

Summary of the Approach to the Analysis

In the species accounts below, we review the status of the species (described further in Appendix C), the environmental baseline for the action area, cumulative effects, and the effects of the action. Relevant life history and other information related the *Status of the Species* is provided. For the *Environmental Baseline* and *Cumulative Effects*, we briefly summarize the relevant information for the species, with more information provided in the overarching *Environmental Baseline* and *Cumulative Effects* sections in the body of the Opinion. We summarize our approach to the analysis of the effects of the action to listed animal species below. We utilized our approach (outlined below) for each species in the consultation and addressed our assumptions regarding 1) the extent of exposure; 2) magnitude of effect on the species if exposure occurs; and 3) an evaluation of predicted runoff scenarios to further contextualize the likelihood of exposure and adverse effects occurring. Please see the *Approach to the Effects Analysis* section of the main biological opinion for more details.

Extent of Exposure

To approximate the extent of exposure listed species are likely to experience, we use the overlap between the species' range and Enlist herbicide application sites (i.e., corn, cotton, and soybean fields) and their respective runoff zones. Assuming that species has a uniform distribution, we expect the percent overlap represents the percent of individuals that are likely to experience exposure.

We adjust this extent of exposure when available species-specific information suggests this uniform distribution assumption is inappropriate (e.g., occurrence data, known habitat preference, specific life history traits) and that the percent overlap over- or underestimates the likely extent of exposure. We consider the likelihood of exposure in context of the species' life history and vulnerability. We also reviewed available information (e.g., species range maps, agricultural use maps) to determine whether any areas of particular importance to the species (e.g., mating grounds, migration stopovers, spawning grounds) are likely to experience exposure that could result in a disproportionate adverse impact to the species.

On-field Exposure

Depending on the degree of exposure, we expect animal species that consume contaminated food items on Enlist herbicide application sites may experience some level of toxic effect from 2,4-D and/or glyphosate. We use the percent of a species' range that overlaps with corn, cotton, or soybean fields to represent the extent of potential on-field exposure. We modify the expected extent of potential exposure, when appropriate, based on available information regarding a listed species' tendency to use or not use agricultural areas for foraging. Given that we do not expect listed animal species will occur on-field during spray applications, we anticipate on-field exposure will primarily result from dietary exposure (i.e., consuming contaminated food items). While dermal contact and inhalation of volatilized herbicide may occur, we do not expect these routes of exposure will result in exposures that will cause any adverse growth effects or mortality.

Off-field Exposure

Existing product labels require applicators to use a 30-foot in-field spray buffer, which we expect will contain the majority of spray drift to on-field areas (see the *Approach to the Effects Analysis* in the Opinion for more details). While some amount of spray drift could leave the field and cause off-field exposure to listed species, EPA's spray drift deposition models indicate that only a very small fraction of applied pesticide is expected to move beyond the in-field buffer (i.e., only 0.167% of pesticide applied on-field is expected to drift beyond 30-feet). This level of off-field spray drift will result in exposures well below toxic thresholds for even the most sensitive species. Thus, we consider off-field exposure through spray drift as negligible and runoff as the only source of potential exposure occurring off-field.

We anticipate that runoff will contain the highest off-field estimated environmental concentrations (EECs) in areas adjacent to agricultural fields. To estimate the extent of possible runoff exposure for listed species, we used the overlap between the species range and application sites buffered out to 30 meters. We anticipate that the likelihood of runoff exposure will decrease with increasing distance from application sites as runoff is likely to be intercepted by vegetation, redirected through local topography, and lost through penetration into the soil column. Thus, we consider 30 meters a sufficient estimate of the extent of runoff exposure in field-adjacent areas. While it is possible for runoff to reach wetland habitats located further than 30 meters from agricultural sites through channelized flow, we expect this runoff will similarly dissipate, degrade, or dilute with distance from crop fields. Thus, we consider 30 meters a sufficient estimate of the extent of runoff exposure in field-adjacent areas.

Magnitude of Effects

We expect toxic effects to listed animal species will only result from consumption of 2,4-D and glyphosate contaminated food items. Inhalation and dermal absorption are not considered major routes of exposure and are not considered in our analysis (see the *Exposure* section of the main opinion for more details). Given the lack of data in animal species regarding the effects of co-exposure to 2,4-D and glyphosate, we assessed effects to the species separately for the two active ingredients and assumed an additive toxic effect will occur with co-exposure (see the *Effects of the Action* section of the Opinion for more details).

While we do not expect many listed animal species to use agricultural areas as foraging grounds, we anticipate some species may still forage within agricultural fields, leading to exposure to 2,4-D and/or glyphosate. Depending on the extent individuals may forage on-field and what food items they are consuming, we expect on-field exposure may cause mortality in some animal species. EPA modeled species-specific exposures for vertebrate animals based on preferred dietary items and adjusted them based on factors such as body mass, assimilation efficiency, and metabolic rate. We compared the expected dietary exposures to toxic dose-response curves modeled using data from available scientific literature to determine a magnitude of effect (e.g., percent of individuals that would experience mortality). The EPA and technical registrants proposed additional species-specific conservation measures to further reduce the risk of mortality for any species that our analyses deemed were at high risk of mortality.

EECs in runoff are not expected to cause growth effects or mortality to any listed animal species, as even the highest concentrations are well below established no toxic effect thresholds. However, runoff exposure will likely affect plant species that animals depend on as food or habitat (i.e., effects to plant-based resources). We compared the 95th percentile runoff EECs,

which we consider to be the highest EEC that is reasonably certain to occur within the duration of the action, to a plant growth species sensitivity distribution (SSD) to estimate the proportion of plant species that will experience reduced growth (i.e., at least 25% growth inhibition). We assumed that the proportion of sensitive plant species experiencing moderate growth effects reflects an equivalent loss of plant-based resources for animals (e.g., if 27% of plant species experience moderate growth effects, that represents a 27% loss in plant-based resources for animals).

We consider EECs that result in moderate effects to 50% or more plant species a high magnitude of effect. While most plant species will likely only experience moderate growth effects at this exposure, more sensitive species may experience high levels of reduction in growth and may even experience some level of acute mortality, which could result in immediate impacts to the availability of plant-based resources. We consider EECs that result in moderate effects to 25-50% of plant species a moderate magnitude of effect to plant-based resources as we do not expect acute mortality is likely to occur at these exposure levels (even in the most sensitive plant species). However, growth effects may be severe enough to impact the long-term survival of exposed plants, which could reduce long-term availability of plant-based resources for listed animals. We consider EECs that result in moderate effects to less than 25% of plant species a low magnitude of effect as we expect no mortality is likely, and only the most sensitive plant species are likely to experience measurable impacts to growth, suggesting only minimal effects to plant-based resources are likely to occur at these exposures.

Runoff Scenario Evaluations: We further contextualize the risk of adverse effects expected to occur from runoff exposure by assessing individual runoff scenarios that are likely to occur within a species' range. The EPA modeled location-specific runoff scenarios within the range of each species to predict how often runoff EECs are likely to cause more than low levels of adverse effects (described in greater detail in USEPA 2022e). Each runoff scenario is associated with a specific location within the species' range and incorporates locally specific information, such as soil type, crop type, and local climatic records, to generate a site-specific distribution of EECs. Any given species' range can contain hundreds to thousands of scenarios, each with their own distribution of EECs. Because EPA's model does not identify which of these scenarios occur in areas of the species' range that overlap with Enlist runoff zones, we assume all scenarios modeled will occur within the areas of overlap between the species' range and the 30-m runoff zones.

We compare the 95th percentile runoff EEC from each scenario (i.e., the 1 in 10-year runoff EEC for that location) to the relevant toxic reference (i.e., growth and mortality dose response curves for plants) to determine how many locations within the species' range are not likely to ever experience runoff exposures that will exceed relevant toxic thresholds for the species. We use this information to further contextualize the likelihood that runoff exposure will cause an adverse effect to listed species. For example, if 100% of modeled scenarios are likely to exceed toxic thresholds within the duration of the action, then we expect all areas of overlap between the species' range and the runoff zone are at risk of adverse toxic effects. As the percent of scenarios likely to exceed toxic thresholds decrease, we can qualitatively reduce the expected risk of adverse effects to the species in the runoff zone.

This analysis is accompanied by a visual inspection of both the species' range and areas of expected high runoff EECs. As needed, Service biologists visually inspect individual species ranges using maps that delineate relevant features such as USDA cropland maps, tree cover estimation, hydrologic soil groups, elevation and topography, state and federally protected land, and areas of known importance to specific species (e.g., preferred nesting habitat, foraging grounds, slope and aspect). We compare these features directly to maps that illustrate locations where EPA's Tier 3 geographic distribution models anticipate will experience high levels of runoff EECs. Using these visual tools, we can further assess the likelihood of exposure to Enlist pesticide runoff and further modify the expected risk of adverse effects to the continued existence of the species overall.

Integration and Synthesis Summary: Amphibians – Dusky gopher frog

Scientific Name:	Common Name:	Entity ID:
<i>Rana sevosa</i>	Dusky gopher frog	208

Overview

In reviewing the status of the species, the environmental baseline for the action area, cumulative effects, and the effects of the action, the Service has determined that while the species' vulnerability ranking is high, the risk of adverse effects to the species from the registration of Enlist One/Duo is low, as described in the following sections. Therefore, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the dusky gopher frog. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 09-30-2022 - Wherever found

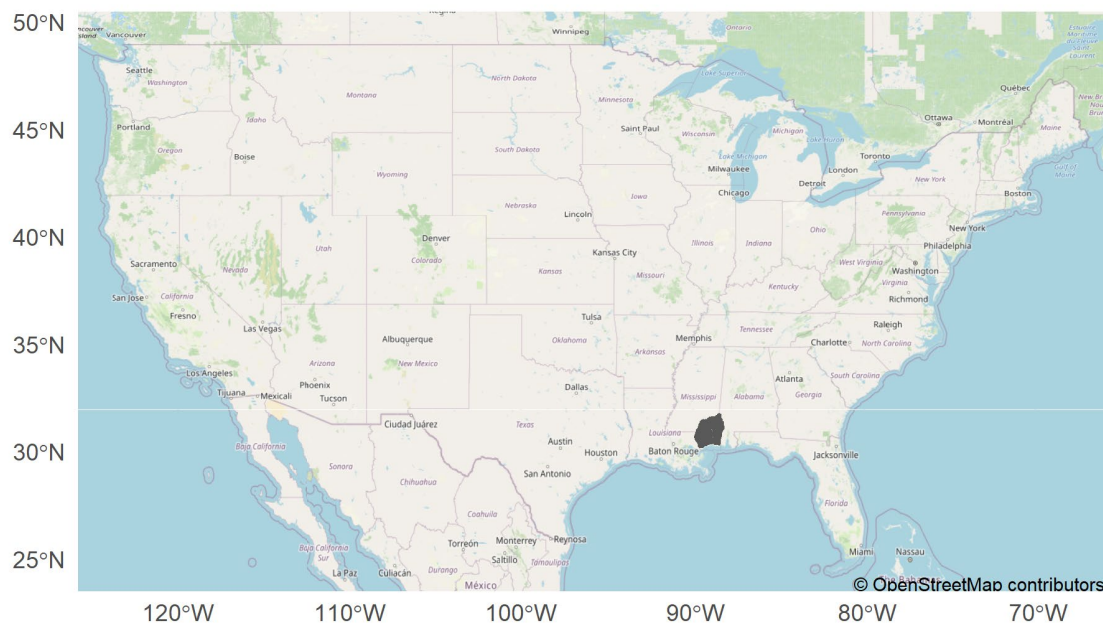


Figure 1. Range map of Dusky gopher frog (red polygon overlay). Range map accessed on November 3, 2022, at <https://ecos.fws.gov/ecp/species/5600>.

Vulnerability

This section includes a summary of the status of the species, environmental baseline, cumulative effects, and a summary of how these contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered

Recommendations for Status from Latest 5-Year Review: No change

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

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

States within the range: AL, MS.

Critical Habitat designated: Yes

Pesticides noted in USFWS documents: Yes, Pesticides and Herbicides

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

Dusky gopher frogs are amphibians with a complex life cycle that consists of an aquatic and terrestrial component. Dusky gopher frog habitat includes both upland sandy and sandy loam habitats, longleaf pine-dominated forests, and wetland breeding sites embedded within the forested landscape. Adult dusky gopher frogs spend most of their lives underground in forested habitat consisting of fire-maintained, open-canopied woodlands historically dominated by longleaf pine (*Pinus palustris*) with an understory of grasses such as little bluestem (*Schizachyrium scoparium*). Populations are naturally (but often only historically) distributed across the landscape among multiple breeding ponds interconnected by suitable upland habitat. Larval (tadpole) habitat consists of grassy, acidic, isolated, ephemeral, depressional wetlands that lack predaceous fish.

Dusky frog tadpoles are likely filter-feeders in their pond water column and also grazers on algae. Adult dusky gopher frogs are carnivorous and likely have a diet similar to that reported for other species of gopher frogs which includes frogs, toads, small mammals, beetles, hemipterans (bugs), grasshoppers, spiders, roaches, and earthworms (Deckert 1920, Carr 1940, Dickerson 1969, Blihovde, USFWS, pers. comm. 2005).

During the breeding season (typically December through March), dusky gopher frogs leave their subterranean retreats in the uplands and migrate to their breeding sites during rains associated with passing cold fronts (Young 1997). Metamorphic frogs leave pond sites during rainfall events and move to terrestrial belowground refugia once their development is complete. Both forested uplands and isolated wetland breeding sites are needed to provide space for normal behavior and both individual and population growth.

Since its listing in 2001, three naturally occurring populations supported by four breeding ponds have been documented (USFWS 2015). A fourth population, breeding at The Nature Conservancy Pond, has been established through translocation of Glen's Pond frogs. The Glen's Pond population is the only population that has breeding with enough egg masses to supply frogs needed for translocation and the loss of this population would severely limit the potential for recovery of the dusky gopher frog (USFWS 2021). Currently there is one known wild population and seven reintroduced populations (USFWS 2021).

Environmental Baseline

Modification and alteration of habitat within the species' range is the primary contributor to the present condition of the dusky gopher frog, and we anticipate these activities to continue in the future. In addition to the relevant activities described in the overarching *Environmental Baseline* section of the Opinion, past activities and threats in the action area that were considered in the environmental baseline include, but are not limited to: habitat fragmentation, predation, disease, urbanization from residential and commercial development, lack of prescribed fire as a management tool, invasive red fire ants, pesticides and herbicides, and climate change. The Service identifies pesticides and herbicides as threats to this species due to the potential for adverse effects to amphibians and their habitat as generally described in the literature. Where possible and if the private and/or Federal partner approves, the Service works with private and Federal partners who own property occupied by the dusky gopher frog and use any pesticides and/or herbicides on these sites. Past consultations, such as on the registration of the pesticide malathion under FIFRA, have also contributed to the condition of the environmental baseline for the species in the action area by developing and implementing measures to reduce the impacts of pesticides to listed species.

Activities that benefit this species have also occurred within the action area. For example, The Nature Conservancy introduced this species to one of their ponds in Jackson County, Mississippi at Old Fort Bayou Mitigation Bank (OFBMB), and the frogs are now breeding. TNC also translocated frogs to augment a naturally occurring dusky gopher frog population that was discovered in 2004 at Mike's Pond, also in Jackson County, Mississippi.

In this case, the environmental baseline for this species describes activities that have led to the current status of the frog, and is, therefore, reflective of the current condition of the species. Primarily due to habitat degradation and destruction, the species range is restricted to a few populations within Alabama and Mississippi, and the overall population level of the species is considered low, with an estimated 249 adult frogs.

Cumulative Effects

We anticipate that many of the non-Federal activities described in the Vulnerability section above will continue into the future, including modification and alteration of habitat. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of animals, or indirectly through the loss of breeding ponds interconnected by suitable upland habitat leading to changes in habitat quality required by the species. These effects are anticipated to be greatest in privately owned portions of the range.

Overall Vulnerability: High

In summary, past and present activities have impacted the species and its critical habitat through modification and alteration of habitat and other associated impacts. Some activities, such as those associated with translocation by TNC described above have provided varying degrees of protection for the species and its critical habitat. Given that the species is endangered, has few populations, and has an unknown population trend, the vulnerability of the species is high.

Risk

The dusky gopher frog will not occur in agricultural areas, indicating no risk of adverse effects to growth or survival resulting from consuming contaminated food items on-field. There is a small extent of overlap between the species' range and runoff areas, indicating a low likelihood of exposure to individuals. Runoff concentrations of Enlist herbicides will not be high enough to cause adverse growth effects or mortality to individuals, and spatially refined runoff exposure models indicate that the majority of runoff events are not likely to cause more than low levels of adverse growth effects to plants. Furthermore, the dusky gopher frog is not reliant on plant species that are sensitive to Enlist pesticides. Thus, the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

On-field exposure

While small portions of the species range overlap with Enlist pesticide use sites (**Table 1**), based on our knowledge of its life history and behaviors, we do not expect the dusky gopher frog will occur on corn, cotton, or soybean fields. Thus, the species is not likely to experience on-field exposure to spray or ingestion of contaminated food items. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

Off-field exposure

We expect the dusky gopher frog to occur in terrestrial and wetland runoff zones adjacent to application sites (Table 1). The overlap of the species range with the runoff zone is 1.13%.

Table 1. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0.13	0.25
Cotton	0.38	0.7
Soybean	0.16	0.44
Total ¹	0.54	1.13

Magnitude of effect

Effects to Growth and Mortality

We do not expect the dusky gopher frog to occur on-field, and thus, it is not at risk of adverse effects to growth or mortality from on-field exposure. We do not expect off-field exposure to

¹ Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices. Total overlap is capped at 100%.

result in concentrations high enough to cause mortality or growth effects. Thus, we only expect adverse effects to this species through effects to food and habitat availability.

Effects to Plant-based Resources

We expect Enlist herbicide runoff exposure will result in growth effects to sensitive non-listed plant species (e.g., herbaceous forbs), which may cause a decrease in their availability within the runoff zone for the dusky gopher frog. Runoff from corn, cotton, and soybean fields treated with Enlist pesticides may result in EECs up to 0.03-0.033 lbs/acre, which can result in adverse growth effects in up to 35-39% of sensitive plant species (Table 2).

Table 2. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the percent of sensitive plant species expected to experience at least moderate adverse growth effects from runoff exposure.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Corn	0.031	36
Cotton	0.03	35
Soybean	0.033	39

However, while these EECs reported above represent high end exposure estimates, we do not expect that all areas within the runoff zone will experience such high levels of EECs. EPA's Tier 3 geographic distribution models show that, with the implementation of required runoff mitigation measures, 68% of corn, 75% of cotton, and 75% of soybean runoff areas are not likely to ever experience runoff EECs that cause more than low levels of adverse growth effects to plants throughout the duration of the action (Table 3).

Table 3. Number of local runoff scenarios modeled for the species, and the number and percent of runoff scenarios that could cause no more than low levels of adverse effects to plant species.

Crop	# runoff scenarios	# scenarios that will not cause more than low levels of effects	% scenarios that will not cause more than low levels of effects
Corn	50	34	68
Cotton	48	36	75
Soybean	64	48	75

Thus, we expect that most locations within the runoff zone will not likely experience EECs that cause more than low levels of adverse growth effects to sensitive plants. While a moderate proportion of plant species in the runoff zone may experience adverse effects, we expect this will

result in, at most, a low magnitude of decreases to food and habitat resources as the species is not reliant on these sensitive plant species. Dusky gopher frogs primarily consume algae as tadpoles and animal prey as adults, which are both groups of organisms that are not sensitive to Enlist pesticide active ingredients as demonstrated by laboratory studies. Similarly, gopher frogs are known to inhabit longleaf pine ecosystems, which are made up of numerous species of plants that are expected to be tolerant to Enlist pesticide active ingredients (e.g., trees and woody shrubs). We do not expect runoff EECs will ever reach a concentration high enough to cause trophic cascades that reduce the availability of algae, animal prey, or longleaf pine ecosystems that would cause a significant adverse effect to the species. Thus, we expect the magnitude of effect to the species will be, at most, low. We do not anticipate this level of effect will reduce reproduction or adversely influence the distribution of the species.

Risk summary

We do not expect the dusky gopher frog to occur on-field, and we expect runoff concentrations of Enlist herbicides will be well below levels where adverse growth effects or mortality are likely to occur. There is a low extent of overlap between the species' range and runoff areas (1.13%), indicating that, at most, only a few individuals are likely to experience adverse effects from runoff exposure. Spatially refined runoff exposure model results further indicate that most runoff events within this overlap area are not likely to cause more than low level adverse effects to plants. While there may be up to moderate magnitudes of adverse effects to sensitive plant species at some locations within this zone, we expect there will be, at most, a low magnitude of decreases to food and habitat availability as the species is not reliant on sensitive plant species. We do not expect this level of adverse effects to resources will reduce reproduction or adversely influence the distribution of the species. Thus, we expect the overall risk to the species is low.

Overall Effects of the Action to the Species: Low

Conclusion for the Species

After reviewing the current status of the species, the environmental baseline for the action area, the effects from the proposed action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo, as proposed, is not likely to jeopardize the continued existence of the dusky gopher frog. As discussed below, although the vulnerability is high, the risk of adverse effects to individuals of the species from the effects of the proposed action is low. While mortality and adverse growth effects to amphibians can occur from on-field exposure, we do not expect the dusky gopher frog will occur on-field, and as such, we do not expect these effects to occur for this species. Additionally, we do not expect more than low level adverse effects off-field to individuals of the species, given that there is a low overlap between the range of the dusky gopher frog and Enlist runoff areas and that dusky gopher frogs are not reliant on plant species sensitive to Enlist herbicides for food or habitat. Thus, we anticipate that only a small number of individuals will be adversely affected over the duration of the Action. However, given that we only expect low levels of decreased food and habitat availability, we do not expect these effects will rise to the level of take.

The dusky gopher frog is listed as endangered and has limited distribution, small population sizes, and is susceptible to climate change, making it a highly vulnerable species. Modification and alteration of habitat (e.g., residential and commercial development, lack of prescribed fire as a management tool, and invasive red fire ants) are listed as two of the main threats preventing the recovery of the species. Although agricultural pesticide use may continue to degrade habitat quality by affecting plant health, we do not expect the action will significantly contribute to habitat loss. While habitat degradation through runoff might occur, we do not expect runoff EECs to be high enough to cause community- or ecosystem-level effects to the plant communities supporting the dusky gopher frog, which are comprised of a diversity of plants such as trees, woody shrubs, and perennial species and have differential sensitivity to Enlist herbicides.

The overlap between the dusky gopher frog's range with Enlist pesticide use sites and runoff areas is low. We do not expect individuals to forage or otherwise occur on agricultural fields, and thus, mortality or adverse growth effects from exposure to Enlist in dietary items within agricultural use sites is not expected. While dusky gopher frogs rely on plants in the form of algae as food (as tadpoles) and plant habitat (as adults), we do not anticipate that runoff EECs will be high enough to cause more than low level adverse effects to these plant-based resources in runoff zones. Thus, the risk of adverse effects to the species is low.

Species Conclusion: Not likely to jeopardize

References

- U.S. Fish and Wildlife Service (USFWS). 2015a. Dusky Gopher Frog (*Rana sevosa*) Recovery Plan Revised Recovery Plan. U.S. Fish and Wildlife Mississippi Field Office, Southeast Region, Atlanta, GA. 96 pp.
- U.S. Fish and Wildlife Service (USFWS). 2015b. Dusky Gopher Frog (*Rana sevosa*) Recovery Plan Revised Recovery Plan. U.S. Fish and Wildlife Mississippi Field Office, Southeast Region, Atlanta, GA. 16 pp
- U.S. Fish and Wildlife Service (USFWS). 2019. Dusky Gopher Frog (*Rana servosa*) Recovery Plan Amendment U.S. Fish and Wildlife Service Mississippi Field Office, Atlanta, GA. 5 pp.
- U.S. Fish and Wildlife Service (USFWS). 2021. Dusky Gopher Frog (*Rana servosa*). 5-Year Review Summary and Evaluation. Mississippi Ecological Services Field Office Jackson, MS. 16 pp.

Integration and Synthesis Summary: Birds - Attwater's greater prairie-chicken

Scientific Name:	Common Name:	Entity ID:
<i>Tympanuchus cupido attwateri</i>	Attwater's greater prairie-chicken	83

Overview

In reviewing the status of the species, the environmental baseline for the action area, cumulative effects, and the effects of the action, the Service has determined that while the species' vulnerability ranking is high, the risk of adverse effects to the species from the registration of Enlist One/Duo is low, as described in the following sections. Therefore, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Attwater's greater prairie-chicken. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 03-19-2018 - Wherever found

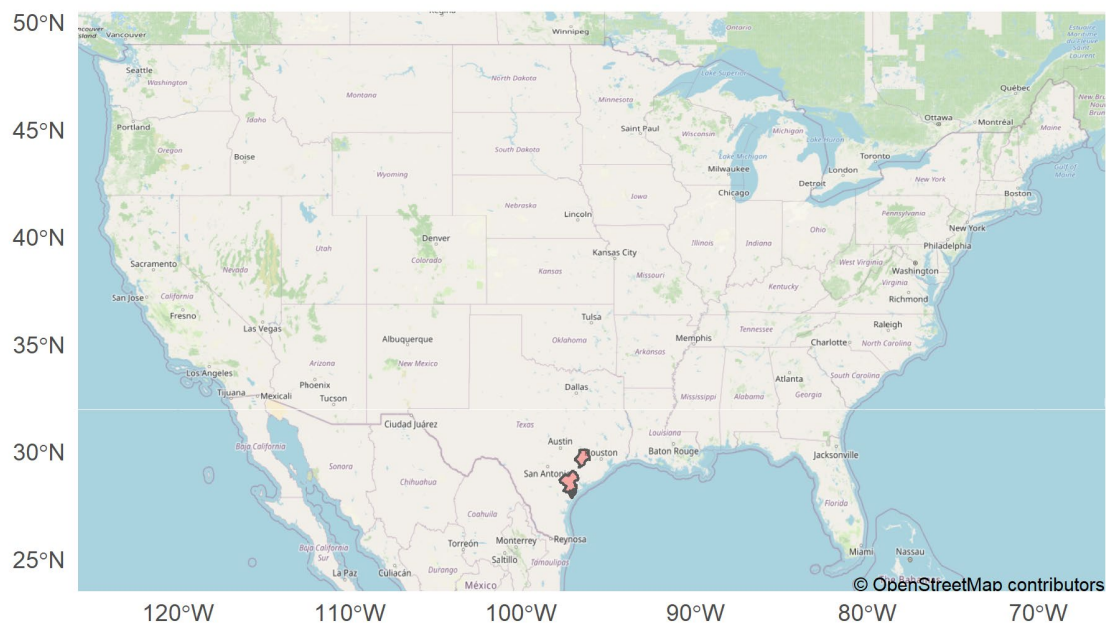


Figure 2. Range map of Attwater's greater prairie-chicken (red polygon overlay). Range map accessed on August 8, 2022, at <https://ecos.fws.gov/ecp/species/7259>.

Vulnerability

This section includes a summary of the status of the species, environmental baseline, cumulative effects, and a summary of how these contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered

Recommendation in Status from Latest 5-Year Review: No change

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

Number of Populations: Multiple populations (few)

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

States within the range: TX

Critical Habitat designated: None

Pesticides noted in USFWS documents: Yes, Pesticides

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

The Attwater's greater prairie-chicken represents the southern-most subspecies of *Tympanuchus cupido* and uses different areas of coastal prairie grassland, preferring a variety of short, mid and tall grass prairie. Adults use shorter grasses (i.e., 10-16 inches tall) for roosting and feeding and use taller grasses (i.e., 16-24 inches tall) for nesting, loafing, feeding, and escape. Individuals generally avoid densely vegetated areas over 24 inches in height but may use these areas for protection from inclement weather and predators as well as fall feeding grounds (Service 1983).

The Attwater's greater prairie-chicken diet consists mostly of insects, especially grasshoppers during the summer and at other times eats fruit, leaves, flowers, shoots, seeds, or grain (Campbell 1995).

The period from February through September covers the nesting and brooding seasons. Attwater's greater prairie-chicken booming activity typically ends by the third week in May (Lehmann 1941). Copulations begin to occur in late February, peak in early March, and gradually decrease through April and early May (Jurries 1979, Lutz 1979). Secondary peaks in breeding occur in April resulting from hens attempting to reneest after initial attempts fail (Jurries 1979). Incubation lasts 23-24 days. Young leave the nest a few hours after hatching. Most nests are located in grasslands within one mile (1.6 km) from the booming grounds, although some studies have found a small number of nests in fallow rice fields.

Jurries (1979) described summer months as a time of wandering for the prairie-chicken, although Lehmann (1941) observed that once the Attwater's greater prairie-chicken found suitable summer cover, they moved little until fall. Beginning in late August to early September, flocks begin to form which move as a unit in their daily activities (Yeatter 1943, Schwartz, 1945, Baker 1953, Kessler 1978, Jurries 1979). Jurries (1979) noted Attwater's greater prairie-chicken males showed a pronounced movement back to booming grounds in September-early October. By approximately November 15, Lehmann (1941) observed Attwater's greater prairie-chicken moved to pastures. Having found such an area, they remain until spring.

The Attwater's greater prairie-chicken currently occurs in the wild at only two locations - the Attwater Prairie Chicken National Wildlife Refuge (Colorado County, Texas) and on private ranchlands in Goliad County, Texas. In 2015, biologists estimated that there was a total of 104 birds, with 100 birds in Attwater Prairie Chicken National Wildlife Refuge and 4 birds in Goliad County (personal communication, T. Rossignol, Attwater Prairie Chicken National Wildlife Refuge, August 2015). Periods of population growth between 2007-2011 and 2012-2016 were ended by a near-historic drought and catastrophic flooding followed by impacts of hurricane Harvey, respectively. However, while numbers remain low, populations have shown continued growth since 2017, and in 2021 reached numbers not seen since 1993 (approximately 180 total).

Environmental Baseline

Habitat degradation and destruction from woody species encroachment and expansion of urban centers have contributed to the present condition of the Attwater's greater prairie-chicken, and we anticipate these activities to continue in the future. In addition to the relevant activities described in the overarching Environmental Baseline section of the Opinion, past activities in the action area that have contributed to the species' decline include, but are not limited to, loss of grassland habitat, invasive red imported fire ants (*Solenopsis invicta*), disease, ectoparasites, accidents (e.g., flying into fences and wires), flooding, incompatible grazing, and altered fire regimes. We considered all of these activities in the environmental baseline for the species. Past consultations, such as on the registration of the pesticide malathion under FIFRA, have also contributed to the condition of the environmental baseline for the species in the action area by developing and implementing measures to reduce the impacts of pesticides to listed species.

In addition to activities that have adversely impacted the species, activities that benefit this species have also occurred within the action area. For example, captive-reared birds have been released at The Nature Conservancy's (TNC) Texas City Prairie Preserve (Galveston County, Texas), and on private ranchlands in Goliad County, Texas (USFWS 2021). In addition, an initiative was undertaken beginning in 1995 with the primary mission of restoring native prairie grasslands within the species' former range. This effort, now known as the Coastal Prairie Conservation Initiative (CPCI) is a diverse partnership effort involving private landowners, local soil and water conservation districts, the Service, the Sam Houston Resource Conservation and Development Board, the U.S. Natural Resources Conservation Service (NRCS), TNC, Texas Parks and Wildlife Department (TPWD), and the Grazing Lands Conservation Initiative (GLCI).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction. These activities are expected to result in on-going mortality and/or decreased reproduction of individuals through direct removal of animals, or indirectly through the loss of coastal prairie grassland habitat leading to changes in habitat quality required by the species. These effects are anticipated to be greatest in privately owned portions of the range.

Overall Vulnerability: High

In summary, past activities have impacted the species through habitat degradation and destruction and other associated impacts, and we expect similar activities and impacts to occur in

the future. Some activities, such as those associated with populations occurring at least in part on conservation or public lands have provided varying degrees of protection for the species. Given that the species is endangered, has a restricted range, and has relatively few populations, we consider the vulnerability of the species to be high.

Risk

The overlap between the species' range and on-field and runoff areas indicates that individuals may be exposed to Enlist pesticides. However, on-field exposure, with implementation of the species-specific mitigation measure proposed by the EPA and technical registrant, will result in a low likelihood of mortality from consumption of contaminated food items. Similarly, implementation of required runoff mitigation measures will sufficiently reduce off-field exposure to a level that will not cause more than low levels of adverse effects to food and habitat resources. Thus, the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

On-field Exposure

We expect the Attwater's greater prairie-chicken will occur on agricultural fields, and thus, is at risk of dietary exposure to Enlist pesticides (primarily through ingestion of contaminated food items). Corn, cotton, or soybean fields overlap with 5.22% of the species' range (Table 4). While Attwater's prairie-chickens are known to forage on agricultural land, information solicited from species experts indicate that individuals are not likely to use cotton fields as these fields do not match preferred foraging areas. Thus, we only consider overlap with corn or soybean fields as likely areas for on-field exposure.

Off-field Exposure

We expect the Attwater's greater prairie chicken will also occur on terrestrial runoff areas adjacent to application sites. The terrestrial runoff zone overlaps with 15.49% of the species range (Table 4).

Table 4. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field	Runoff zone
Corn	5.22	7.86
Cotton	5.6 ²	7.62
Soybean	1.16	2.04
Total ³	5.22	15.49

Magnitude of Effect

Effects to Growth and Mortality

The EPA and the technical registrants have proposed a species-specific mitigation measure to further reduce the risk of adverse effects to the Attwater's greater prairie-chicken. A pesticide use limitation area will be set within the species' range. In this use limitation area, applicators are not to apply Enlist pesticides more than two times a year (instead of three applications per year).

Without the species-specific mitigation measure, we estimated that that on-field dietary exposure of Attwater's prairie-chickens consuming contaminated food items from fields treated with either Enlist One or Enlist Duo would result in maximum concentrations of 1.8-153.4 mg/kg-bw of 2,4-D, depending on the specific types of food items consumed (Table 5). Of these food items, we anticipate no effects from the consumption of arthropods or seeds, and mortality in up to 6% (1 in 17) of exposed individuals from consumption of contaminated leaves. Where applications of Enlist or Enlist Duo are limited to two per year, we expect mortality of prairie-chickens foraging on leaves in treated fields to be reduced to less than 1% mortality (approximately 1 in 200) in exposed individuals. We consider this acute effect as an upper bound estimate of mortality as the likelihood of individuals consuming only leaves in application sites is low. Based on known life history traits, we expect the Attwater's greater prairie-chicken will consume a varied diet that also includes seeds or arthropods, which are expected to result in lower dosages of 2,4-D. Dietary 2,4-D exposure is not expected to cause any chronic effects to growth or adversely affect reproduction or the species' distribution within the range.

We expect on-field exposure to Enlist Duo will result in exposures of 2.1-174.3 mg/kg-bw of glyphosate, depending on the specific food items consumed (Table 5). This range of exposures is not expected to cause any mortality or growth effects in birds, nor result in any reductions in reproduction or changes in distribution within the range.

² Attwater's greater prairie-chickens are not expected to enter or forage in cotton fields and are not further considered in our analyses.

³ Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices. Total overlap is capped at 100%.

Table 5. Estimated dietary dosages of Enlist pesticide active ingredients and expected magnitudes of effect to birds (i.e., mortality, growth inhibition) occurring from on-field exposures.

Active Ingredient	Anticipated Exposure	Magnitude of Mortality	Sublethal Effect
2,4-D	1.8 - 153.4 mg/kg-bw	Up to 6% (1 in 17 exposed individuals)	No effects
Glyphosate	2.1-174.3 mg/kg-bw	No mortality	No effects

Effects to Plant-based Resources

We expect Enlist herbicide runoff exposure will result in adverse growth effects to sensitive non-listed plant species (e.g., herbaceous forbs), which may cause a decrease in their availability within the runoff zone for the Attwater's greater prairie-chicken. Runoff from corn, cotton, and soybean fields treated with Enlist pesticides may result in EECs up to 0.01-0.015 lbs/acre, which can result in adverse growth effects in up to 4-13% of sensitive plant species (Table 6). We consider this a low magnitude of effect to sensitive plant species within the runoff zone. Given the expected efficacy of the required runoff mitigations, we do not anticipate non-listed plants in terrestrial habitats (such as those occupied by the Attwater's greater prairie-chicken) will experience more than low levels of adverse effects in any runoff scenarios. We do not expect these effects will result in any reductions in reproduction or change the distribution of the species within the range.

Table 6. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the percent of sensitive plant species expected to experience at least moderate growth effects from runoff exposure.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Corn	0.0149	12
Cotton	0.015	13
Soybean	0.01	4

Risk Summary

The extent of on-field and off-field overlap indicates that a potentially large number of individuals may be exposed to Enlist pesticides. We do not expect individuals will be present on-field during spray application, however, individuals are likely to be exposed to contaminated food sources as the species is known to forage on-field (within corn and soybean fields). We anticipate the proposed species-specific mitigation measure will reduce the likelihood of mortality from this on-field exposure to a low level. In contrast, individuals off-field are not

likely to experience any effects to growth or mortality. Although individuals occurring off-field may experience reductions in food availability, we expect that this reduction in food availability will have at most, minor adverse effects on off-field individuals, due to the required runoff mitigations; these minor adverse are also not likely to impact the long-term survival of individuals. Thus, with implementation of the species-specific mitigation measure, we expect the overall risk to the species is low.

Overall Risk from the Action to the Species: Low

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects from the proposed action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo, as proposed, is not likely to jeopardize the continued existence of the Attwater's prairie-chicken. As discussed below, although the vulnerability is high, the risk of adverse effects to individuals of the species from the effects of the proposed action, as well as the likelihood of exposure, is low. While there is some risk to individual survival from the consumption of contaminated food items on Enlist herbicide use sites, the mitigation measures (including the species-specific conservation measure) will sufficiently reduce on-field exposure to a level where the likelihood of mortality is low. Thus, we anticipate that small numbers of individuals will be adversely affected, resulting in take of no more than one individual throughout the duration of the Action.

The Attwater's prairie-chicken is listed as endangered, making it a highly vulnerable species. Habitat degradation and destruction (e.g., from woody species encroachment, expansion of urban centers, altered fire regimes, and invasive ants) are listed as the main threats preventing the recovery of the species. Although agricultural pesticide use may continue to degrade habitat quality by affecting plant health, the refined spatial modelling does not indicate that runoff EECs will be high enough to cause significant reductions in sensitive plant growth, indicating no risk of adverse effects to plant-based resources. We also do not expect the action will significantly contribute to habitat loss as we do not expect EECs will be high enough to cause community- or ecosystem-level effects to the plant communities that provide habitat to the Attwater's greater prairie-chicken, which are comprised of a diversity of plants such as older/established plants, perennials, and plants with woody tissue like shrubs and trees that are not sensitive to Enlist herbicides.

While the overlap between the Attwater's prairie-chicken's range with Enlist pesticide use sites and runoff areas is 5.22% and 15.49%, respectively, we do not expect exposure will result in more than low levels of adverse effects to exposed individuals. A species-specific mitigation measure will reduce on-field exposure to a level where we expect the likelihood of mortality in exposed individuals to be low. Similarly, we expect general runoff mitigations required by the label will reduce runoff concentrations of Enlist herbicides to a level where we expect no more than low magnitudes of adverse effects will occur to the prairie-chicken's food and habitat. Thus, the risk of adverse effects, with the implementation of general and species-specific mitigation measures, will be low. Thus, we expect only a small number of individuals of the species will experience adverse effects and anticipate take of no more than one individual from exposure to contaminated items on-field throughout the duration of the Action.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service. 2010. Attwater's Prairie-Chicken Recovery Plan, Second Revision. Albuquerque, New Mexico. 117 pp.

U.S. Fish and Wildlife Service. 2016. Status of the Species and Critical Habitat: *Tympanuchus cupido attwateri* (Attwater's Prairie Chicken). U.S. Fish and Wildlife Service, Portland, OR.

U.S. Fish and Wildlife Service. 2021. Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*) 5-year review: Summary and evaluation. Attwater Prairie Chicken National Wildlife Refuge, Eagle Lake, Texas and Texas Coastal Ecological Services, Houston, Texas. 20 pp.

Integration and Synthesis Summary: Crustaceans – Panama City crayfish

Scientific Name:	Common Name:	Entity ID:
<i>Procambarus econfinae</i>	Panama City crayfish	9386

Overview

In reviewing the status of the species, the environmental baseline for the action area, the cumulative effects, and the effects of the action, the Service has determined that the species' vulnerability ranking is high, and the risk of adverse effects to the species from the registration of Enlist One/Duo is low, as described in the following sections. Furthermore, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Panama City crayfish. We discuss our rationale for the species in the sections below.

Species Current Range

Last Updated: 02-18-2022 - Wherever found

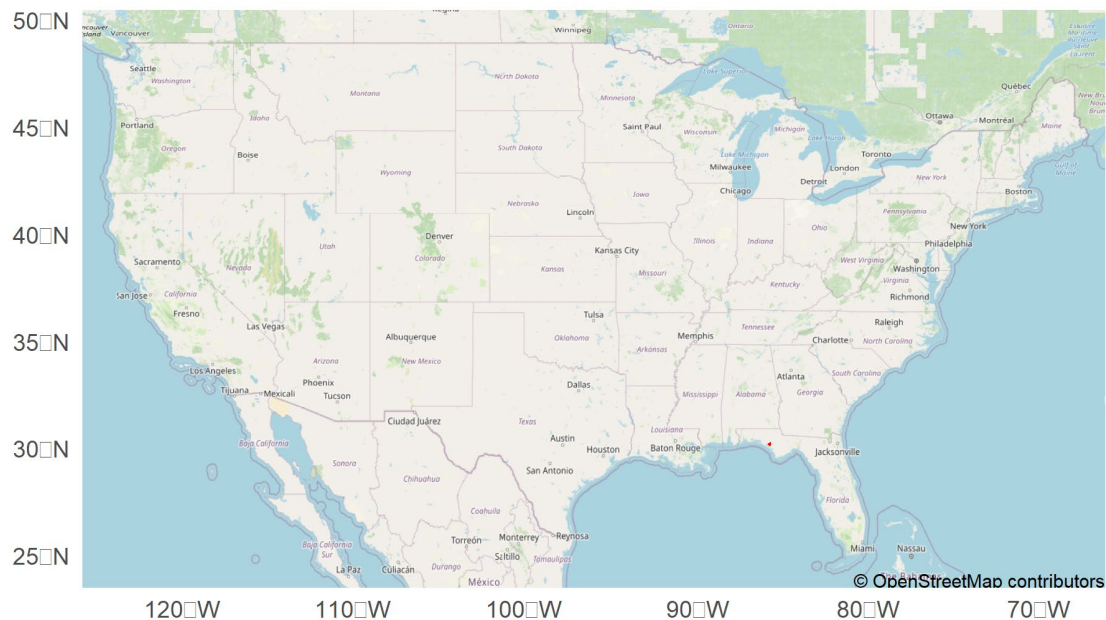


Figure 3. Range map of Panama City crayfish (red polygon overlay). Range map accessed on December 21, 2022, at <https://ecos.fws.gov/ecp/species/8915>.

Vulnerability

This section includes a summary of the status of the species, environmental baseline, cumulative effects, and a summary of how these contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened

Recommendations for Status from Latest 5-Year Review: No change

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

Number of Populations: Multiple populations (few)

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

States within the range: Florida

Critical Habitat designated: Yes

Pesticides noted USFWS documents: Yes

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

The Panama City crayfish is a semi-terrestrial crayfish that is endemic to a portion of Bay County, Florida, in the vicinity of Panama City (Hobbs 1942, Mansell 1994, Keppner and Keppner 2001, USFWS 2019). Historically, the species inhabited natural and often temporary bodies of shallow fresh water within open pine flatwoods and prairie-marsh communities (Hobbs 1942, USFWS 2019). However, most of these communities have been cleared for residential or commercial development or replaced with slash pine plantations (FWC 2016, USFWS 2019). Thus, the species currently is known to inhabit the waters of grassy, gently sloped ditches and swales, slash pine plantations, and utility rights-of-way (Keppner and Keppner 2001, USFWS 2019). The highest densities of Panama City crayfish have been recorded in areas with little to no shrub or tree cover. Suitable habitat is normally dominated by herbaceous vegetation such as redroot (*Lachnanthes caroliniana*), beakrushes (*Rhynchospora* spp.), pitcher plants (*Sarracenia* spp.), sundews (*Drosera* spp.), butterworts (*Pinguicula* spp.), and lilies (*Hymenocallis* spp.) (Keppner and Keppner 2004, Keppner and Keppner 2005, USFWS 2019). We expect herbaceous forbs like these species are particularly sensitive to Enlist herbicides. Lowest population densities have occurred in small, open sites where shrubs or trees were present, or in the furrows between bedding rows in some pine plantations (Keppner and Keppner 2005, USFWS 2019).

Female Panama City crayfish have been found with eggs and/or young from March through September (USFWS 2019). Juveniles are most frequently found in the summer and have been observed through December, so young appear to be produced from at least March to December. Panama City crayfish males alternate between reproductively mature forms (Form I) and nonreproductive forms (Form II) through a continuous series of molts (Taylor et al. 1996, p. 27, USFWS 2019). Most breed more than once, with mating among mature yearlings frequent. Juveniles can be carried overland by sheet flow during rainy periods, which aids in dispersal (Keppner and Keppner 2002, USFWS 2019).

Observations of Panama City crayfish held in aquaria spanning 1.5+ years (Keppner 2014, USFWS 2019) indicate they are detritivores and herbivores. Specimens were offered dead

animal material, but they avoided it in favor of processing the substrate from particles of prepared fish food and the fresh aquatic vegetation that were provided as primary food sources.

The Panama City crayfish's historical range is located in south-central Bay County, Florida, and is estimated to cover a 56 square mile area, of which approximately 9,180 acres of core and 5,647 acres of secondary soils remain undeveloped (USFWS GIS 2017, 2019). Its range, on a peninsula, is bounded by Callaway Bayou to the southeast, Callaway Creek to the east, Bayou George Creek and the headwaters of Callaway Creek to the northeast, North Bay to the north, West Bay to the west, and St. Andrew Bay and East Bay to the south. The species' range overlaps jurisdictional boundaries of four cities (Panama City, Lynn Haven, Callaway, Springfield) and Bay County proper. Currently, five populations are spread throughout the western range and four throughout the eastern range.

Several conservation easements within their range are under management for the PCC (USFWS 2019). These easements are largely wet pine flatwoods and wet prairie habitats. Other private lands are inaccessible to surveyors although are likely occupied by the Panama City crayfish given the appropriate soil types and a lack of significant disturbance.

Environmental Baseline

Habitat loss, fragmentation, and degradation have contributed to the present condition of the Panama City crayfish, and we anticipate these activities to continue in the future. In addition to the relevant activities described in the overarching Environmental Baseline section of the Opinion, past activities in the action area that have contributed to the species' decline include, but are not limited to, residential, commercial, infrastructure, and industrial development; conversion of habitat to intensive pine silviculture, ranching, and farming uses; altered hydrology; roadside ditch maintenance and construction activities; fire suppression; declines in water quality; incompatible applications of chemicals or spills, offroad vehicle use, illegal harvest, direct competition with indigenous and/or nonindigenous species; sea level rise; hurricanes; and climate change (Mansell 1994; Keppner 2001; Keppner and Keppner 2001, 2005; FWC 2006; USFWS 2019, 2022). We considered all of these activities in the environmental baseline for the species. Past consultations, such as on the registration of the pesticide malathion under FIFRA, have also contributed to the condition of the environmental baseline for the species in the action area by developing and implementing measures to reduce the impacts of pesticides to listed species.

In addition to activities that have negatively impacted the species, activities that benefit the species have also occurred within the action area. For example, efforts have been made since 2011 to restore parcels of degraded habitat to make them suitable for Panama City crayfish. Florida Fish and Wildlife Conservation Commission (FFWCC) staff has worked closely with Service staff to identify conservation easements (e.g., 11-acre easement for the High Point Population) within the species' habitat, establish agreements with landowners, conduct habitat and faunal surveys, implement habitat management, and monitor the progress of such sites in supporting viable Panama City crayfish populations (USFWS 2019).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat loss, fragmentation, and degradation. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct removal of animals, or indirectly through the loss of natural and temporary bodies of shallow fresh water within open pine flatwoods and prairie-marsh communities, leading to changes in habitat quality required by the species. These effects are anticipated to be greatest in privately owned portions of the range.

Similarly, we anticipate that actions designed to benefit the species (e.g., conservation easements, habitat restoration, etc.) may continue. For example, Bay County, Florida and at least one other partner intend to conserve approximately 1,900-2,000 acres of suitable lands (USFWS 2019). Individuals in these conservation areas are anticipated to experience fewer of the adverse effects described due to land protection and enhanced habitat quality.

Overall Vulnerability: High

In summary, past and present activities have impacted the species and its critical habitat through habitat loss, fragmentation, and degradation, and other associated impacts. Some activities, such as those associated with conservation easements as described above have provided varying degrees of protection for the species and its critical habitat. However, given that the species is threatened, has a restricted range, few populations, and shows declining population trends, the vulnerability of the species is high.

Risk

The Panama City crayfish does not occur on-field and is thus not at risk of growth or survival effects resulting from consuming contaminated food items. The extent of overlap between the species' range and runoff areas is 3.31%, indicating that individuals are likely to experience runoff exposure. Runoff concentrations of Enlist herbicides will not be high enough to cause toxic effects to exposed individuals. Although the Panama City crayfish is reliant on herbaceous forbs that are sensitive to Enlist herbicides for food and shelter, spatially refined runoff model results indicate that most runoff events will not cause more than low levels of adverse effects to food and habitat resources for the crayfish. Thus, the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

On-field Exposure

While the Panama City crayfish's range has a small extent of overlap with Enlist pesticide use sites (Table 7), based on our knowledge of its life history and behaviors, we do not expect the crayfish will enter and forage in agricultural areas. Thus, the species is not likely to experience on-field exposure via spray application or ingestion of contaminated food items.

Off-field Exposure

We expect the Panama City crayfish could occur in runoff zones adjacent to application sites. Corn, cotton, or soybean runoff zones overlap with 3.31% of the species range (Table 7).

Table 7. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field	Runoff zone
Corn	0.2	0.54
Cotton	1.3	2.4
Soybean	0.33	0.91
Total ⁴	1.63	3.31

Magnitude of Effects

Effects to Growth and Mortality

We do not expect the Panama City crayfish to occur on-field and, thus, the species is not at risk of adverse effects to growth or mortality from on-field exposure. We do not expect runoff exposure will result in any adverse growth effects or mortality to individuals as we anticipate runoff concentrations of Enlist herbicides will be well below levels where laboratory studies have observed toxic effects to animals.

Effects to Plant-based Resources

We expect Enlist herbicide runoff exposure will result in growth effects to sensitive non-listed plant species (e.g., herbaceous forbs), which may cause a decrease in their availability within the runoff zone for the Panama City crayfish. The Panama City crayfish is reliant on herbaceous forbs that are sensitive to Enlist herbicides for food and shelter. Runoff from corn and soybean fields treated with Enlist pesticides may result in EECs up to 0.02-0.05 lbs/acre, which can result in growth effects in up to 21-53% of sensitive plant species (Table 8). We consider this low to high magnitude of effect to sensitive plants species within the runoff zone.

Table 8. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the percent of sensitive plant species expected to experience at least moderate growth effects from runoff exposure.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Corn	0.05	53
Cotton	0.02	21

⁴ Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices. Total overlap is capped at 100%.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Soybean	0.02	21

However, while the EECs reported above represent high end exposure estimates, we do not expect all areas within the runoff zone will experience such high levels of EECs. EPA's Tier 3 geographic distribution models show that, with the implementation of required runoff mitigation measures, 61% of corn, 95% of cotton, and 91.9% of soybean runoff areas are not likely to ever experience runoff EECs that cause more than low levels of adverse effects throughout the duration of the action (Table 9). Thus, while a small number of locations could experience EECs that result in moderate to high levels of adverse effects to sensitive plant species, we expect that most locations within the runoff zone will not likely experience EECs that cause more than low levels of adverse effects to sensitive plants. In summary, although the Panama City crayfish is reliant on herbaceous forbs that are sensitive to Enlist herbicides for food and shelter, spatially refined runoff model results show that the majority of runoff scenarios are unlikely to cause more than low levels of effects to herbaceous forbs. Thus, we expect the magnitude of effect to the species will be low. We do not anticipate this level of effect will reduce reproduction or influence the distribution of the species.

Table 9. Number of local runoff scenarios modeled for the species, and the number and percent of runoff scenarios that could cause no more than low levels of effects to plant species.

Crop	# runoff scenarios	# scenarios that will not cause more than low levels of effects	% scenarios that will not cause more than low levels of effects
Corn	162	99	61
Cotton	196	186	95
Soybean	211	17	91.9

Risk Summary

The Panama City crayfish is not likely to occur on-field and thus is not at risk of effects to growth or survival from on-field exposure to Enlist pesticides. Overlap between the species range' and runoff areas is 3.31%, indicating that, at most, only a few individuals are likely to experience runoff exposure. Spatially refined runoff exposure models further indicate that the majority of runoff events are not likely to cause more than low levels of adverse effects to plants, resulting in no more than low levels of adverse effects to food and habitat resources. We do not anticipate that this level of adverse effects to plant-based resources will reduce reproduction or adversely influence the distribution of the species. Thus, we expect very few individuals are likely to experience adverse effects, and the overall risk to the species is low.

Overall Risk to the Species: Low

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects from the proposed action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo, as proposed, is not likely to jeopardize the continued existence of the Panama City crayfish. As discussed below, although the species' vulnerability is high, the risk of adverse effects to individuals of the species from the effects of the proposed action is low. Thus, we anticipate, at most, small numbers of individuals may be adversely affected over the duration of the Action, and we do not expect species-level effects to occur.

The Panama City crayfish is listed as threatened and has a restricted range, 9 populations, and is susceptible to climate change, making it a highly vulnerable species. Habitat loss, fragmentation, and degradation (e.g., residential, commercial, infrastructure, and industrial development; conversion of habitat to intensive pine silviculture, ranching, and farming uses; altered hydrology; roadside ditch maintenance and construction activities; fire suppression; declines in water quality; incompatible applications of chemicals or spills, offroad vehicle use, illegal harvest, direct competition with indigenous and/or nonindigenous species; sea level rise; hurricanes; and climate change) are listed as the main threats preventing the recovery of the species. Although agricultural pesticide use may continue to degrade habitat quality by adversely affecting plant health, we do not expect the action will significantly contribute to habitat loss, because we do not expect runoff EECs to be high enough to cause community- or ecosystem-level adverse effects to plant communities comprised of a diversity of plants such as trees, woody shrubs, and perennial species, which have differential sensitivity to Enlist herbicides.

The overlap between the Panama City crayfish's range with Enlist pesticide use sites and runoff areas is 3.31%. We do not expect individuals to forage or otherwise occur on agricultural fields, suggesting that only runoff exposure is likely to occur. We expect estimated concentrations of Enlist herbicides in runoff to be well below levels where toxic effects will occur to individuals. While the Panama City crayfish is reliant on herbaceous forbs that are sensitive to Enlist herbicides for food and shelter, spatially refined runoff model results show that the majority of runoff scenarios are unlikely to cause more than low levels of effects to herbaceous forbs. Thus, we do not expect runoff will result in more than a low magnitude of adverse effects to the species and consider the overall risk to the species to be low.

Thus, while the Panama City crayfish is a highly vulnerable species, we anticipate, at most, only a few individuals are likely to experience off-field exposure, which will result in only low magnitudes of adverse effects herbaceous forbs used for food and shelter, causing no more than low levels of adverse effects to the crayfish. We do not expect this level of adverse effect will rise to the level of take.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 2019. Species status assessment of the Panama City crayfish, Version 2.0, July 2019, Panama City, Florida. 112 pp.

U.S. Fish and Wildlife Service (USFWS). 2022. Endangered and Threatened Wildlife and Plants; Threatened Species Status With Section 4(d) Rule for Panama City Crayfish and Designation of Critical Habitat. Federal Register 87(3):546-581.

Integration and Synthesis Summary: Insects – Dakota skipper

Scientific Name:	Common Name:	Entity ID:
<i>Hesperia dacotae</i>	Dakota skipper	3412

Overview

In reviewing the status of the species, the environmental baseline for the action area, the cumulative effects, and the effects of the action, the Service has determined that while the species' vulnerability ranking is medium, the risk of adverse effects to the species from the registration of Enlist One/Duo is low, as described in the following sections. Therefore, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Dakota skipper. We discuss our rationale for the species in the sections below.

Species Current Range

Last Updated: 04-07-2021 - Wherever found



Figure 4. Range map of Dakota skipper (red polygon overlay). Range map accessed on February 21, 2023, at <https://ecos.fws.gov/ecp/species/1028>.

Vulnerability

This section includes a summary of the status of the species, environmental baseline, cumulative effects, and a summary of how these contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened

Recommendations for Status from Latest 5-Year Review: No change

Distribution: Species/Populations neither constrained or widespread

Number of Populations: Multiple populations (numerous)

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

States within the range: Illinois, Iowa, Minnesota, North Dakota, South Dakota

Critical Habitat designated: Yes

Pesticides noted USFWS documents: Yes, Pesticides and Herbicides

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

The Dakota skipper is a small prairie butterfly that inhabits remnants of tallgrass prairie and mixed-grass prairie in the north-central United States and into southern Saskatchewan and Manitoba Provinces of Canada (USFWS 2021). Within the native prairie patches where it persists, the species relies on high-quality habitat conditions – diverse native grassland plant communities – and on natural or human disturbances (e.g., prescribed burning and grazing (USFWS 2018)) that maintain the integrity of these plant communities while minimizing mortality to vulnerable life stages.

Dakota skippers are univoltine (having a single flight per year), with an adult flight period that may occur from the middle of June through the end of July (McCabe 1979, p. 6; McCabe 1981, p. 180; Dana 1991, p. 1; Royer and Marrone 1992a, p. 26; Skadsen 1997, p. 3; Swengel and Swengel 1999, p. 282, USFWS 2014). The actual flight period varies somewhat across the range of each species and can also vary significantly from year to year (e.g., Rigney 2013a, p. 138, USFWS 2014), depending on temperature patterns (Bink and Bik 2009, Koda and Nakamura 2012, USFWS 2014). The Dakota skipper flight period in a locality lasts 2 to 4 weeks.

Dakota skipper mating occurs throughout the flight period (Braker 1985, p. 46; McCabe and Post 1977, pp. 36–38; McCabe 1979, p. 6; McCabe 1981, p. 180; Dana 1991, p. 15; Swengel and Swengel 1999, p. 282; Rigney 2013a, p. 138, USFWS 2014). Dakota skippers lay eggs on broadleaf plants (McCabe 1981, p. 180) and grasses (Dana 1991, p. 17, USFWS 2014), although larvae feed only on grasses. Dakota skippers overwinter as larvae and complete one generation per year. Dakota skipper eggs hatch after incubating for 7–20 days; therefore, hatching is likely completed before the end of July. Dana (1991, p. 32, USFWS 2014) estimated the potential adult life span of Dakota skipper to be 3 weeks and the average life span (or residence on site before death or emigration) to be 3 to 10 days on one Minnesota prairie.

Nectar and water sources for adult Dakota skippers vary regionally and include purple coneflower (*Echinacea angustifolia*), blanketflower (*Gaillardia aristata*), black-eyed Susan (*Rudbeckia hirta*), purple locoweed (*Oxytropis lambertii*), bluebell bellflower (*Campanula rotundifolia*), prairie milkvetch (*Astragalus adsurgens*) (syn. *A. laxmannii*), and yellow sundrops (*Calylophus serrulatus*) (Dana 1991; McCabe and Post 1977, pp. 36–38; Royer and Marrone 1992a, p. 21; Rigney 2013a, p. 142, USFWS 2014). Dakota skipper larvae feed on several native grass species; little bluestem (*Schizachyrium scoparium*) is a frequent food source of the larvae (Dana 1991, p. 17; Royer and Marrone 1992a, p. 25, USFWS 2014).

Dakota skippers are not known to disperse widely (USFWS 2014). They may be incapable of moving greater than 1 kilometer (km) (0.6 miles (mi)) between patches of prairie habitat separated by structurally similar habitats (e.g., crop fields, grass dominated fields or pasture, but not necessarily native prairie) (Cochrane and Delphey 2002, p. 6, USFWS 2014).

As of 2018, there were an estimated 76 metapopulations consisting of 150 distinct subpopulations that persisted (67 Present and 83 Unknown status subpopulations) across 3 states and 2 Canadian provinces (USFWS, Unpublished geodatabase, USFWS 2019). Approximately 56 subpopulations have become extirpated since the time of listing, with the majority of subpopulations lost occurring in Minnesota (USFWS 2019). Many of the sites that became extirpated, however, were small and isolated populations where a low likelihood of persistence was anticipated based on poor habitat quality. While the number of known Dakota skipper subpopulations is in decline, new subpopulations have been discovered in areas not previously surveyed at the far western edge of the species' range. A total of 36 new subpopulations have been found, 34 in North Dakota and 2 in South Dakota (USFWS 2019).

Environmental Baseline

Habitat loss, fragmentation, and degradation have contributed to the present condition of the Dakota skipper, and we anticipate these activities to continue in the future. In addition to the relevant activities described in the overarching Environmental Baseline section of the Opinion, past activities in the action area that have contributed to the species decline include, but are not limited to, conversion of native prairie (e.g. from agriculture, urbanization, and oil & gas development); ecological succession of native prairie to habitats dominated by brush or trees; invasive species; direct and indirect effects of pesticides, including herbicides; flooding; climate change; and incompatible land management regimes that degrade the species' habitat (USFWS 2019). In addition, the decrease of grasslands increases fragmentation and the potential for pesticide drift and exacerbates the spread of invasive species into natural habitats (USFWS 2019). We considered all of these activities in the environmental baseline for the species. Past consultations, such as on the registration of the pesticide malathion under FIFRA, have also contributed to the condition of the environmental baseline for the species in the action area by developing and implementing measures to reduce the impacts of pesticides to listed species.

In addition to activities that have adversely impacted the species, activities that benefit this species have also occurred within the action area. For example, the Minnesota Zoo has been involved with maintaining stable insurance populations of Dakota skippers, which has led to reintroduction of the species at one extirpated site in Minnesota and has provided research opportunities to learn more about life history, survivorship, and recovery needs for the species (USFWS 2019). In addition, 58 Dakota skipper sites are protected from destruction or conversion through a conservation easement or fee title ownership by a conservation agency (USFWS 2014). Furthermore, about one-half of the present or unknown Dakota skipper sites (total number of present/unknown sites is 171) in the United States are privately owned (excluding populations on land owned by The Nature Conservancy) (USFWS 2014). Twelve of these populations are on private land protected by conservation easements that preclude plowing and haying before July 16. Finally, The Nature Conservancy acquired a reserve in the Sheyenne Grassland area, Brown Ranch, which is a Dakota skipper site with an unknown status, and

manages some of the most significant habitats for the species in Minnesota, including the Hole-in-the Mountain Prairie preserve (USFWS 2014).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat loss, fragmentation, and degradation. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct removal of animals, or indirectly through the loss of tallgrass prairie and mixed-grass prairie leading to adverse changes in habitat quality required by the species. These effects are anticipated to be greatest in privately owned portions of the range.

Overall Vulnerability: Medium

In summary, past and present activities have impacted the species and its critical habitat through habitat loss, fragmentation, and degradation, and other associated impacts. Some activities, such as those associated with establishing conservation easements have provided or will provide varying degrees of protection for the species and its critical habitat. However, given that the species is threatened, has a range that is neither restricted nor widespread, has numerous populations, and has a declining population trend, the vulnerability of the species is Medium.

Risk

We do not expect the Dakota skipper will occur on-field, indicating no adverse effects to growth or mortality resulting from exposure via spray application or the consumption of contaminated food items. There extent of overlap between the species' range and runoff zones indicates that individuals may be exposed to runoff. Runoff concentrations of Enlist herbicides will not be high enough to cause growth or mortality effects to individuals, and spatially refined runoff exposure models indicate that the majority of runoff events are not likely to cause more than low levels of effects to plants. Furthermore, the Dakota skipper is not reliant on plant species that are sensitive to Enlist pesticides. Thus, the overall risk of adverse effects to the species is low. We discuss our rationale below.

Extent of exposure

On-field Exposure

The Dakota skipper's range does not overlap with Enlist pesticide use sites (Table 10). Thus, the species is not likely to experience on-field exposure through contact or ingestion of contaminated food items. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

Off-field Exposure

We expect the Dakota skipper could occur in runoff zones adjacent to application sites. The overlap of the species range with corn, cotton, or soybean runoff zones is 7.77% (Table 10).

Table 10. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field	Runoff zone
Corn	0	7.55
Cotton	0	0
Soybean	0	7.77
Total ⁵	0	7.77

Magnitude of Effects

Effects to Growth and Mortality

We do not expect the Dakota skipper will enter and forage on agricultural fields as the species' range does not overlap with use sites. Thus, we do not expect any on-field contact or dietary exposure will occur, and no subsequent risk of mortality or growth effects from either 2,4-D or glyphosate. We do not expect runoff exposure will result in any adverse growth effects or mortality to the Dakota skipper either as we expect runoff concentrations of Enlist herbicides will be well below levels where toxic effects to insect species have been previously observed.

Effects to Plant-based Resources

We expect Enlist runoff exposure will result in growth effects to sensitive non-listed plant species (e.g., herbaceous forbs), which may cause a decrease in their availability within the runoff zone for the Dakota skipper. Runoff from corn and soybean fields treated with Enlist pesticides may result in EECs up to 0.021-0.026 lbs/acre, which can result in growth effects in up to 22-30% of sensitive plant species (Table 11). We consider this a low to moderate magnitude of adverse effect to sensitive plant species within the runoff zone.

Table 11. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients that are reasonably certain to occur resulting from application to corn, cotton, and soybean fields and the expected percent of sensitive plant species expected to experience at least moderate growth effects from runoff exposure.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Corn	0.021	22
Cotton	--	--
Soybean	0.026	30

⁵ Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices. Total overlap is capped at 100%.

However, while these EECs reported above represent high end exposure estimates, we do not expect all areas within the runoff zone will experience such high levels of EECs. EPA's Tier 3 geographic distribution models show that, with the implementation of required runoff mitigation measures, 97.1% of corn and 89.7% of soybean runoff areas are not likely to ever experience runoff EECs that cause more than low levels of adverse effects throughout the duration of the action (Table 12).

Table 12. Number of local runoff scenarios modeled for the species, and the number and percent of runoff scenarios that could cause no more than low levels of effects to plant species.

Crop	# runoff scenarios	# scenarios that will not cause more than low levels of effects	% scenarios that will not cause more than low levels of effects
Corn	10593	10286	97.1
Cotton	--	--	--
Soybean	273	245	89.7

Thus, we expect that most locations within the runoff zone will not likely experience EECs that cause more than low levels of adverse effects to sensitive plants. While there is a potentially moderate effect to sensitive plant species at a small percentage of locations, we expect this will result in, at most, a low magnitude of reduction in food and habitat resources as the Dakota skipper is not reliant on these sensitive plant species. Dakota skipper larvae only use monocot species such as native grass species, as food and shelter. While this specialized requirement can make them more vulnerable to resource loss, greenhouse studies show that monocot species are typically less sensitive to Enlist pesticide active ingredients. Thus, we expect the magnitude of adverse effects to the species will be low. We do not anticipate this level of adverse effects will reduce reproduction or influence the distribution of the species.

Risk Summary

We do not expect the Dakota skipper will enter and forage on agricultural fields as the species range does not overlap with use sites. The overlap between the species' range and runoff areas is 7.77%, indicating that more than a few individuals are likely to experience runoff exposure. However, we anticipate runoff concentrations of Enlist herbicides are likely well below the level where previous studies have observed any adverse effects to other insect species, indicating that there is a very low risk of adverse growth effects or mortality to individuals exposed to runoff. Spatially refined runoff exposure model results indicate that most runoff events within this overlap area are not likely to cause more than low level adverse effects to plants. While there may be up to moderate magnitudes of adverse effects to sensitive plant species at a small percentage of locations within the runoff zone, we expect there will be, at most, a low magnitude of decreases in food or habitat as the Dakota skipper does not rely on plant species considered to be sensitive to Enlist herbicides. We do not anticipate that this level of adverse effect to plant-

based resources will reduce reproduction or influence the distribution of the species. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk to the Species: Low

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects from the proposed action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo, as proposed, is not likely to jeopardize the continued existence of the Dakota skipper. As discussed below, although the vulnerability is medium, we expect there is a very low risk of adverse growth effects or mortality to exposed individuals and a low risk of decreases in food and habitat resources from the effects of the proposed action. Thus, while we anticipate, at most, a small number of individuals may experience low levels of indirect effects over the duration of the Action, we do not expect species-level adverse effects will occur.

The Dakota skipper is listed as threatened, has a range that is neither restricted or widespread, has numerous populations, and is susceptible to climate change, making it a moderately vulnerable species. Habitat loss, fragmentation, and degradation (e.g., from agriculture, urbanization, and oil & gas development); ecological succession of native prairie to habitats dominated by brush or trees; invasive species; direct and indirect effects of pesticides, including herbicides; flooding; climate change; and incompatible land management regimes that degrade the species' habitat) are the main threats preventing the recovery of the species. Although agricultural pesticide use may continue to degrade habitat quality by affecting plant health, we do not expect the Action will significantly contribute to habitat loss as we do not expect runoff EECs will be high enough to cause community- or ecosystem-level effects to the plant communities supporting the Dakota skipper, which are comprised of a diversity of plants like grasses and other monocots that are less sensitive to Enlist herbicides.

The range of the Dakota skipper does not overlap with Enlist pesticide use sites, and as such, we do not expect any on-field exposure via spray or consumption of contaminated food will occur. The range of the Dakota skipper overlaps 7.77% with runoff areas, though we expect runoff concentrations of Enlist herbicides to be well below levels where previous studies have observed adverse growth effects or mortality to insect species. While growth effects to sensitive plant species will likely occur within the runoff zone, the majority of runoff scenarios do not result in more than low levels of adverse effects to these plant species. Furthermore, we do not expect the specific plants that the Dakota skipper relies on for food, habitat, and recruitment resources to be sensitive to Enlist herbicides, and thus, the Dakota skipper will likely experience no more than low magnitudes of adverse effects from all runoff exposure. Thus, the risk of adverse effects to the species is low.

We do not anticipate any individuals of the species will experience mortality, growth, or reproductive effects, and we anticipate that only small adverse effects to habitat quality will result from the proposed Action. We do not expect this level of adverse effect will rise to the level of take.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 2014. Endangered and Threatened Wildlife and Plants; Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling. Federal Register 79(206):63672-63748.

U.S. Fish and Wildlife Service (USFWS). 2018. Species status assessment report for the Dakota skipper (*Hesperia dacotae*). 97 pp.

U.S. Fish and Wildlife (USFWS). 2019. Dakota skipper (*Hesperia dacotae*) 5-Year Review: Summary and Evaluation. Bloomington, Minnesota. 9 pp.

U.S. Fish and Wildlife Service (USFWS). 2021. Recovery Plan for Dakota skipper (*Hesperia dacotae*). U.S. Fish and Wildlife Service, Great Lakes Region, Bloomington, Minnesota. 13 pp.

Integration and Synthesis Summary: Insects - Poweshiek Skipperling

Scientific Name:	Common Name:	Entity ID:
<i>Oarisma poweshiek</i>	Poweshiek skipperling	10147

Overview

In reviewing the status of the species, the environmental baseline for the action area, the cumulative effects, and the effects of the action, the Service has determined that while the species' vulnerability ranking is high, the risk of adverse effects to the species from the registration of Enlist One/Duo is low, as described in the following sections. Therefore, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Poweshiek skipperling. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 10-26-2021 - Wherever found

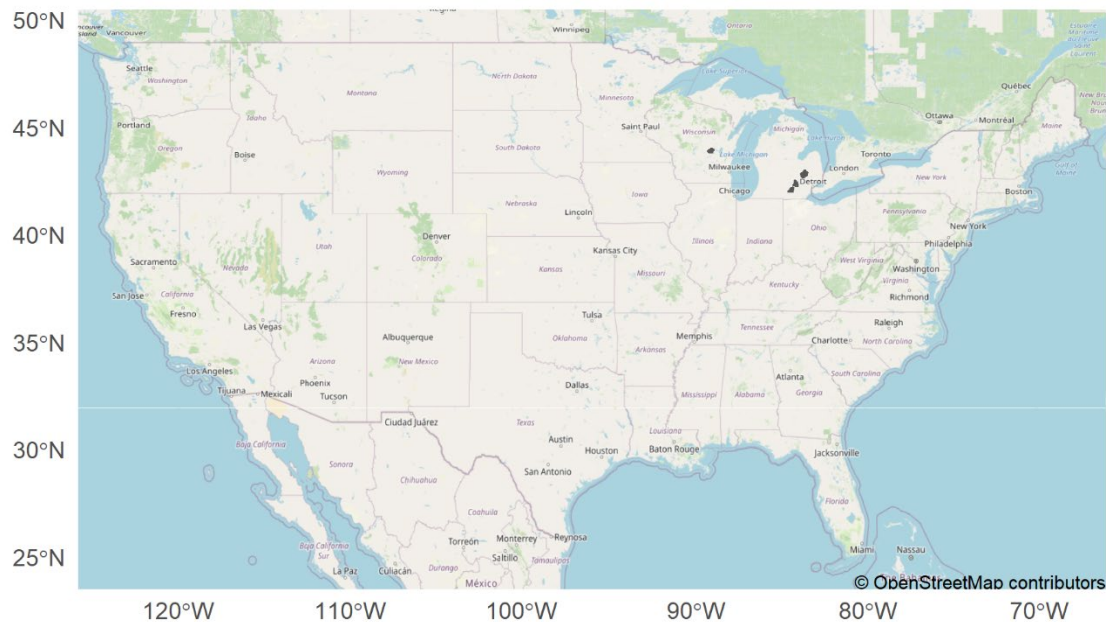


Figure 5. Range map of Poweshiek skipperling (red polygon overlay). Range map accessed on November 2, 2022, at <https://ecos.fws.gov/ecp/species/9161>.

Vulnerability

This section includes a summary of the status of the species, environmental baseline, cumulative effects, and a summary of how these contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered

Recommendation for Status from Latest 5-Year Review: No change

Distribution: Species/Populations neither constrained or widespread

Number of Populations: Multiple populations (few)

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

States within the range: IA, MI, ND, SD, WI

Critical Habitat designated: Yes

Pesticides noted in USFWS documents: Yes, Pesticides and Herbicides

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

Poweshiek skipperlings are obligate residents of undisturbed (remnant, untilled) high-quality prairie, ranging from wet-mesic tallgrass prairie to dry-mesic mixed-grass prairie, including prairie fens, grassy lake and stream margins, moist meadows, sedge meadow, and wet-to-dry prairie. The preferred larval food plant for some populations of Poweshiek skipperling is prairie dropseed (Borkin 1995, p. 6); larvae have also been observed feeding on little bluestem (*Schizachyrium scoparium*) (Borkin 1995, pp. 5–6) and sideoats grama (*Bouteloua curtipendula*) (Dana 2005a, pers. comm.). Poweshiek skipperling larvae have been observed feeding on *Carex* sp. (Borkin 1994, p. 6; Borkin 1996, p. 2), although not through the entire larval development (Borkin 2014, pers. comm.).

Poweshiek skipperlings lay their eggs near the tips of leaf blades and overwinter as larvae on the host plants (Bureau of Endangered Resources in Swengel and Swengel 1999, p. 285, Borkin 2000, p. 7). Poweshiek skipperlings have also been documented laying eggs on the entire length of grass leaf blades and on low-growing deciduous foliage (Dupont 2013, p. 133). McAlpine (1972, pp. 85–93) observed hatching of larval Poweshiek skipperling after about 9 days. Unlike Dakota skippers, Poweshiek skipperling do not form shelters underground (McAlpine 1972, pp. 88–92; Borkin 1995, p. 9; Borkin 2008, pers. comm.), instead the larvae overwinter up on the blades of grasses and on the stem near the base of the plant (Borkin 2008, pers. comm.; Dana 2008, pers. comm.). Borkin (2008, pers. comm.) observed larvae moving to the tips of grass blades to feed on the outer and thinner edges of the blades, with later movement down and among blades.

Poweshiek skipperlings have low mobility and are non-migratory. Their dispersal is very limited, and they are unlikely to immigrate. Larvae are very sedentary.

A drastic decline in this species was observed nationwide. The Poweshiek skipperling was once a common prairie butterfly widely dispersed in eight States, extending from Michigan to North Dakota, and portions of Manitoba, Canada. However, its range is now substantially reduced such that the Poweshiek skipperling is restricted to small patches of fragmented native prairie remnants in portions of two States and one Canadian province. The species is presumed extirpated from Illinois and

Indiana, and the status of the species is unknown in four of the six States with relatively recent records (within the last 20 years). Survey data indicate that the Poweshiek skipperling has declined to zero or to undetectable levels in approximately 96% of sites where it was recorded. Out of the 298 historically documented Poweshiek skipperling sites, there are currently 7 sites where the species is considered present (at the time of listing, 12 sites were considered to have Poweshiek skipperling present).

Environmental Baseline

Habitat loss and degradation within the species' range are the primary contributors to the present condition of the Poweshiek skipperling, and we anticipate these activities and threats to continue in the future. In addition to the relevant activities described in the overarching Environmental Baseline section of the Opinion, past activities in the action area that have contributed to the species' decline include, but are not limited to, conversion of prairie for agriculture, invasive species, reduction in diversity of native prairie communities, non-agricultural development, chemical contaminants, pesticides, herbicides, grazing, haying, energy development, wind development, wildfire, altered hydrology, and climate change. We considered all of these activities in the environmental baseline for the species. Past consultations, such as on the registration of the pesticide malathion under FIFRA, have also contributed to the condition of the environmental baseline for the species in the action area by developing and implementing measures to reduce the impacts of pesticides to listed species.

In addition to activities that have adversely impacted the species, activities that benefit this species have also occurred within the action area. For example, in 2018, Springfield Township (Michigan) was awarded Great Lakes Restoration Initiative (GLRI) grant money to partially fund the acquisition of an approximately 55-acre tract of critically important for the species. This parcel has since been incorporated as part of Springfield Township's Shiawassee Basin Preserve (USFWS 2019).

Cumulative Effects

We anticipate that many of the non-Federal activities described in the Vulnerability section will continue in the future, including habitat loss and degradation, leading to changes in habitat quality required by the species. These effects are anticipated to be greatest in privately owned portions of the range.

Overall Vulnerability: High

In summary, past activities have impacted the species and its critical habitat through habitat loss and degradation and other associated impacts, and we expect similar activities and effects to occur in the future. Some activities, such as those described above associated with the purchase of important land to incorporate into a preserve have provided varying degrees of protection for the species and its critical habitat. However, given that the species is endangered, has a restricted range, few populations, and shows declining population trends, the vulnerability of the species is high.

Risk

We do not expect the Poweshiek skipperling will occur on-field, indicating no risk of adverse effects to growth and survival from exposure to spray or the consumption of contaminated food items on Enlist herbicide use sites. The overlap between the species' range and runoff areas is 70.33%, indicating that a large number of individuals may be exposed off-field. However, we expect runoff exposure will not cause any adverse growth effects or mortality to exposed individuals, as concentrations of Enlist herbicides in runoff are likely well below levels where previous studies have observed any toxic effects to insects. Spatially refined runoff exposure modeling indicates that the majority of runoff events are not likely to cause more than low levels of adverse effects to plants. Furthermore, the Poweshiek skipperling is not reliant on plant species that are sensitive to Enlist pesticides. Thus, the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

On-field Exposure

While there is a high extent of overlap with Enlist application sites (up to 61.5% total overlap with corn and soybean fields), Poweshiek skipperlings are obligate residents to undisturbed prairielands, and as such, we do not expect this species to occur on agricultural fields (Table 13). Thus, the species is not likely to experience on-field exposure through contact or ingestion of contaminated food items.

Off-field Exposure

We expect the Poweshiek skipperling to occur in runoff zones adjacent to application sites. The overlap of the species' range with the runoff zone is 70.33% (Table 13).

Table 13. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field	Runoff zone
Corn	61.50	70.33
Cotton	0.00	0.00
Soybean	61.04	69.82
Total ⁶	61.50	70.33

Magnitude of Effects

Effects to Growth and Mortality

We do not expect the Poweshiek skipperling to occur on-field, and thus, it is not at risk of adverse effects to growth or mortality from on-field exposure. While individuals may occur in

⁶ Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices. Total overlap is capped at 100%.

runoff areas, we anticipate runoff concentrations of Enlist herbicides will be well below levels where laboratory studies have observed toxic effects to insects.

Effects to Plant-based Resources

We expect Enlist herbicide runoff exposure will result in growth effects to sensitive non-listed plant species (e.g., herbaceous forbs), which may cause a decrease in their availability within the runoff zone. Runoff from corn and soybean fields treated with Enlist pesticides may result in EECs up to 0.023-0.05 lbs/acre, which can result in growth effects in up to 25-53% of sensitive plant species (Table 14).

Table 14. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients that are reasonably certain to occur resulting from application to corn, cotton, and soybean fields and the expected percent of sensitive plant species expected to experience at least moderate growth effects from runoff exposure.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Corn	0.023	25
Cotton	--	--
Soybean	0.05	53

However, while these EECs reported above represent high end exposure estimates, we do not expect all areas within the runoff zone will experience such high levels of EECs. EPA's Tier 3 geographic distribution models show that, with the implementation of required runoff mitigation measures, 95.6% of corn and 75.4% of soybean runoff areas are not likely to ever experience runoff EECs that cause more than low levels of adverse effects throughout the duration of the action (Table 15).

Table 15. Number of local runoff scenarios modeled for the species, and the number and percent of runoff scenarios that could cause no more than low levels of effects to plant species.

Crop	# runoff scenarios	# scenarios that will not cause more than low levels of effects	% scenarios that will not cause more than low levels of effects
Corn	3327	3180	95.6
Cotton	--	--	--
Soybean	65	49	75.4

Furthermore, even in areas that may experience higher levels of runoff EECs, we do not anticipate all plants that provide food and habitat resources will experience high levels of adverse effects. Monocot plants, such as the native grasses that provide habitat and food for larvae, are not sensitive to Enlist herbicide active ingredients and are not likely to experience more than low levels of adverse effects from runoff exposure (see the *Assumptions and Uncertainties* section of the main Opinion for more details). Additionally, while dicot plants that provide nectar for adult Poweshiek skipperling are more susceptible to adverse effects from runoff exposure, previous studies show that reproductive effects occur at higher exposure levels than growth effects (see the *Effects of the Action* section of the main Opinion for more details). As such, while a moderate proportion of flowering forbs may experience growth effects, we do not expect this will result in more than a small reduction in flower availability. Thus, we expect the Poweshiek skipperling will experience, at most, a low magnitude of reduction to food and habitat resources. We do not anticipate that this level of adverse effects will reduce reproduction or influence the distribution of the species.

Risk Summary

We do not expect the Poweshiek skipperling to occur on-field, and we expect runoff concentrations of Enlist herbicides will be well below levels where adverse growth effects or mortality to insects are likely to occur. While there is a high extent of overlap between the species' range and runoff areas (70.77%), spatially refined runoff exposure modeling indicates that most runoff events within this overlap area are not likely to cause more than low level adverse effects to plants. While there may be up to moderate magnitudes of adverse effects to sensitive plant species at some locations within this zone, we expect there will be, at most, a low magnitude of decreases to food and habitat resources as the Poweshiek skipperling is not reliant on plant species considered to be sensitive to Enlist herbicides. We do not anticipate this level of adverse effect to plant-based resources will reduce reproduction or influence the distribution of individuals within the range. Thus, we expect the overall risk to the species is low.

Overall Risk to the Species: Low

Conclusion for the Species

After reviewing the current status of the species, the environmental baseline for the action area, the effects from the proposed action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo, as proposed, is not likely to jeopardize the continued existence of the Poweshiek skipperling. As discussed below, although the vulnerability is high, the risk of adverse effects to individuals from the effects of the proposed action is low. Thus, while we anticipate that, at most, a small number of individuals will experience low magnitudes of reduced food and habitat resources over the duration of the Action, indicating that species-level adverse effects are not likely to occur.

The Poweshiek skipperling is listed as endangered, has multiple populations with one or more declining, and is susceptible to climate change, making it a highly vulnerable species. Habitat loss and degradation are listed as two of the main threats preventing the recovery of the species. Although agricultural pesticide use may continue to degrade habitat quality by affecting plant

health, we do not expect the action will significantly contribute to habitat loss. While habitat degradation through runoff might occur, we do not expect runoff EECs to be high enough to cause community- or ecosystem-level effects to the plant communities supporting the Poweshiek skipperling, which are comprised of a diversity of plants such as trees, woody shrubs, and perennial species, which have differential sensitivity to Enlist herbicides.

While the overlap between the Poweshiek skipperling's range with Enlist pesticide use sites and runoff areas is high, we do not expect on-field exposure, as the species is an obligate resident of undisturbed high-quality prairie and not expected to occur on agricultural use sites. While there is a high extent of overlap with runoff areas, we anticipate runoff concentrations of Enlist herbicides will be well below levels to cause adverse growth effects or mortality to the species and that most runoff events are unlikely to cause more than low level adverse effects to the species' plant resources. While runoff may cause up to moderate magnitudes of adverse effects to sensitive plants in some locations, we do not expect this will result in more than low levels of decreases in food and habitat availability as the species is not reliant on plants that are sensitive to Enlist pesticides. Thus, the risk of adverse effects to the species is low.

We do not anticipate individuals of the species will experience mortality or effects to growth and reproduction. We anticipate only small effects to habitat quality will result from the proposed Action. We do not expect this level of adverse effect will rise to the level of take.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 2019. Poweshiek skipperling (*Oarisma poweshiek*). 5-Year Review Summary and Evaluation. Midwest Regional Office, Bloomington, MN. 17 pp.

U.S. Fish and Wildlife Service (USFWS). 2022. Recovery Plan for the Poweshiek Skipperling (*Oarisma poweshiek*). Midwest Regional Office, Bloomington, MN. 12 pp.

Integration and Synthesis Summary: Reptiles – Bog turtle

Scientific Name:	Common Name:	Entity ID:
<i>Clemmys muhlenbergii</i>	Bog turtle	182

Overview

In reviewing the status of the species, the environmental baseline for the action area, the cumulative effects, and the effects of the action, the Service has determined that while the species' vulnerability ranking is medium, the risk of adverse effects to the species from the registration of Enlist One/Duo is low, as described in the following sections. Therefore, 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 the species in the sections below.

Species Current Range

Last updated: 04-15-2022 - Wherever found

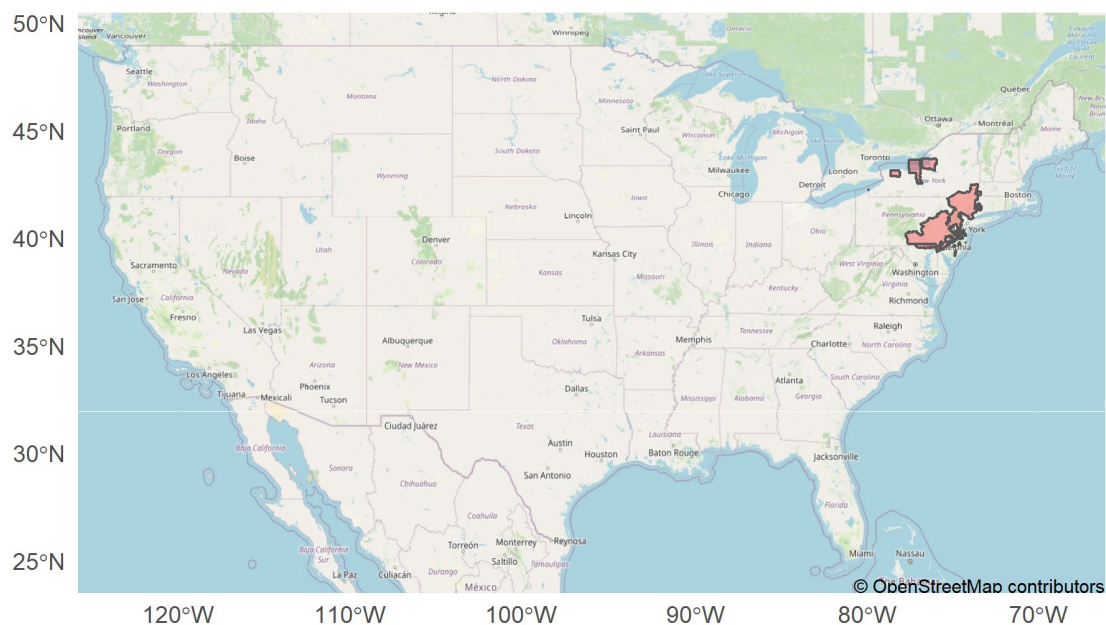


Figure 6. Range map of bog turtle (red polygon overlay). Range map accessed on October 7, 2022 at <https://ecos.fws.gov/ecp/species/6962>.

Vulnerability

This section includes a summary of the status of the species, environmental baseline, cumulative effects, and a summary of how these contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened

Recommendation for Status from Latest 5-Year Review: No change

Distribution: Species/Populations neither constrained or widespread

Number of Populations: Multiple populations (numerous)

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

States within the range: CT, DE, MD, MA, NJ, NY, PA

Critical Habitat designated: None

Pesticides noted in USFWS documents: Yes, Pesticides and Herbicides

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

Bog turtles inhabit slow, shallow, muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps; the habitat usually contains an abundance of sedges or mossy cover. The turtles depend on a mosaic of microhabitats for foraging, nesting, basking, hibernation, and shelter (USFWS 2000). Bog turtles commonly bask on tussocks in the morning in spring and early summer. They burrow into soft substrate of waterways, crawl under sedge tussocks, or enter muskrat burrows during periods of inactivity in summer (Bury 1979).

The bog turtle feeds opportunistically on land and water on insects, worms, slugs, crayfish, snails, and other small invertebrates; the bog turtle also consumes amphibian larvae and fruits. Diet generally is dominated by insects. Most activity occurs from mid-April to late September in New Jersey and Pennsylvania. The species is typically active during daylight hours, mostly from mid-morning to late afternoon or early evening.

Bog turtle mating occurs from late April to early June. The turtles dig a shallow nest or lay eggs in the top of a sedge tussock. Eggs hatch in about 6-9 weeks, from late July to early September. In the north, hatchlings may not emerge from the nest until October, or they may overwinter in the nest.

The species may migrate about 200 m between winter hibernation sites and the upstream summer range in some areas (Ernst and Barbour 1972). Occasionally, individual bog turtles are found crossing roads a considerable distance from any apparently suitable habitat.

The bog turtle southern population declined 30-70% based on known sites, with its population estimated at 2,500-4,000 individuals. Inclusion of potential occurrences in apparently suitable habitat brings the estimate up to about 4,000-6,000. In the northern segment of the range, the species is currently known from 360 sites (5 in Connecticut, 4 in Delaware, 71 in Maryland, 3 in Massachusetts, 165 in New Jersey, 37 in New York, and 75 in Pennsylvania) (USFWS 1997, 2000; NatureServe 2015).

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of the bog turtle, and we anticipate these activities to continue in the future. In addition to the relevant activities described in the overarching Environmental Baseline section of the Opinion, past activities in the

action area that have contributed to the species' decline include, but are not limited to, development, lower water tables, accelerated succession, drilling under wetlands, intensive pasturing, drainage and flooding, chemical and heavy metal pollution, nutrient enrichment from fertilizer and septic runoff, alien plants, exploitation of bog turtles for commercial or private use, predators, and disease. We considered all of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as on the registration of the pesticide malathion under FIFRA, have also contributed to the condition of the environmental baseline for the species in the action area by developing and implementing measures to reduce the impacts of pesticides to listed species.

In addition to activities that have adversely impacted the species, activities that benefit this species have also occurred within the action area. For example, a small number of wetlands containing bog turtle populations have been protected throughout the species' range, and habitat management has occurred at some of these sites to offset accelerated succession resulting from disturbance or to restore habitats damaged by ditching and draining (USFWS 2001).

Cumulative Effects

We anticipate that many of the non-Federal activities described in the Vulnerability section will continue in the future, including habitat degradation and destruction. These activities are expected to result in increased mortality and/or decreased reproduction of animals through direct killing of animals, or indirectly through the loss of muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamp habitats leading to changes in habitat quality required by the species. These effects are anticipated to be greatest in privately owned portions of the range.

Overall Vulnerability: Medium

In summary, past activities have impacted the species through habitat degradation and destruction and other associated impacts, and we expect similar activities and impacts to occur in the future. Some activities, such as those associated with populations occurring at least in part on conservation or public lands, have provided varying degrees of protection for the species. Given that the species is threatened, is neither constrained or widespread, and has numerous populations with some declining, we consider the vulnerability of the species to be medium.

Risk

While bog turtles may disperse through agricultural fields, we do not expect the bog turtle will occur on-field during spray application, nor forage on agricultural areas, indicating on-field exposure through direct contact or the consumption of contaminated food items is unlikely to occur. The overlap between the species' range and runoff areas is 17.71%, indicating that a large number of individuals may be exposed off-field through runoff. However, we do not expect runoff concentrations of Enlist herbicides to be high enough to cause adverse growth effects or mortality to individuals, and spatially refined runoff exposure models indicate that the majority of runoff events are not likely to cause more than low levels of adverse effects to plants. Furthermore, bog turtles are not reliant on plant species that are sensitive to Enlist pesticides.

Thus, the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

On-field Exposure

While there is overlap between the bog turtle's range and Enlist pesticide use sites (Table 16), based on our knowledge of its life history and behaviors, we do not expect individuals will occur on agricultural fields during spray application, nor forage on agricultural fields during dispersal. Thus, the species is not likely to experience any on-field exposure through spray application or ingestion of contaminated food item.

Off-field Exposure

We expect the bog turtle to occur in runoff areas adjacent to application sites. The overlap of the species range with the runoff zone is 17.71% (Table 16).

Table 16. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field	Runoff zone
Corn	12.23	17.71
Cotton	0.00	0.00
Soybean	8.96	13.98
Total ⁷	12.23	17.71

Magnitude of Effects

Effects to Growth and Mortality

While we expect bog turtles may occasionally occur in agricultural areas (e.g., when dispersing to other habitats), we do not expect individuals will occur on-field during spray application, nor forage on-field. Thus, we do not expect any individuals will be exposed on-field through the consumption of contaminated food items or otherwise be exposed on-field. While exposure to runoff may occur, we anticipate runoff concentrations of Enlist herbicides will be well below levels where previous studies have observed any adverse growth effects or mortality to vertebrate species to occur. Thus, we do not expect any effects to growth or survival will occur to exposed bog turtles.

Effects to Plant-based Resources

We expect Enlist pesticide runoff exposure will result in adverse growth effects to vulnerable non-listed plant species (e.g., herbaceous forbs), which may cause a decrease in their availability

⁷ Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices. Total overlap is capped at 100%.

within the runoff zone for the bog turtle. Runoff from corn and soybean fields treated with Enlist pesticides may result in EECs up to 0.034-0.048 lbs/acre, which can result in growth effects in up to 40-52% of sensitive plant species (Table 17).

Table 17. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the percent of sensitive plant species expected to experience at least moderate growth effects from runoff exposure.

Crop	95 th percentile EEC (lbs AI/acre)	Percent of plant species affected
Corn	0.048	52
Cotton	--	--
Soybean	0.034	40

However, while these EECs reported above represent high end exposure estimates, we do not expect all areas within the runoff zone will experience such high levels of EECs. EPA's Tier 3 geographic distribution models show that, with the implementation of required runoff mitigation measures, 85.3% of corn and 95.5% of soybean runoff areas are not likely to ever experience runoff EECs that cause more than low levels of effects throughout the duration of the action (Table 18).

Table 18. Number of local runoff scenarios modeled for the species, and the number and percent of runoff scenarios that could cause no more than low levels of effects to plant species.

Crop	# runoff scenarios	# scenarios that will not cause more than low levels of effects	% scenarios that will not cause more than low levels of effects
Corn	5550	4735	85.3
Cotton	--	--	--
Soybean	5992	5724	95.5

Even in areas that may receive higher concentrations of runoff EECs, we expect this will result in, at most, a low magnitude of reductions in available food or habitat resources as the species is not reliant on sensitive plant species for food or habitat resources. Bog turtles are able to use a variety of habitat types comprised of different vegetative communities. While some species of plants within these vegetative communities may experience growth effects as a result of runoff exposure, we do not expect all plant species within these required vegetative communities will be as sensitive to the effects of Enlist pesticides as herbaceous forbs. Thus, we do not anticipate more than low levels of growth effects to the vegetative communities supporting the turtle's prey

species, resulting in no more than low levels of decreases to the turtle's food resources. Thus, we expect the magnitude of adverse effects to food and habitat availability resulting from runoff exposure will be, at most, low in magnitude. We do not anticipate that this level of adverse effects will reduce reproduction or influence the distribution of the species.

Risk Summary

While bog turtles may disperse through agricultural areas, we do not expect that the bog turtle is likely to forage on-field, indicating no risk of on-field exposure. The overlap between the species' range and runoff areas is 17.71%, indicating that a potentially large number of individuals may be exposed to runoff. Runoff exposure is not likely to cause adverse effects to growth or mortality, and spatially refined runoff exposure model results further indicate that most runoff events within this overlap area are not likely to cause more than low level adverse effects to plants. While some locations within the runoff area may experience higher levels of runoff exposure, we do not expect that this will result in more than low levels of decreases to food and habitat resources as runoff EECs are not likely high enough to cause adverse effects to the vegetative communities that provide habitat to the species. We do not expect that this level of adverse effects will result in any reductions in reproduction or other changes to the distribution of individuals within the range. Thus, we expect that the overall risk of adverse effects to the species is low.

Overall Risk to the Species: Low

Conclusion for the Species

After reviewing the current status of the species, the environmental baseline for the action area, the effects from the proposed action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo, as proposed, is not likely to jeopardize the continued existence of the bog turtle. As discussed below, although the vulnerability is medium, the risk of adverse effects to individuals from the effects of the proposed action is low. While bog turtles may disperse through agricultural fields, we do not expect them to forage on agricultural fields, indicating no risk of on-field effects. Similarly, while runoff exposure may adversely affect plant growth in areas adjacent to use sites, we do not expect more than low levels of adverse effects off-field, given that bog turtles are not reliant on plant species sensitive to Enlist herbicides for food or habitat. Thus, while we anticipate that small numbers of individuals will be adversely affected over the duration of the Action, we do not expect species-level effects to occur.

The bog turtle is listed as threatened, there are numerous populations with one or more declining, and the species is susceptible to exploitation, predators, and disease, making it a moderately vulnerable species. Habitat degradation and destruction are listed as the main threats preventing the recovery of the species. Although agricultural pesticide use may continue to degrade habitat quality by adversely affecting plant health, we do not expect the action will significantly contribute to habitat loss. While habitat degradation through runoff might occur, we do not expect runoff EECs to be high enough to cause community- or ecosystem-level effects to plant communities supporting the bog turtle, which are comprised of a diversity of plants such as trees, woody shrubs, and perennial species that are less sensitive to Enlist herbicides.

While the overlap between the bog turtle's range with Enlist pesticide use sites is high, we do not expect individuals to forage on agricultural fields while they are dispersing through Enlist pesticide use sites. While runoff off-field may occur, we do not expect this will result in any adverse growth effects or mortality as we expect runoff concentrations of Enlist herbicides to be well below levels where such effects have been observed in laboratory studies. There may be high magnitudes of adverse effects to sensitive plant species at some locations within the runoff area. However, as the bog turtle has broad habitat requirements and is not reliant on plants that are considered sensitive to Enlist herbicides, we do not expect effects to sensitive plant species will result in more than low levels of decreases in food and habitat availability. Thus, we expect the overall risk of adverse effects to the species is low.

We do not anticipate that any individuals of the species will experience mortality, growth, or reproductive effects resulting from on-field exposure and no more than low levels of adverse effects to food and habitat resources will occur off-field as a result of the proposed Action. We do not expect this level of adverse effect will rise to the level of take.

Species Conclusion: Not likely to jeopardize

References

- U.S. Fish and Wildlife Service (USFWS). 2001. Bog Turtle (*Clemmys muhlenbergii*) Northern Population Recovery Plan. Hadley, Massachusetts. 109 pp.
- U.S. Fish and Wildlife (USFWS). 2022. Bog Turtle (*Clemmys muhlenbergii*) 5-Year Review: Summary and Evaluation. Cortland, New York. 39 pp.