxicity data in insect species, we anticipate there will be a high level of arthropod mortality where exposure occurs. However, we expect the level of mortality will vary across species as a result of natural variability in physiology, exposure, and other factors. We do not expect the entire insect community is likely to experience mortality and that individual turtles will have sufficient food resources available, particularly in areas away from carbaryl use sites where we expect turtles and their prey to be more likely to occur. Furthermore, plant food resources are not likely to experience any mortality or sublethal adverse effects from carbaryl exposure, indicating that northwestern pond turtles can use alternative food resources when sensitive insect prey species die from carbaryl exposure. As such, we anticipate only low levels of indirect adverse effects are likely to occur.

Toxicity Summary

We do not anticipate individual northwestern pond turtles will accumulate more than low levels of carbaryl through dietary exposure and will not experience any direct adverse effects to survival, growth, or reproduction. While we anticipate some loss of invertebrate prey is likely, we expect that individuals will still have sufficient food resources available in the form of plant material and insect species that are less sensitive to carbaryl exposure. The northwestern pond turtle has a low toxicity ranking.

Overall Toxicity Summary: Low

Effects of the Action Summary

The northwestern pond turtle has a high exposure ranking. We do not anticipate non-agricultural uses will expose more than a small number of individuals, but there is a high level of overlap between the species' range and agricultural use sites and a high level of past agricultural usage within the range, indicating that a large number of individuals are likely to be exposed. We expect exposed individuals will experience no direct adverse effects, no sublethal effects, and only low levels of indirect adverse effects from loss of insect prey. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The semi-aquatic northwestern pond turtle is a species proposed for threatened status found from the San Joaquin Valley in California north through coastal and Cascade Oregon and Washington, and one population in Nevada. They feed on small aquatic invertebrates, fish, tadpoles, frogs, carrion, and some plant materials and appear limited to aquatic feeding behaviors. They migrate between upland and aquatic environments typically within 500 m. Threats to the species include habitat loss and fragmentation, altered hydrology, predation, competition with non-native species, disease, road impacts, collection, contaminants (including pesticides), and effects of climate change.

Even though northwestern pond turtles are habitat generalists, we do not expect them to frequent agricultural areas. However, we cannot rule out their presence on agricultural carbaryl use sites. There is large overlap (25.8%) between the species' range and agricultural carbaryl use sites, and past usage data indicates that a large portion of the range (10.7%) will be exposed to agricultural carbaryl treatments annually. After considering low carbaryl usage on non-agricultural areas, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. We do not expect northwestern pond turtles to die or experience sublethal effects from dietary exposure after consuming contaminated prey in on-field or off-field areas. We expect no more than low indirect effects from loss of prey because they are opportunistic omnivores, only some insect prey items will decrease in abundance with carbaryl exposure, plant forage will not be affected, and we expect both the species and its insect prey to primarily occur in areas not exposed to carbaryl (i.e., wetlands, ponds, lakes, rivers, etc).

Therefore, we expect impacts to the northwestern pond turtle to be low and no more than a small number of exposed individuals will die or be adversely affected due to loss in insect prey. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably

reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the northwestern pond turtle.

References

U.S. Fish and Wildlife Service. 2023. Species Status Assessment Report for Northwestern Pond Turtle (*Actinemys marmorata*) and Southwestern Pond Turtle (*Actinemys pallida*). Version 1.1. Ventura, California. 183 pp.

Integration and Synthesis Summary: Alligator snapping turtle

Scientific Name:	Common Name:	Entity ID:
Macrochelys temminckii	Alligator snapping turtle	4936

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is medium. In our evaluation of the effects of the proposed action to the species, we determine there is moderate overlap of the action area with the species' range and low past usage of carbaryl within the species' range, indicating a medium extent of exposure. No more than a small number of exposed individuals are likely to die or experience sublethal adverse effects. We expect low levels of indirect effects from loss of secondary prey and no indirect effects from loss of its primary prey, fish. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the alligator snapping turtle. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 12/16/2022; Wherever found; *States within the range:* AL, AR, FL, GA, IL, KS, KY, LA, MO, MS, OK, TN, TX

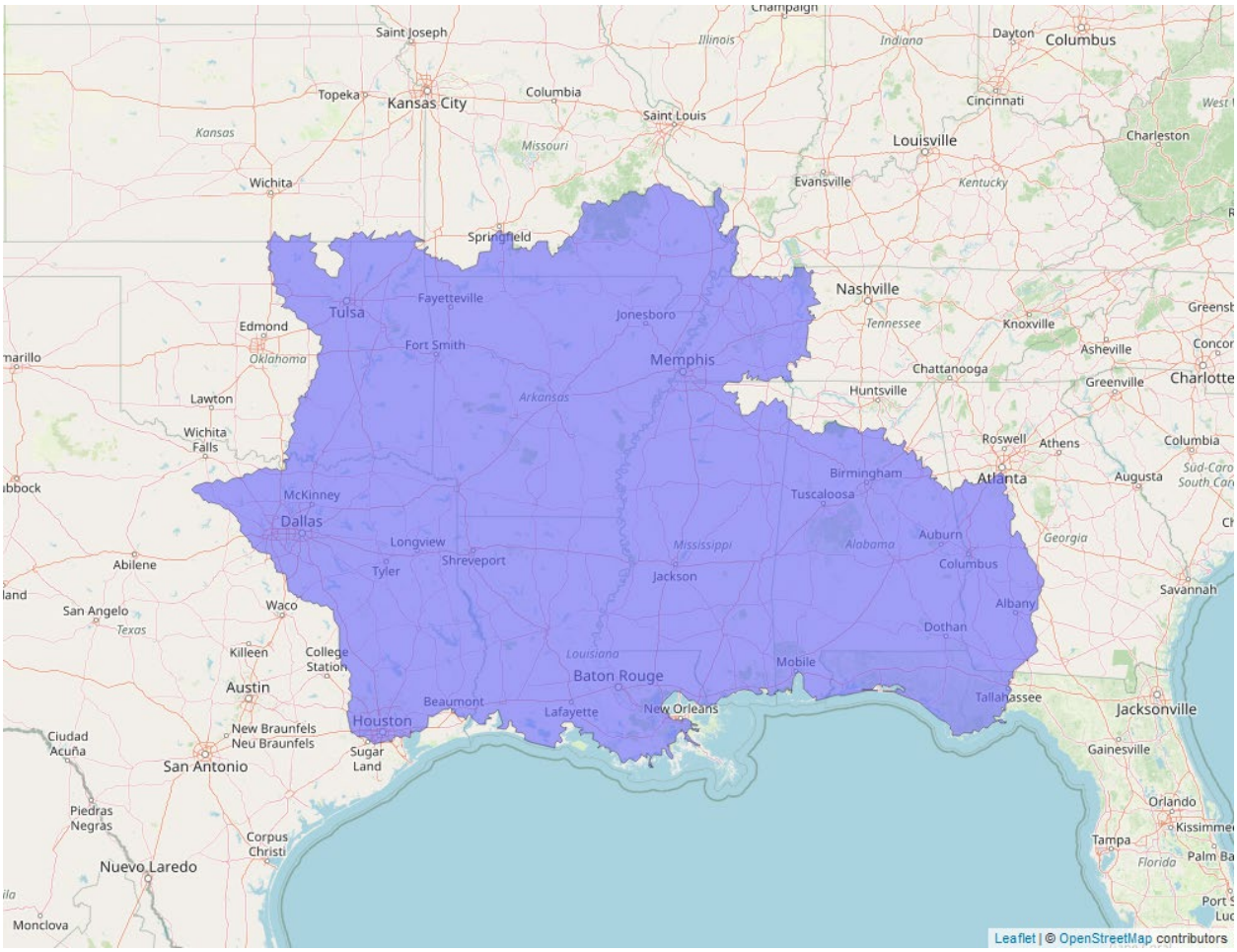

Figure 7. Range map of alligator snapping turtle (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/4658.

Vulnerability

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

Summary of status

Listing status: Proposed Threatened

Most recent 5 Year Status Review recommendation: N/A

Most recently completed 5 Year Status Review: N/A

Distribution: Species/Populations widespread or wide-ranging

Number of populations: Multiple populations (few)

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

The alligator snapping turtle is the largest freshwater turtle in North American and is among the most aquatic. Overland movements are generally restricted to nesting females and juveniles moving from then nest to water; nesting occurs in low forested areas or areas with leaf litter and root mats. It is found in eastern Texas, Oklahoma, Kansas, Missouri, Illinois, Kentucky, Tennessee, Louisiana, Alabama, Mississippi, Georgia, and the Florida panhandle. While the distribution of the species still encompasses much of its historical range, resilience within that range has decreased, largely from historical harvest pressures. They are associated with deeper water (i.e., usually large rivers, major tributaries, bayous, canals, swamps, lakes, ponds, and oxbows), with shallower water occupied in early summer and deeper depths in late summer and mid-winter. Alligator snapping turtles are also associated with structure (e.g., tree root masses, stumps, submerged trees, etc.), and may occupy areas with a high percentage of canopy cover or undercut stream banks. In Florida, optimum habitat is swamp forests comprised of bald cypress and tupelos associated with flooded channels. In Louisiana, they used open water, bald cypress bordered channels, buttonbush with bald cypress and aquatics, or floating marshes with bald cypress or buttonbush. In other areas of their range, alligator snapping turtles have been observed using small streams with mud and gravel bottoms, areas with high canopy cover, near-shore areas of a shallow lake with gravel or rocky bottoms and underwater cover, and overhead canopy and submerged cover. Some individuals have been seen with barnacles, suggesting they may be able to spend prolonged periods in brackish water. Alligator snapping turtles are opportunistic predators and foragers and consume a variety of foods. Fish comprise a significant portion of the alligator snapping turtle’s diet; however, crayfish, mollusks, smaller turtles, insects, nutria, snakes, birds, and vegetation (including acorns) have also been reported. They are the only turtle species with a predatory lure (i.e., a small worm-like appendage on the tongue). There are seven analysis units with higher abundances estimated in southern analysis units (high estimate in the Alabama Unit of 200,000; low estimate in the Northern Mississippi - East Unit of 212.5). Range-wide abundance estimates are between 68,154-1,436,825 turtles (USFWS 2021).

Threats include legal and illegal harvest (including for export), bycatch associated with commercial fishing of catfish and buffalo fish, habitat alteration, and nest predation. Climate change and disease might negatively influence the species, but the impacts of these drivers on the species are more speculative due to a lack of information. Conversely, conservation measures that have been implemented for the alligator snapping turtle include head-starting and reintroductions, as well as various efforts to restore and improve habitat.

Overall Vulnerability: Medium

Effects of the Action: Exposure

Overlap

Data indicate that 15.1% of the species' range overlaps with agricultural use sites and 6.9% of the species' range overlaps with areas adjacent to use sites that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 22% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 12. Overlap and usage (% range treated annually) data for the alligator snapping turtle.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Citrus	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Corn	4.9	2.3	7.3	0.4	0.2	0.6
Grapes	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other Crops	3.3	2.4	5.8	1.2	1.1	2.4
Other Grains	0.9	0.7	1.7	0.1	0.2	0.3
Other Orchards[14]	0.3	0.4	0.8	<0.1	<0.1	0.2
Other Row Crops	1.1	0.6	1.7	<0.1	<0.1	0.1
Soybeans[15]	9.3	2.6	11.8	1.1	0.4	1.5
Vegetables and Ground Fruit	0.1	<0.1	0.2	<0.1	<0.1	0.1

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

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

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Total	**15.1**	**6.9**	**22**	**2.7**	**1.9**	**4.6**

Usage

Past usage data indicate that up to 4.6% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

Alligator snapping turtles are generally found in deeper water of large rivers and their major tributaries; however, they are also found in a wide variety of habitats, including small streams, bayous, canals, swamps, lakes, reservoirs, ponds, and oxbows. While the species is largely aquatic, individuals can occur in nearby terrestrial areas (up to 200 meters from water) to nest (adults) and travel to the water from the nest (juveniles) (USFWS 2021). Given their specific habitat preferences, we do not anticipate individuals are likely to occur on agricultural use sites because they do not represent suitable habitat for the species. As such, while there is overlap between the species' range and agricultural use sites, we do not anticipate any individuals are likely to be exposed directly on agricultural use sites. To account for this difference in exposure potential, we only consider off-site exposure in our assessment, indicating that total overlap with agricultural areas is 6.9% and up to 1.9% of the range is likely to be treated annually.

Non-agricultural Uses

The alligator snapping turtle occupies a specific habitat that is not likely to coincide with non-agricultural carbaryl use sites, including developed, open space developed, nurseries, managed forests, or rights of way. We also expect these non-agricultural uses to have a low potential for off-site transport due to application methods that limit drift and runoff, low usage, and required buffers from aquatic habitats. In addition, mitigations from the USDA-APHIS grasshopper and Mormon cricket consultation for the alligator snapping turtle require a 2,500-foot buffer for all ultra-low volume applications of carbaryl and a 300-foot buffer for all ground applications of carbaryl. For carbaryl bait aerial applications all reptiles are protected by a 750-foot buffer and a 100-foot ground buffer. As such, we do not anticipate more than small numbers of individuals are likely to be exposed to non-agricultural uses of carbaryl over the duration of the proposed action.

Exposure Summary

While we do not anticipate non-agricultural uses of carbaryl will significantly contribute to the overall exposure of the species and we do not anticipate individuals will occur on agricultural use sites, there is a moderate level of overlap between the species' range and off-field areas

where exposure to carbaryl through spray drift and runoff is likely to occur (6.9% total off-field overlap). While there is a low level of past agricultural carbaryl usage within the species' range (up to 1.9% range treated annually), we anticipate a medium portion of the species' range, and a moderate number of individuals, are likely to be exposed over the duration of the proposed action. The alligator snapping turtle has a medium exposure ranking.

Overall Exposure Ranking: Medium

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the alligator snapping turtle and subsequent risk of direct effects and indirect effects to prey items.

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the alligator snapping turtle is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). We expect individuals primarily consume fish but may also eat crustaceans, mollusks, smaller turtles, insects, snakes, birds, and vegetation. As stated in the above section, we do not anticipate individuals are likely to occur on or forage in agricultural use sites and expect all exposure to occur in off-field areas. Given that carbaryl is not likely to bioaccumulate in aquatic food items, we do not anticipate the alligator snapping turtle is likely to be exposed to more than low levels of carbaryl from dietary exposure and is not likely to experience any adverse effects to survival, growth, or reproduction.

Indirect Effects:

The alligator snapping turtle consumes a wide variety of food items spanning a diverse array of taxa, from fish, to invertebrates, to plant matter. While we expect some prey species are sensitive to carbaryl (such as aquatic invertebrates) and may decrease in availability in response to

exposure, we anticipate the alligator snapping turtle can rely on other food resources that are less sensitive to carbaryl, such as fish or plant matter. As such, we do not anticipate the species will experience more than low levels of indirect adverse effects.

Toxicity Summary

Given that the alligator snapping turtle is an aquatic species that primarily consumes aquatic prey species, which are not likely to bioaccumulate carbaryl, in areas away from carbaryl use sites, we anticipate individuals are not likely to experience more than low levels of dietary exposure, which will not result in any direct adverse effects. While there may be some decreases in the abundance of prey species sensitive to carbaryl, we anticipate the alligator snapping turtle will have sufficient alternative food resources available as the species is an opportunistic forager that consumes a wide range of dietary items.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The alligator snapping turtle has a medium exposure ranking. While we do not anticipate non-agricultural uses will expose more than a small number of individuals, we do not anticipate individuals will be exposed on agricultural use sites, and there is a medium level of overlap between the species' range and agricultural carbaryl use sites. As such, we anticipate a moderate number of individuals will be exposed.

The alligator snapping turtle has a low toxicity ranking. We do not anticipate individuals will accumulate more than low levels of carbaryl from dietary exposure and are not likely to experience any direct adverse effects. Similarly, we anticipate only minor indirect adverse effects from the loss of some of its dietary items.

While a moderate number of individuals will be exposed, we expect no more than a small number of exposed individuals will die or experience more than low levels of indirect adverse effects. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The alligator snapping turtle is a freshwater turtle proposed for threatened status found in the southcentral and southeastern U.S. They are associated with large rivers, major tributaries, bayous, canals, swamps, lakes, pools, and oxbows where vegetative structures like roots or submerged trees are present. Their land movements are limited to nesting females and dispersing juveniles. They are opportunistic predators that primarily eat fish, but also eat crayfish, mollusks, smaller turtles, insects, nutria, snakes, birds, acorns, and other plant material. We believe there are about 68,000-1,436,000 individuals remaining across the range. Threats to the species

include legal and illegal harvest, bycatch associated with fishing operations, habitat alteration, nest predation, and possibly effects of climate change.

Individuals are unlikely to traverse or occur on agricultural fields because they only occur on land to nest up to 200 m from waterbodies. Therefore, we focused our analyses on off-field exposure. There is moderate overlap (6.9%) between the species' range and areas subject to runoff and spray drift from nearby agricultural carbaryl use sites, and past usage data indicates that a small portion of the range (up to 1.9%) will be exposed through spray drift from agricultural carbaryl treatments annually. Because we do not expect the species to occur on non-agricultural use sites and we do not expect significant off-site transport from these uses, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. The primary route of exposure for alligator snapping turtles is through dietary exposure off-field, and we do not expect direct mortality or sublethal effects to occur. Some secondary prey species may die from carbaryl exposure (e.g., crayfish), but the species' primary prey is fish and fish are not expected to die from carbaryl exposure. Therefore, we do not anticipate more than low levels of indirect adverse effects from prey loss.

Therefore, we expect impacts to the alligator snapping turtle will be low. Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. The proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the alligator snapping turtle.

References

U.S. Fish and Wildlife Service. 2021. Species Status Assessment Report for the Alligator Snapping Turtle (*Macrochelys temminckii*). Version 1.2. Atlanta, Georgia. 218 pp.

Integration and Synthesis Summary: Eastern massasauga (=rattlesnake)

Scientific Name:	Common Name:	Entity ID:
Sistrurus catenatus	Eastern massasauga (=rattlesnake)	7800

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is medium. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range and moderate past usage of carbaryl within the species' range, indicating a large extent of exposure. We expect no more than a small number of exposed individuals will die or and that the species will experience only low levels of indirect adverse effects from loss of mammal prey. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the eastern massasauga rattlesnake. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 4/18/2022; Wherever found; *States within the range:* IA, IL, IN, MI, MN, NY, OH, PA, WI

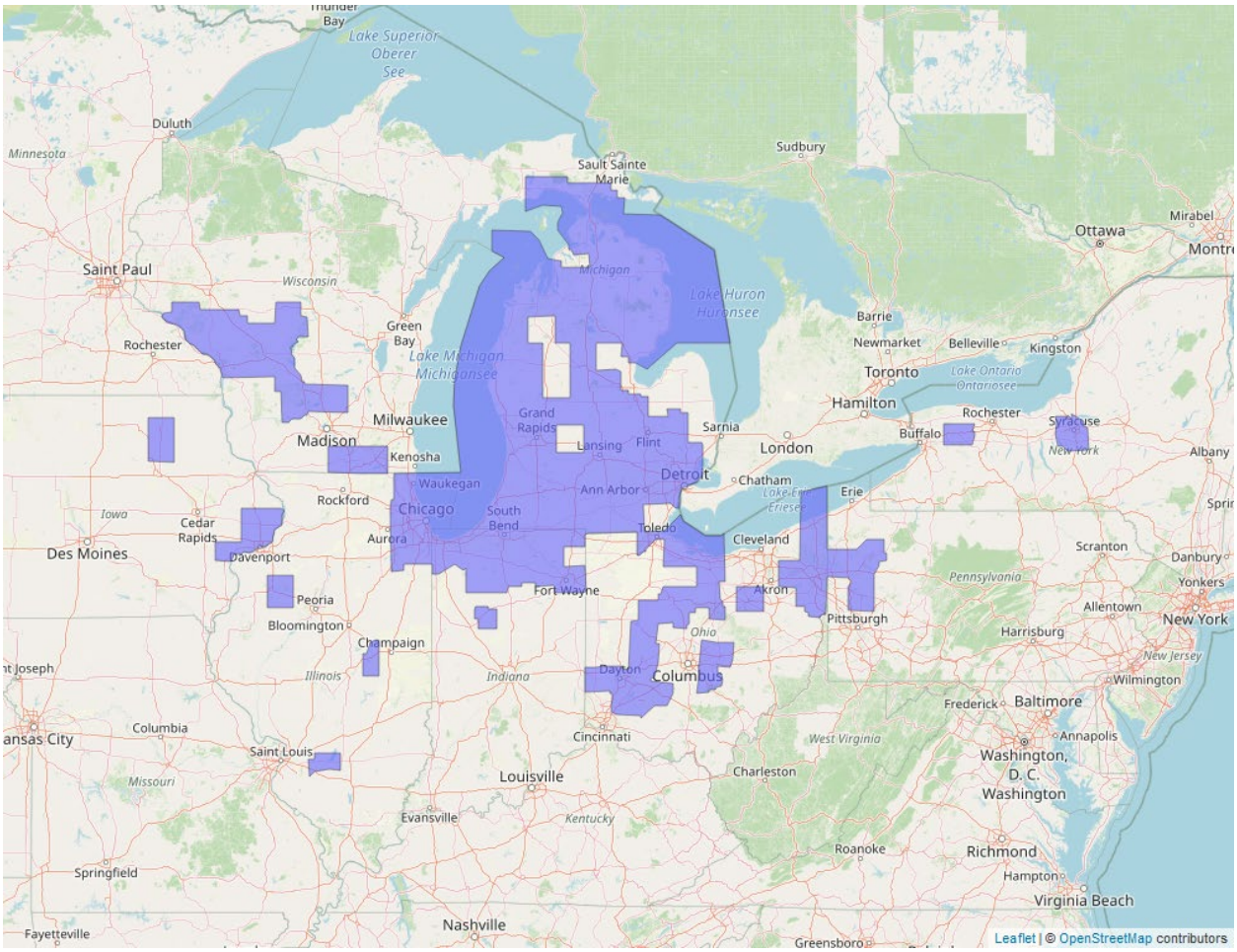

Figure 8. Range map of eastern massasauga (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/2202.

Vulnerability

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

Summary of status

Listing status: Threatened

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

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

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

Number of populations: Multiple populations (numerous)

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

The documented historical range of the eastern massasauga rattlesnake included sections of western New York, western Pennsylvania, southeastern Ontario, the upper and lower peninsulas of Michigan, the northern two thirds of Ohio and Indiana, the northern three quarters of Illinois, the southern half of Wisconsin, extreme southeast Minnesota, east central Missouri, and the eastern third of Iowa. The limits of the current range of the eastern massasauga rattlesnake resemble the boundaries of its historical range. However, the geographic distribution of extant localities has been restricted by the loss of the populations from much of the area within the boundaries of that range. Range-wide, there are 558 known historical eastern massasauga rattlesnake populations, of which 263 are known to still be extant, 211 are likely extirpated or known extirpated, and 84 are of unknown status. According to the 2021 5-year review, the eastern massasauga rattlesnake is still extant in the states of Indiana, Illinois, Iowa, Michigan, New York, Ohio, Pennsylvania, and Wisconsin. One new population was discovered in Indiana, nine new element occurrences were discovered in Michigan, two populations in Wisconsin that were presumed extirpated were found to be extant, and one population considered extant in 2016 is now considered extirpated due to lack of suitable habitat. Eastern massasaugas are considered extirpated from Missouri and Minnesota. They use high, dry habitats, open canopy wetlands, and nearby upland areas during the active season (i.e., spring, summer, fall). They are found in old fields, bogs and fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, sedge meadows, peatlands, forest edge, scrub shrub forest, floodplain forest, and coniferous forests. They use crayfish burrows, rock crevices, rodent holes, hummocks, old stumps, rotten logs, and root systems as hibernacula in the winter. They primarily eat small mammals and other snakes (USFWS 2016).

The most prominent stressors affecting the eastern massasauga rattlesnake include habitat loss and fragmentation, especially through development and vegetative succession; hydrologic alteration (hydrologic drawdown) resulting in drought or artificial flooding; persecution; collection; and mortality of individuals because of habitat management that includes post-emergent (after hibernation) prescribed fire and mowing for habitat management. The emergence of Snake Fungal Disease has proven fatal for the eastern massasauga (USFWS 2016). The largest sources of direct mortality for eastern massasaugas are vehicle mortality and predation by birds of prey, coyotes, feral cats, and other snakes (USFWS 2021). The species faces a moderate degree of threat, meaning there are many threats acting upon the species that are anticipated to continue in the future. They are well understood and can be managed. They also have high

recovery potential, if habitat conservation and expansion is used to reduce impacts of habitat loss.

Overall Vulnerability: Medium

Effects of the Action: Exposure

Overlap

Data indicate that 45.1% of the species' range overlaps with agricultural use sites and 24.5% of the species' range overlaps with areas adjacent to use sites that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 69.5% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 13. Overlap and usage (% range treated annually) data for the eastern massasauga.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	5.9	6.0	11.9	0.8	0.8	1.7
Citrus	0	0	0	0	0	0
Corn[16]	30.2	8.4	38.6	4.6	1	5.6
Grapes	0.1	0.2	0.3	<0.1	<0.1	<0.1
Other Crops	5.1	5.2	10.3	4.8	4.9	9.7
Other Grains	1.4	2.3	3.7	<0.1	<0.1	<0.1
Other Orchards	0.6	0.8	1.4	0.2	0.3	0.5
Other Row Crops	0.4	0.2	0.6	<0.1	<0.1	<0.1
Soybeans	28.7	8.0	36.7	5.2	1.1	6.3
Vegetables and Ground Fruit	1.6	1.5	3.1	0.7	0.6	1.4
Total	**45.1**	**24.5**	**69.5**	**11.9**	**7.8**	**19.7**

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

Usage

Past usage data indicate that up to 19.7% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

We do not anticipate the eastern massasauga is likely to occur on agricultural use sites. Foraging habitat for eastern massasauga rattlesnakes usually has an open canopy, sedge or grass groundcover, and areas like floodplains, riparian, lowland, and upland forests. In addition, they are known to be dispersal limited (neonatal or adult; USFWS 2016). As such, while there is overlap between the species' range and agricultural use sites, we do not anticipate any individuals are likely to be exposed directly on agricultural use sites. To account for this difference in exposure potential, we only consider off-site exposure in our assessment, indicating that total overlap with agricultural areas is 24.5% and up to 7.8% of the range is likely to be treated annually.

Non-agricultural Uses

In addition to agricultural uses, listed species may be exposed to carbaryl through non-agricultural uses of carbaryl, specifically uses in managed forests as the eastern massasauga can be found in a variety of forested habitats (such as forest edges, scrub shrub forests, floodplain forests, and conifer forests). However, we do not expect more than a small number of individuals will be exposed or experience adverse effects from this non-agricultural use. Past usage data from the U.S. Forest Service indicate that no carbaryl has been used on managed forests within the states where the eastern massasauga's range occurs (i.e., Iowa, Illinois, Indiana, Michigan, Minnesota, Wisconsin, New York, Ohio, and Pennsylvania). Where applications have taken place, the majority of treatments have involved small areas (<1 acre). As such, we anticipate a low likelihood of carbaryl usage in the range, and that if usage did occur, exposure to eastern massasauga would be minimal. We do not anticipate individuals are likely to occur in any other non-agricultural use sites as they do not represent suitable habitat for the species, and we do not expect off-site transport from these uses due to low usage, application methods that limit drift and runoff, and required buffers from aquatic habitats. As such, we do not expect non-agricultural uses will expose more than a small number of individuals over the duration of the proposed action.

Exposure Summary

We do not anticipate the eastern massasauga is likely to occur on agricultural use sites. There is a high extent of overlap between the species' range and areas adjacent to agricultural use sites (25.4% overlap with off-field areas) and a moderate level of past carbaryl usage within the species' range (up to 7.8% range treated annually). We do not anticipate non-agricultural uses of carbaryl will expose more than a small number of individuals as available usage data indicates that, between 2014-2020, no carbaryl has been used in managed forests in the nine states where

the range occurs, and the species is unlikely to occur in other non-agricultural use sites. While there is a moderate level of past agricultural usage, the high overlap with agricultural off-field areas indicates that a large portion of the range, and a large number of individuals, are likely to be exposed over the duration of the proposed action, particularly if the areas treated with carbaryl change each year. As such, the species has a high exposure ranking.

Overall Exposure Ranking: High

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the eastern massasauga rattlesnake and subsequent risk of direct effects and indirect effects to prey items.

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the eastern massasauga is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). While the eastern massasauga can consume a variety of prey items, we expect individuals primarily consume small mammal prey and may also eat other snakes. EPA's exposure modeling indicates that individuals that consume small mammals that have recently fed on contaminated food on carbaryl on both agricultural and non-agricultural use sites can accumulate up to 1.8-6.1 mg/kg-bw depending on the specific application rate. We do not anticipate this level of exposure will cause any mortality or sublethal adverse effects to growth and reproduction. We do not expect any direct adverse effects are likely to occur in individuals exposed to carbaryl up to 30 meters off-field as dietary doses are predicted to be well below levels where any adverse effects were observed in toxicity studies.

Indirect Effects:

We expect small mammal prey are likely to die when foraging in recently treated fields (regardless of the application rate used on-field). However, given that the eastern massasauga is not likely to forage on agricultural use sites, we do not anticipate this small mammal prey mortality will likely result in more than low levels of indirect adverse effects to the species.

Toxicity Summary

We do not anticipate the eastern massasauga is likely to experience any direct adverse effects from dietary exposure as individuals are not likely to accumulate more than low levels of carbaryl from consume small mammal and reptile prey. We do not anticipate any direct adverse effects to survival, growth, or reproduction are likely to occur at predicted exposures. Similarly, while small mammal prey that forage on use sites will likely die, given that we do not anticipate individuals are likely to forage on use sites, we do not anticipate this small mammal mortality will result in more than low levels of indirect adverse effects. As such, the species as a low toxicity ranking.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The eastern massasauga has a high exposure ranking. While there is a moderate level of past carbaryl usage within the species' range, the high extent of overlap suggests that a large portion of the species' range is likely to be treated over the duration of the proposed action, particularly if the areas treated change each year. Thus, we anticipate a large number of individuals are likely the be exposed over the duration of the proposed action. We anticipate non-agricultural uses of carbaryl will expose no more than a small number of individuals.

The eastern massasauga has a low toxicity ranking. We do not anticipate individuals are likely to be exposed to more than low levels of carbaryl through dietary exposure and are not likely to experience any direct adverse effects to survival, growth, or reproduction. While there will be some small mammal prey mortality on use sites, given that we do not anticipate individuals are likely to forage on use sites, we do not expect more than low levels of indirect adverse effects are likely to occur.

While there is a high extent of exposure, we anticipate no more than a small number of exposed individuals will die and that the species will experience no more than low levels of indirect adverse effects. As such, we expect the overall risk of adverse effects to the species is low.

Conclusion

The eastern massasauga rattlesnake has medium vulnerability because of its limited distribution, declining trends, and specific habitat requirements. It is listed as threatened and occurs across 263 extant populations (an additional 211 are likely or known to be extirpated) in Indiana, Illinois, Iowa, Michigan, New York, Ohio, Pennsylvania, and Wisconsin. They use high, dry habitats, open canopy wetlands, and nearby upland areas during the active season (i.e., spring, summer, fall). They are found in old fields, bogs and fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, sedge meadows, peatlands, forest edge, scrub shrub forest, floodplain forest, and coniferous forests. They use crayfish burrows, rock crevices, rodent holes, hummocks, old stumps, rotten logs, and root systems as hibernacula in the winter. Eastern massasauga rattlesnakes primarily eat small mammals and other snakes. They are threatened by habitat loss and fragmentation, road mortality, altered hydrology, collection, and some habitat management activities (i.e., prescribed burns and mowing).

Individuals are unlikely to traverse or occur on agricultural fields because they are dispersal limited and otherwise occur in sedge or grasslands and riparian or other forests. Therefore, we focused our analyses on off-field exposure. There is high overlap (25.4%) between the species' range and areas subject to runoff and spray drift from nearby agricultural carbaryl use sites, and past usage data indicates that a moderate portion of the range (up to 7.8%) will be exposed through spray drift from agricultural carbaryl treatments annually. Eastern massasaugas occur in managed forests but based on past forest carbaryl usage in the states where the species is found, we do not expect the species' to be exposed to carbaryl through forestry uses. Because we do not expect the species to occur on developed areas, rangelands, or rights of way, and we expect these uses to have a low potential for off-site transport, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. The primary route of exposure for eastern massasaugas is through dietary exposure off-field, and we do not expect direct mortality or sublethal effects to occur. The species' primary prey is small mammals, which will be killed if exposed on-field. However, because we do not expect the snake to hunt on-field, we expect no more than low levels of indirect adverse effects from prey loss.

The species occurs in many populations and its preferred habitat is not agricultural lands. Although though we expect a large number of eastern massasauga rattlesnakes will be exposed to carbaryl, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. We expect the overall risk to the species is low. We expect that the proposed action will not lead to species-level effects. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the eastern massasauga rattlesnake.

References

U.S. Fish and Wildlife Service. 2021. Eastern Massasauga Rattlesnake (*Sistruurs catenatus*) 5-Year Review: Summary and Evaluation. Chicago, Illinois. 13 pp.

U.S. Fish and Wildlife Service. 2016. Species Status Assessment for the Eastern Massasauga rattlesnake (*Sistruurs catenatus*). Version 2.

Integration and Synthesis Summary: Suwannee alligator snapping turtle

Scientific Name:	Common Name:	Entity ID:
Macrochelys suwanniensis	Suwannee alligator snapping turtle	11657

Species Overview

In reviewing the status of the species, the environmental baseline, and cumulative effects for the action area, the Service has determined that the species' vulnerability is high. In our evaluation of the effects of the proposed action to the species, we determine there is high overlap of the action area with the species' range and moderate past usage of carbaryl within the species' range, indicating a high extent of exposure. No more than a small number of exposed individuals are likely to die or experience sublethal adverse effects. We expect low levels of indirect effects from loss of secondary prey and no indirect effects from loss of its primary prey, fish. As such, we determine the risk of adverse effects to the species is low. Based on our analysis of the effects of the action, in combination with the status of the species, the environmental baseline, and cumulative effects for the action area, we have determined that the proposed action is not expected to affect the survival and recovery of the species in the wild. Thus, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Suwannee alligator snapping turtle. We discuss our rationale for this conclusion for the species in the sections below.

Species range

Based on range map dated: 2/4/2022; ; *States within the range:* FL, GA

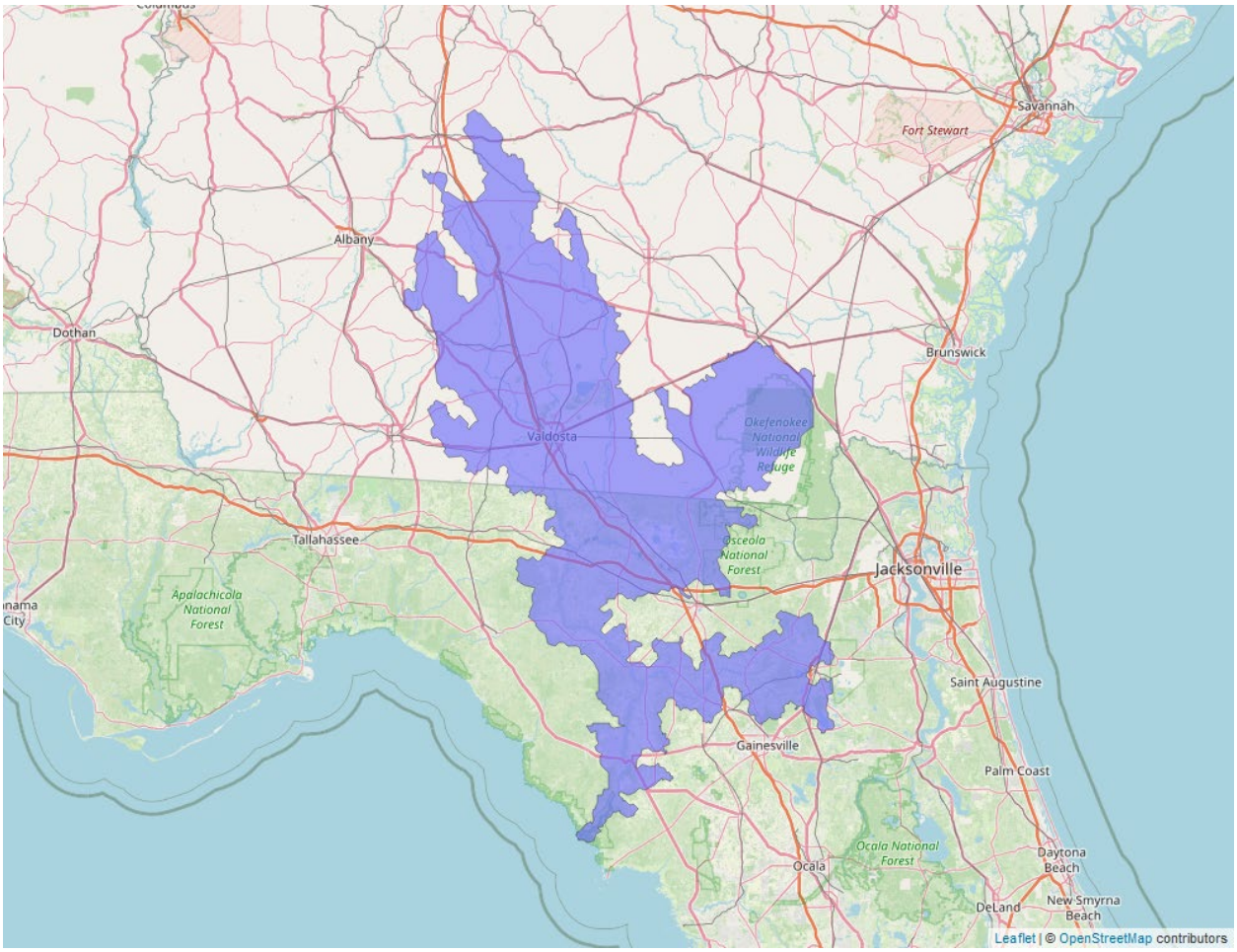

Figure 9. Range map of Suwannee alligator snapping turtle (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/10891.

Vulnerability

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

Summary of status

Listing status: Threatened

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

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

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

Number of populations: Single population

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

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

Suwannee alligator snapping turtles are primarily freshwater turtles endemic to the Suwannee River basin and found more abundantly in the middle reaches of the Suwannee River where freshwater springs contribute to an increase in productivity of the aquatic system. The Suwannee River basin encompasses parts of southern Georgia and northern Florida. Main water bodies that currently or historically supported Suwannee alligator snapping turtle include the Suwannee River, Santa Fe River, New River, Alapaha River, Little River, and Withlacoochee River. Individuals occupy main river channels and tributaries when habitat is present. The species currently encompasses a single population with an estimated abundance of 2,000 turtles across most of its historical range in Georgia and Florida (USFWS 2021).

Current and past threats to the species include illegal harvest, bycatch, habitat alteration, nest predation, climate change, disease, parasitic insects, and contaminants. Commercial and recreational turtle harvesting practices in the last century resulted in a decline of the Suwannee alligator snapping turtle across its range. Commercial harvest of the species reached its peak in the late 1960s and 1970s. Both Florida and Georgia have since prohibited the commercial and recreational harvest, but the effect of historical large-scale removal of large turtles and illegal harvest is ongoing. Suwannee alligator snapping turtles can be killed or harmed incidentally during fishing and other recreational activities. Some of these threats include fish hook ingestion, drowning when hooked on trotlines (a fishing line strung across a stream with multiple hooks set at intervals) and limb lines, or bush hooks (single hooks hung from branches) and jug lines (line with a hook affixed to a floating jug), along with injuries and drowning when entangled in various types of fishing line. Boats and boat propeller strikes may also injure or kill Suwannee alligator snapping turtles. Suwannee alligator snapping turtle aquatic and nesting habitats have been altered by anthropogenic disturbances. Activities and processes that can alter habitat include dredging, deadhead logging (removal of submerged or partially submerged snags, woody debris and other large vegetation for wood salvage), removal of riparian cover, channelization, stream bank erosion, siltation, and land use adjacent to rivers (e.g., clearing land for agriculture). Suwannee alligator snapping turtle habitat is also influenced by water availability, quantity, and quality across its range. Ground water withdrawals for irrigation and contaminants from runoff (both residential and agricultural) have been identified as stressors to the species' habitat. Nest predation rates for *Macrochelys* spp. are high. Raccoons (*Procyon lotor*) are common nest predators, but ninebanded armadillos (*Dasypus novemcinctus*), Virginia opossums (*Didelphis virginiana*), bobcats (*Lynx rufus*), and river otters (*Lontra canadensis*) may also depredate nests.

Additional nonnative species found within the species' range that may depredate nests include feral pigs (Sus scrofa) and invasive red imported fire ants (*Solenopsis invicta*). Climate change may also affect Suwannee alligator snapping turtle to varying degrees, but the extent of impact is influenced by certain geographical factors, including proximity to the coast and latitudinal thermogradients. Other stressors that may affect Suwannee alligator snapping turtles include disease, nest parasites, contaminants from urban and agricultural runoff, and historical recreational harvest, but none of these stressors rise to the level of a threat. These stressors may act on individuals or have highly localized impacts, and while each is relatively uncommon, they may exacerbate the effects of other ongoing threats (USFWS 2021).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap

Data indicate that 22.8% of the species' range overlaps with agricultural use sites and 20.6% of the species' range overlaps with areas adjacent to use sites that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is approximately 43.4% overlap between the species' range and the agricultural footprint of carbaryl use.

Table 14. Overlap and usage (% range treated annually) data for the Suwannee alligator snapping turtle.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Alfalfa	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Citrus	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Corn[17]	5.1	4.2	9.3	1.1	0.9	2
Grapes	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other Crops	1.3	2.4	3.7	1.3	2.4	3.7
Other Grains	1.5	2.4	3.9	<0.1	0.2	0.3

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

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Other Orchards[18]	1.9	3.3	5.2	1.4	2.5	3.9
Other Row Crops	11.4	6.3	17.7	1.9	1.1	2.9
Soybeans	0.8	1.3	2.1	0.8	1.3	2.1
Vegetables and Ground Fruit	1.6	2	3.6	0.4	0.4	0.8
Total	**22.8**	**20.6**	**43.4**	**6.2**	**7.6**	**13.7**

Usage

Past usage data indicate that up to 13.7% of the species' range has been treated with carbaryl annually from agricultural uses.

Additional Exposure Considerations

The Suwannee alligator snapping turtle is a largely aquatic turtle generally found in deeper water of large rivers and their major tributaries. Individuals can also be found in a wide variety of habitats, including small streams, springs, bayous, canals, swamps, lakes, reservoirs, ponds, floodplains during flooding, and oxbows. While the species is largely aquatic, individuals can occur in nearby terrestrial areas (up to 200 meters from water) to nest (adults) and travel to the water from the nest (juveniles) (USFWS 2022). As such, while there is overlap between the species' range and agricultural use sites, we do not anticipate any individuals are likely to be exposed directly on agricultural use sites. To account for this difference in exposure potential, we only consider off-site exposure in our assessment, indicating that total overlap with agricultural areas is 20.6% and up to 7.6% of the range is likely to be treated annually.

Non-agricultural Uses

In addition to agricultural uses, listed reptile species may be exposed to carbaryl through non-agricultural uses of carbaryl. However, as stated above, the Suwannee alligator snapping turtle occupies a specific habitat that is not likely to coincide with non-agricultural carbaryl use sites, including developed areas, nurseries, managed forests, rangelands, or rights of ways. As we generally expect these uses to have a low potential for off-site transport due to low usage,

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

application methods that limit drift and runoff, and required buffers from aquatic habitats, we do not anticipate individuals will likely be exposed to carbaryl through these non-agricultural uses. As such, we anticipate no more than a small number of individuals are likely to be exposed by non-agricultural uses over the duration of the proposed action.

Exposure Summary

While we do not anticipate non-agricultural uses of carbaryl will not expose more than a small number of individuals, and while we do not anticipate individuals will occur on agricultural use sites, there is a high level of overlap between the species' range and off-field areas where exposure to carbaryl through spray drift and runoff is likely to occur (20.6% total off-field overlap). While there is a moderate level of past agricultural carbaryl usage within the species' range, we anticipate a large portion of the species' range, and a large number of individuals, are likely to be exposed over the duration of the proposed action. The Suwannee alligator snapping turtle has a high exposure ranking.

Overall Exposure Ranking: High

General Conservation Measures

Rain restriction: Carbaryl is prohibited from being applied within 48 hours of a forecasted rain event or when soil in the treatment area is saturated. This rain restriction reduces the concentration of carbaryl in aquatic habitats by providing time for carbaryl to degrade before runoff into aquatic habitats can occur, decreasing the likelihood of exposure and risk.

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

We anticipate that in many cases, these buffers will significantly reduce exposure to the Suwannee alligator snapping turtle and subsequent risk of direct effects and indirect effects to prey items.

Effects of the Action: Toxicity

Direct Effects:

We anticipate the main route of exposure for the Suwannee alligator snapping turtle is through dietary exposure (i.e., consuming prey that consumed food contaminated with carbaryl). We expect individuals primarily consume fish but may also eat crustaceans, mollusks, smaller turtles, insects, snakes, birds, and vegetation. As stated in the above section, we do not anticipate

individuals are likely to occur on or forage in agricultural or non-agricultural use sites of carbaryl and expect all exposure to occur in off-field areas. Given that carbaryl is not likely to bioaccumulate in aquatic food items, we do not anticipate the Suwannee alligator snapping turtle is likely to be exposed to more than low levels of carbaryl from dietary exposure and is not likely to experience any adverse effects to survival, growth, or reproduction.

Indirect Effects:

The Suwannee alligator snapping turtle consumes a wide variety of food items spanning a diverse array of taxa, from fish, to invertebrates, to plant matter. While we expect some prey species are sensitive to carbaryl (such as aquatic invertebrates) and may decrease in availability in response to carbaryl exposure, we anticipate the Suwannee alligator snapping turtle can rely on other food resources that are less sensitive to carbaryl, such as fish prey or plant matter. As such, we do not anticipate the species will experience more than low levels of indirect adverse effects.

Toxicity Summary

Given that the Suwannee alligator snapping turtle is an aquatic species that primarily consumes aquatic prey species in areas away from carbaryl use sites, we anticipate individuals are not likely to experience more than low levels of dietary exposure, which will not result in any direct adverse effects. While there may be some decreases in the abundance of prey species sensitive to carbaryl, we anticipate the Suwannee alligator snapping turtle will have sufficient alternative food resources available as the species is an opportunistic forager that consumes a wide range of dietary items.

Overall Toxicity Ranking: Low

Effects of the Action Summary

The Suwannee alligator snapping turtle has a high exposure ranking. While we do not anticipate non-agricultural uses will expose more than a small number of individuals, and while we do not anticipate individuals will be exposed on agricultural use sites, there is a high level of overlap between the species' range and the action area and a moderate level of past agricultural carbaryl usage within the species' range. As such, we anticipate a large number of individuals will be exposed.

The Suwannee alligator snapping turtle has a low toxicity ranking. We do not anticipate individuals will accumulate more than low levels of carbaryl from dietary exposure and that no more than small numbers of exposed individuals will die or experience sublethal adverse effects. Similarly, we anticipate only minor indirect adverse effects from the loss of some of its dietary items.

While a large number of individuals will be exposed, no more than a small number of exposed individuals will die, and the species is not likely to experience more than low levels of indirect adverse effects. As such, we anticipate the overall risk of adverse effects to the species is low.

Conclusion

The Suwannee alligator snapping turtle is listed as threatened. It is a freshwater turtle endemic to the Suwannee River basin in southern Georgia and northern Florida. They eat mostly fish but also crustaceans, mollusks, smaller turtles, snakes, birds, insects, and plant material. Overland movements are expected to be limited, primarily nesting females and juveniles. The species occurs in a single population with an overall estimated abundance of 2,000 turtles. Population numbers historically decreased due to recreational and commercial take primarily, and these threats have been greatly reduced. Current threats include habitat loss and degradation, bycatch, effects of climate change, and urban and agricultural contaminants.

Individuals are unlikely to traverse or occur on agricultural fields because they only occur on land to nest up to 200 m from waterbodies. Therefore, we focused our analyses on off-field exposure. There is high overlap (20.6%) between the species' range and areas subject to runoff and spray drift from nearby agricultural carbaryl use sites, and past usage data indicates that a moderate portion of the range (up to 7.6%) will be exposed through spray drift from agricultural carbaryl treatments annually. Because we do not expect the species to occur on developed areas, managed forests, rangelands, or rights of way, and expect these uses to have a low potential for off-site transport, we anticipate non-agricultural uses will result in the exposure of, at most, a small number of individuals. The primary route of exposure for Suwannee alligator snapping turtles is through dietary exposure off-field, and we do not expect direct mortality or sublethal effects to occur. Some secondary prey species may die from carbaryl exposure (e.g., crustaceans), but the species' primary prey is fish and fish are not expected to die from carbaryl exposure. Therefore, we do not anticipate more than low levels of indirect adverse effects from prey loss.

Therefore, we expect impacts to the Suwannee alligator snapping turtle will be low. Although we anticipate individuals are likely to be exposed, those exposed individuals will not experience mortality or sublethal adverse effects from direct exposure. A small loss of food resources may result in death or sublethal adverse effects to, at most, a very small number of individuals of these species. As the proposed action will not likely reduce the reproduction, numbers and distribution of the species and we do not expect species-level effects to occur. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Suwannee alligator snapping turtle.

References

U.S. Fish and Wildlife Service. 2022. Species Status Assessment Report for the Suwannee Alligator Snapping Turtle (*Macrochelys suwanniensis*). Version 1.2. Atlanta, Georgia. 112 pp.

U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; 12-Month Petition Finding and Threatened Species Status with 4(d) Rule for Suwannee Alligator Snapping Turtle; Proposed Rule. Federal Register 86: 18014-18033.