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 plant 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 adverse growth effects or mortality on the species if exposure occurs; and 3) an evaluation of predicted runoff scenarios to further contextualize the likelihood of exposure and adverse growth effects occurring. Please see the *Approach to the Effects Analysis* section of the main biological opinion for more details.

Extent of Exposure

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 to approximate the extent of exposure. Assuming that the species has a uniform distribution, we would also expect the percentage of overlap represents the percentage of the species' population that is 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 percentage of overlap over- or underestimates the likely extent of exposure.

On-field Exposure

We expect that some listed plant species will experience toxic effects (see below) from direct contact with pesticide residues via spray application. We use the percent of a species' range that overlaps with corn, cotton, or soybean fields to represent the extent of on-field exposure. We use the percent of a species' range that overlaps with corn, cotton, or soybean fields to represent the potential extent of on-field exposure. We modify the expected extent of exposure, when appropriate, based on available information regarding a listed plant species' tendency to occur in agricultural areas. In general, we expect most listed plants are unlikely to occur on-field as agricultural practices generally create conditions not conducive for sensitive plant species; however, this is not true for every listed plant species. As such, we analyze the potential on-field exposure for all listed plant species.

Off-field Exposure

Existing product labels require applicators to use a 30-feet 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 exposures 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. We expect a high extent of overlap will result in many individuals experiencing exposure, a medium extent of exposure will result in more than a few individuals experiencing exposure, and a low extent of exposure will result in only a few individuals experiencing exposure.

Magnitude of Effect

Given the high sensitivity of plants to herbicides, we expect that listed plant species will primarily experience adverse growth effects or mortality resulting from direct exposure to Enlist pesticides. We primarily focus on direct effects to growth and mortality as toxicity studies in plants indicate that these effects occur at the lowest exposure levels. While indirect effects from decreased availability of pollinators and seed dispersers may occur, these sublethal impacts are not expected to result in measurable effects to the species compared to the impact of direct toxic effects to growth and survival. Thus, we do not further consider indirect effects in our analysis.

We expect toxic effects to listed plant species will result from contact exposure of 2,4-D and glyphosate in spray application on-field or in runoff off-field. Given that toxicity data regarding Enlist Duo in plants is available, we assess the effects of 2,4-D and glyphosate together to address any potential interactive effects the two active ingredients may have. To simplify our analysis, we report exposures in terms of 2,4-D (lbs/acre) but assume that glyphosate is present in runoff and is contributing to toxic effects to plants. We expect this analysis of 2,4-D and glyphosate is representative and protective of potential effects that may occur from use of Enlist One, which will only result in exposure to 2,4-D alone.

On-field exposure will likely cause mortality of all exposed individuals as Enlist pesticides are designed specifically to kill non-genetically modified plant species that occur on agricultural fields. Thus, we assume all listed plant species individuals occurring on-field will experience mortality. Off-field exposure through runoff will result in substantially lower concentrations of EECs as compared to on-field exposure. 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 and mortality dose-response curves to estimate the percent growth inhibition an individual plant may experience or the percent of exposed individuals that will suffer acute mortality, respectively.

We consider responses of 50-99% growth inhibition or 1% or greater mortality as a high magnitude of adverse effect. We categorize growth effects ranging from 25-50% as a moderate magnitude of effect. While direct mortality is unlikely at this exposure, we expect impacts to long-term survival of individuals are still likely as this level of reduced growth will likely reduce an individual plant's capacity to recover from herbivory, pest pressure, or other environmental stressors (e.g., drought). Exposures causing less than 25% growth inhibition are considered low in magnitude as these effects are likely temporary, recoverable within a growing season, and not likely to impede recovery from other stressors.

Runoff Scenario Evaluations: We can 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, at a proportion similar to that of the entire range.

We compare the 95th percentile runoff EEC from each scenario (i.e., the 1 in 10-year runoff EEC for that location) to the plant growth dose-response curve to determine how many locations within the species' range are not likely to experience runoff exposures that will exceed relevant toxic thresholds for sensitive plant 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 decreases, we reduce the expected risk of adverse effects to the species in the Enlist 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. 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: Flowering Plants - Whorled Sunflower

Scientific Name:	Common Name:	Entity ID:
Helianthus verticillatus	Whorled Sunflower	1881

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 the species' vulnerability 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. Therefore, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the whorled sunflower. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 02-24-2021 – *Wherever found*

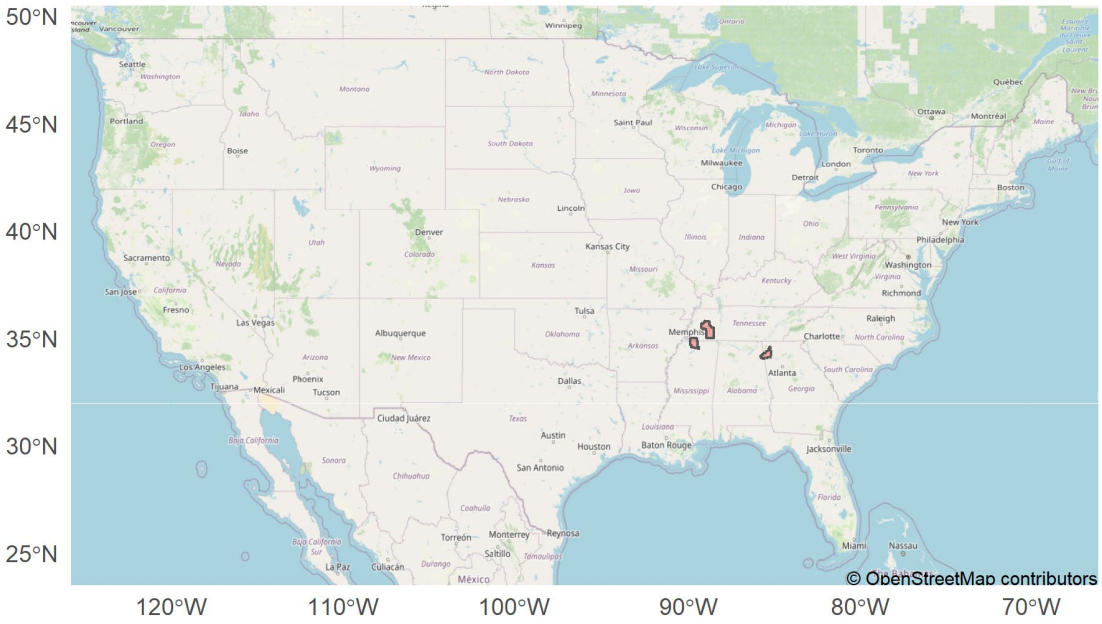

Figure 1. Range map of whorled sunflower (red polygon overlay). Accessed on August 26, 2022, at https://ecos.fws.gov/ecp/species/3375.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered
Recommendation 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, GA, MS, TN
Critical Habitat designated: Yes
Pesticides noted in USFWS documents: Yes, Herbicides

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

The whorled sunflower is a narrow habitat specialist occurring in remnant wet prairie areas and calcareous barrens, in moist, prairie-like openings in woodlands, and along adjacent creeks. Soils are sandy clays which are alkaline, high in organic matter, and seasonally wet. Full or partial sunlight for most of the day is an essential feature for this species (USFWS 2014).

The whorled sunflower is a perennial that propagates clonally via rhizomes (horizontal underground stems that produce roots and shoots) as well as by sexual reproduction (i.e., flowering and seed production), (USFWS 2022). The species is self-incompatible and flowers from August into October. Clumped distribution coupled with the species' self-incompatibility and short flight distances of potential pollinators (e.g., two-spotted long-horned bees [*Mellisodes bimaculatus*] and honeybees [*Apis mellifera*]) increase the likelihood of unsuccessful pollination (Ellis 2008, Mandel 2010; both as cited in USFWS 2020). The whorled sunflower likely requires pollinating invertebrates for successful reproduction; although, studies to determine effective pollinators of this species have not been conducted.

The whorled sunflower is known from nine populations, eight of which are extant. Most populations are found in degraded sites along agricultural fields and road, railroad, or utility rights-of-way (USFWS 2022). This species has a disjunct distribution with two populations found near the state line in Cherokee County, Alabama, and adjacent Floyd County, Georgia; two populations in Marshall County, Mississippi; one population in Benton County, Mississippi; one population each in Tennessee's Madison and McNairy counties; and one population in Franklin County, Virginia (USFWS 2022). Historically, the species was thought to have occurred in prairies and open woodlands, but today, while a few subpopulations and populations are found in remnant prairies and woodlands, most populations are found in degraded sites along agricultural fields and roads, railroads, or utility rights-of-way. Most populations are small, isolated, and have little potential for natural recolonization (USFWS 2022).

At the McNairy County, Tennessee, population, 36 clusters of plants were found growing along creek banks along the unplowed edges of cultivated crop fields and extended into a railroad right-of-way (Tennessee Division of Natural Areas [TDNA] 2008, as cited in USFWS 2020).

Initial efforts to estimate population sizes of whorled sunflower relied on counting individual stems (Allison 2002, pp. 3–8; Schotz 2001, pp. 8–10; both as cited in USFWS 2020); however, due to the species' clonal growth habit, stem counts overestimate the true number of genetically distinct individuals (genets) (USFWS 2013).

Environmental Baseline

Habitat degradation and destruction associated with industrial forestry practices, maintenance of transportation and utility rights-of-way, and agricultural practices have contributed to the present condition of the whorled sunflower, 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, mechanical or chemical vegetation management, shading and competition, and climate change (USFWS 2020). Furthermore, indiscriminate herbicide application along rights-of-way threatens some whorled sunflower populations (USFWS 2020). As an example, whorled sunflower plants extending onto a roadside within a powerline right-of-way at the Madison County, Tennessee population were sprayed with herbicide during roadside and powerline maintenance in 2004, which caused substantial mortality (Lincicome pers. comm. 2006; Andrea Bishop pers. comm. 2008; as cited in USFWS 2020). Agricultural practices including field preparation, herbicide use, and harvesting of crops also threaten both extant Tennessee populations due to the species' presence in habitats adjacent to actively farmed crop fields in both locations. We considered all these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as right-of-way vegetation management and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, Temple-Inland Corporation donated a conservation easement for the Coosa Valley Prairie property in Floyd County, Georgia to The Nature Conservancy (TNC), thereby protecting most of the Georgia population of this species. This is the only whorled sunflower population protected by a permanent conservation easement (Hodges pers. comm. 2012a, as cited in USFWS 2020).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as industrial forestry practices, maintenance of transportation and utility rights-of-way, agricultural practices, mechanical or chemical vegetation management at a broad scale without conservation or minimization measures, and shading and competition. These activities are expected to result in mortality and/or decreased reproduction of individuals through direct crushing or removal of

plants, or indirectly through the loss of wet prairie and calcareous barren 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.

Similarly, we anticipate that actions designed to benefit the species will continue which would provide future protections for this species. For example, the Weyerhaeuser Company owns the land where one of the two Alabama subpopulations is located and is willing to work with the U.S. Fish and Wildlife Service, TNC, and others to improve habitat conditions for the whorled sunflower (Chris Muckenfuss pers. comms. 2017, as cited in USFWS 2022). Should these efforts occur, individuals in these areas would be anticipated to experience fewer of the adverse effects described due to land protection and enhanced habitat quality.

Overall Vulnerability: High

In summary, past activities impacted and continue to impact the species through habitat degradation and destruction and other associated impacts, and we expect similar activities and effects to occur in the future. Some activities, such as those associated with a conservation easement, as described above, provide varying degrees of protection for the species. Given that the species is endangered, has a restricted range, few populations, and shows unknown population trends, the vulnerability of the species and its critical habitat is high.

Risk

We do not anticipate the whorled sunflower will occur on-field, indicating that exposure to spray application is not likely to occur. Overlap data indicates that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause high levels of adverse effects to exposed individuals, spatially refined runoff models indicate that most areas within the runoff zone are not likely to experience runoff EECs that would cause more than low levels of adverse effects. Furthermore, we anticipate a critical habitat-specific mitigation measure (see the critical habitat analysis in Appendix B-3 for more information) will further decrease the likelihood of adverse effects to individuals resulting from runoff exposure. Therefore, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

Based on our understanding of the species' life history, we do not anticipate the whorled sunflower will occur on corn, cotton, and soybean fields, indicating that the species is unlikely to be exposed on-field to spray application. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

The whorled sunflower is expected to occur in runoff areas directly adjacent to Enlist pesticide use sites. 4.94% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 1).

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

Crop	On-field (%)	Runoff zone (%)
Corn	0	2.6
Cotton	0	1.34
Soybean	0	3.6
Total[1]	0	4.94

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to Enlist pesticides in runoff from corn, cotton, and soybean fields can result in up to 74% growth inhibition and, at most, 0.05% mortality (Table 2). While the mortality rate is low, we consider this a high magnitude of effect as the level of anticipated reduction in growth could reduce long term survival and could decrease potential recovery from stressors like herbivory, disease, and other environmental stressors.

Table 2. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.038	74	0.05% (1 in 2000 exposed individuals)
Cotton	0.037	73	0.05% (1 in 2000 exposed individuals)
Soybean	0.026	54	0.0001% (1 in a million exposed individuals)

However, while the EECs reported in Table 2 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 32.6% of corn, 45.3% of cotton, and 57.9% of soybean runoff areas are not likely to experience runoff EECs that cause more than low level effects throughout the duration of the action (Table 3).

[1] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

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 growth effects (i.e., no more than 25% growth inhibition).

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	598	195	32.6
Cotton	364	165	45.3
Soybean	961	556	57.9

Thus, we expect that a portion of locations within the runoff zone will not likely experience EECs that cause more than low levels of effects to sensitive plants and that effects from runoff exposure will be more localized. Furthermore, we anticipate an additional mitigation measure proposed to protect the whorled sunflower's critical habitat, which prohibits the use of Enlist system herbicides within 60 meters of designated critical habitat, will also reduce the risk of adverse growth effects to the species as a whole as it would reduce the likelihood of runoff exposure in areas where the species is known to occur. Thus, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individual whorled sunflowers are likely to occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely. We expect only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause high levels of adverse growth effects, we anticipate these effects will likely be highly localized as most locations within the runoff zone are not likely to experience runoff EECs that would cause more than low levels of adverse growth effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Furthermore, we anticipate that the mitigation measure proposed to protect the whorled sunflower's designated critical habitat will further reduce the likelihood of adverse effects resulting from runoff exposure. Thus, we expect the overall risk of adverse effects 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the whorled sunflower. As discussed below, while the vulnerability is high, we expect only a few individuals are likely to experience more than low levels of adverse effects from the Action,

particularly as the critical habitat-specific mitigation measure will also be protective of the species as a whole. Additionally, we do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we anticipate only a few individuals will be affected over the duration of the Action, and we do not expect species-level effects will occur.

The whorled sunflower is listed as endangered, and only 8 populations exist in a very restricted range. Only one population on private land is fully protected through management by The Nature Conservancy. Additionally, threats such as mechanical or chemical vegetation management at a broad scale without conservation or minimization measures, and shading and competition are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our current understanding of the whorled sunflower's life history, we do not anticipate individuals are likely to occur on corn, cotton, or soybean fields. Thus, we do not expect on-field exposure to spray application. We expect only a few individuals are likely to experience exposure. While runoff EECs may occasionally cause high magnitude adverse growth effects, spatially refined runoff models indicate that these effects are likely highly localized and that most locations within the runoff zone are not likely to experience runoff EECs that will cause more than low magnitude adverse effects. Furthermore, we anticipate that the mitigation measures proposed to protect the whorled sunflower's critical habitat will also be protective of the species as a whole. Therefore, we anticipate that the overall risk of adverse effects to the species is low.

In summary, we expect only a few individuals are likely to be exposed to Enlist One and Enlist Duo. While exposure may occasionally result in more than low levels of adverse effects, we expect these effects will occur infrequently and in highly localized areas. The proposed mitigation measure for the species' designated critical habitat will also be protective of the species as a whole, further reducing the likelihood of adverse effects from runoff exposure. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing adverse effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the whorled sunflower.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife (USFWS). 2013. Endangered and Threatened Wildlife and Plants; Endangered Status for *Physaria globosa* (Short's bladderpod), *Helianthus verticillatus* (whorled sunflower), and *Leavenworthia crassa* (fleshy-fruit gladecress). Federal Register 78 (149):47109-47134.

U.S. Fish and Wildlife (USFWS). 2020. Whorled Sunflower (*Helianthus verticillatus*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Mississippi Field Office, Jackson, Mississippi. 32 pp.

U.S. Fish and Wildlife Service (USFWS). 2022. Draft Recovery Plan for Whorled Sunflower (*Helianthus verticillatus*). Atlanta, Georgia. 7 pp.

Integration and Synthesis Summary: Flowering Plants - American chaffseed

Scientific Name:	Common Name:	Entity ID:
Schwalbea americana	American chaffseed	996

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 Action is not likely to jeopardize the continued existence of the American chaffseed. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 04-15-2022 – *Wherever found*

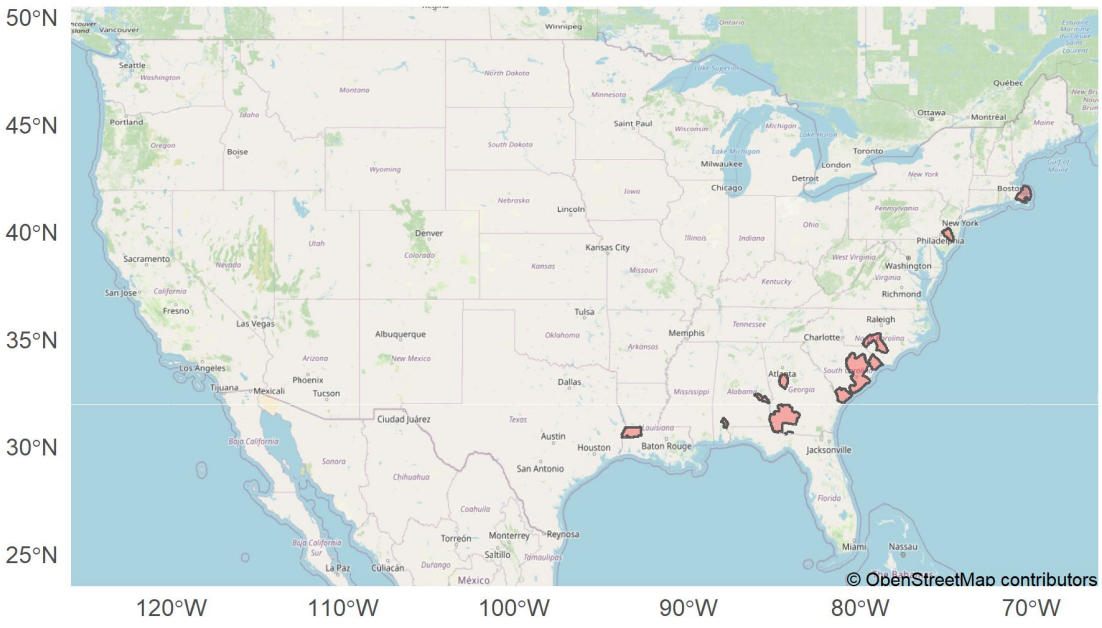

Figure 2. Range map of American chaffseed (red polygon overlay). Range map accessed on August 26, 2022, at https://ecos.fws.gov/ecp/species/1286.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in

the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered
Recommendation for from Latest 5-Year Review: No change
Distribution: Species/Populations widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) - one or more populations declining
States within the range: AL, FL, GA, LA, MA, NC, NJ, SC
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes

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

The American chaffseed is a monotypic (genus containing only one species) perennial member of the figwort family. Characteristically, the American chaffseed occurs in sandy (sandy peat, sandy loam), acidic, seasonally moist to dry soils. The species is generally found in habitats described as pine flatwoods, fire-maintained savannas, ecotonal (transitional) areas between peaty wetlands and xeric sandy soils, and other open grass-sedge systems. The American chaffseed appears to be shade intolerant and, therefore, occurs in areas maintained in an open to partially open condition.

The American chaffseed produces showy, insect-pollinated flowers with a high degree of zygomorphy (brightly colored central portions of the flowers) elaborated for pollination by bees (Pennell 1935, as cited in USFWS 1995). On Fort Bragg, bumblebees were observed visiting American chaffseed flowers exclusively (The Nature Conservancy 1993, as cited in USFWS 1995), and observations of insect visitation suggest that probable pollinators of the species are worker bumblebees (*Bombus impatiens* and *Bombus pennsylvanicus*) (Kirkman 1993, as cited in USFWS 1995). Fire plays a role on the growth and reproduction of American chaffseed. In the absence of fire, the species will transition from a reproductive individual to a vegetative individual (Kirkman et al. 1998, p. 134, as cited in USFWS 2019a), and there is also a higher incidence of seedling/new recruit mortality (Kirkman 1996, p. 9) and lower recruitment overall (Kirkman et al. 1998, p. 134). In contrast, with prescribed fire or post fire, rapid stem elongation occurs from undeveloped buds at the stem base (Kirkman et al. 1998, p. 131). Regardless of season, flowering response is induced, density of reproductive individuals remains stable (Kirkman et al. 1998, p. 126), and higher recruitment rates occur in comparison to mowed and unburned plots (Kirkman et al. 1998, p. 125). American chaffseed seeds can remain viable in the seed bank for four years (USFWS 1995).

The structure of the American chaffseed seed, somewhat flattened or compressed, slightly curved, and enclosed in a loose-fitting sac-like structure, suggests wind dispersal; however, no information is available to support this hypothesis. Information is lacking on both the mechanism and distance of seed dispersal.

This species is in decline and most states only have 2 – 3 populations and only three states (NC, SC, and GA) contain more than five populations (USFWS 2019a). The range of American chaffseed has greatly constricted and the species only occurs in eight states along the Eastern seaboard and Gulf Coast. As of 2019, there were 43 extant populations across the species range: Massachusetts (1), New Jersey (2), North Carolina (6), South Carolina (18), Georgia (9), Alabama (2), Florida (3), and Louisiana (2) (USFWS 2019a). A total of 41 of these populations are considered protected: 18 populations occur on either federal or state land that have formal management plans, 13 populations occur on lands protected by conservation easements, occur in mitigation banks, or on conservation lands, and 10 populations have safe harbor agreements (USFWS 2019a).

Environmental Baseline

Habitat destruction and modification from development and fire suppression along the coast have contributed to the present condition of the American chaffseed, 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 urbanization resulting in fire suppression, conversion of longleaf flatwoods and savannas to commercial pine plantations and agriculture fields, herbivory (e.g., striped leaf beetle (*Kuschelina* sp.), Chrysomelid leaf beetle sp., and Buckeye caterpillar (*Junonia coenia*) larvae), herbicide application, and an increase in drought frequency and decrease in precipitation events (USFWS 1995, 2019a). We considered all of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as development, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with consultations on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, current plans are underway for two future reintroductions on state land (Atco and Hampton Gate) in Burlington County, New Jersey (USFWS 2019a). American chaffseed seed capsules (<5%) were collected from New Jersey's Brendan T. Byrne State Forest and Franklin Parker Preserve reintroduction site to continue ex situ (off-site) propagation efforts in 2017 (USFWS 2019a).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and adverse modification, as well as other threats such as development, fire suppression, industrial forestry practices, maintenance of transportation and utility rights-of-way, agricultural practices, mechanical or chemical vegetation management at a broad scale without conservation or minimization measures, and shading and competition. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of pine flatwoods, savannas, peaty wetlands, and open-grass-sedge 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.

Similarly, we anticipate that actions designed to benefit the species may continue. For example, propagation efforts for future reintroductions are underway at Duke Farms and New Jersey Department of Environmental Protection (NJDEP) Forest Nursery (USFWS 2019a). In addition, there is interest in reintroducing this species in Delaware (USFWS 2019a). Populations are expected to improve due to an increase of individuals and reintroductions.

Overall vulnerability: High

In summary, past activities have impacted the species through habitat destruction and degradation from development and fire suppression, 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, found in 8 states, and consists of only 2-3 populations per state that are declining, the vulnerability of the species is considered high.

Risk

We do not anticipate the American chaffseed will occur on Enlist herbicide use sites, indicating that direct exposure to spray application is unlikely to occur. There is a low likelihood of runoff exposure to individuals. Runoff concentrations of Enlist herbicides may cause moderate to high magnitudes of adverse effects to exposed individuals. However, spatially refined runoff exposure models indicate that the majority of runoff events are not likely to cause more than low levels of adverse effects. Thus, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

Based on our understanding of the American chaffseed's life history, we do not expect individuals will occur on corn, cotton, or soybean fields. Thus, we expect on-field exposure to spray application is unlikely to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

The American chaffseed is expected to occur in runoff areas directly adjacent to Enlist pesticide use sites. 2.74% of the species range overlaps with runoff areas adjacent to corn, cotton, and soybean fields (Table 4).

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

Crop	On-field (%)	Runoff zone (%)
Corn	0	1.55
Cotton	0	1.19
Soybean	0	1.37
Total[2]	0	2.74

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn, cotton, and soybean runoff can cause 38-57% growth inhibition and up to 0.0005% mortality (i.e., 1 in 200,000 exposed individuals) (Table 5). While the mortality rate is low, we consider this a moderate to high magnitude of effect as the level of anticipated reduction in growth is expected to reduce long term survival and is likely to decrease potential recovery from other stressors like herbivory, disease, and other environmental stressors.

Table 5. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.027	57	0.0005% (< 1 in 200,000 exposed individuals)
Cotton	0.019	38	<0.0001% (<1 in a million exposed individuals)
Soybean	0.023	48	<0.0001% (<1 in a million exposed individuals)

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 56% of corn, 58% of cotton, and 68% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 6).

[2] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 6. 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 growth effects (i.e., no more than 25% growth inhibition).

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	4862	2720	56
Cotton	3146	2127	58
Soybean	5213	3042	68

Furthermore, while the American chaffseed can be found in areas of high runoff EECs (e.g., wetland-like habitats), they are also known to occur in other habitat types, including terrestrial areas such as flatwoods and savannas, which are not expected to experience high levels of runoff EECs. Thus, we expect the likelihood of adverse growth effects occurring to individuals in these habitat types are even less likely to occur, further reducing the risk of growth effects or mortality to individuals.

Risk Summary

We do not anticipate individuals are likely to occur on Enlist herbicide use sites, indicating that exposure to spray application is unlikely. Exposure to runoff is unlikely to occur in most of the range as only 2.74% of the range overlaps with runoff areas. While some locations within the runoff zone may be exposed to levels of Enlist herbicides that result in moderate to high magnitudes of adverse growth effects, we anticipate the majority of locations within the runoff zone will not experience runoff EECs that will result in more than low levels of adverse effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the American chaffseed. As discussed below, although the vulnerability is high, we expect few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The American chaffseed is listed as endangered, and only 43 populations exist in a restricted range. There are 41 that have some level of protection and of these 20 are self-sustaining populations (USFWS 2019a). Eighteen populations occur on either federal or state land that have formal management plans. Thirteen populations occur on lands protected by conservation easements, occur in mitigation banks, or on conservation lands (one site in Louisiana occurs on land owned by The Nature Conservancy (TNC)). Ten populations have safe harbor agreements that include enhancement management activities for red-cockaded woodpeckers that would maintain the sub-climax habitat required by American chaffseed. Additionally, threats such as development, fire suppression, industrial forestry practices, maintenance of transportation and utility rights-of-way, agricultural practices, mechanical or chemical vegetation management at a broad scale without conservation or minimization measures, and shading and competition, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our understanding of the American chaffseed's life history, we do not expect individuals will occur in corn, cotton, or soybean fields. Thus, we do not expect on-field exposure to spray application. Overlap between the American chaffseed's range with potential runoff areas is 2.74%, indicating that only a few individuals are likely to be exposed. While runoff EECs may occasionally be high enough to cause moderate to high levels of adverse effect, spatially refined runoff model results suggest the majority of locations within the runoff zone are not likely to experience runoff EECs high enough to cause more than low levels of adverse growth effects. Furthermore, we expect some of the habitat types the American chaffseed is able to use, such as terrestrial grasslands, are unlikely to experience high levels of runoff EECs with the implementation of required runoff mitigations, further reducing the risk of adverse growth effects resulting from runoff exposure.

In summary, while runoff exposure to Enlist One and Enlist Duo is likely to occur, impacts are expected to be highly localized and affect only a few individuals at most. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the American chaffseed.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1995. American chaffseed (*Schwalbea Americana*) Recovery Plan. U.S. Fish and Wildlife Service, Hadley, Massachusetts. 62 pp.

U.S. Fish and Wildlife Service (USFWS). 2019a. American chaffseed (*Schwalbea americana*); 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, South Carolina Ecological Services Field Office. 45 pp.

U.S. Fish and Wildlife Service (USFWS). 2019b. Amendment 1. American chaffseed (*Schwalbea americana*) Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 5 pp.

Integration and Synthesis Summary: Flowering Plants - Neches River rose-mallow

Scientific Name:	Common Name:	Entity ID:
Hibiscus dasycalyx	Neches River rose-mallow	6617

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 Action is not likely to jeopardize the continued existence of the Neches River rose-mallow. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 10-17-2017 *– Wherever found*

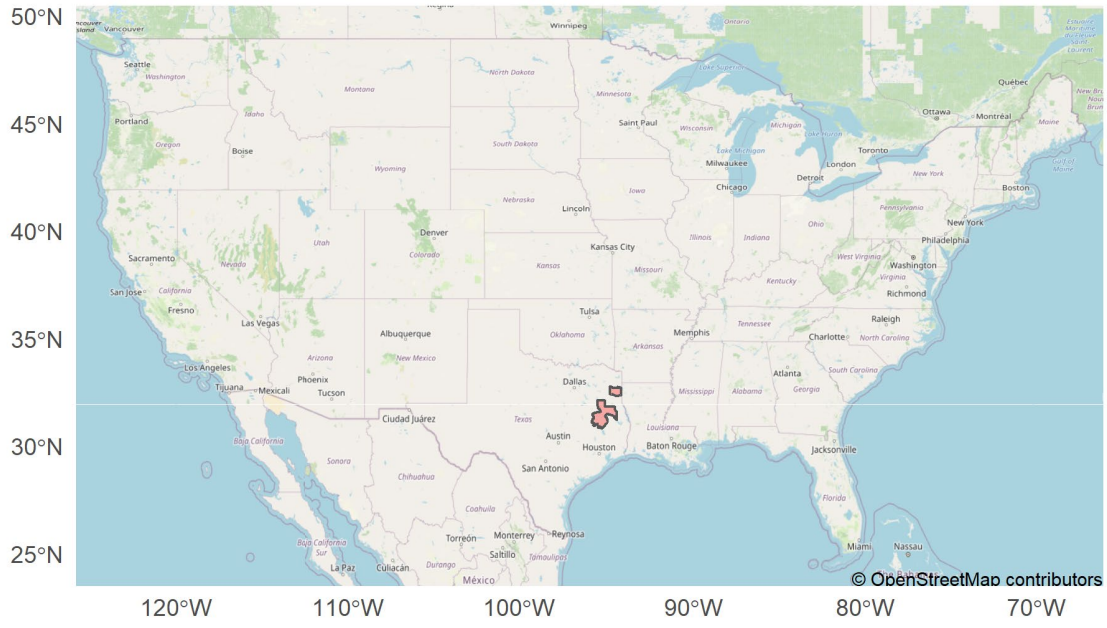

Figure 3. Range map of Neches River rose-mallow (red polygon overlay). Range map accessed on August 26, 2022*,* at https://ecos.fws.gov/ecp/species/1441.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in

the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened
Recommendation 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: TX
Critical Habitat designated: Yes
Pesticides noted in USFWS documents: Yes, Herbicides

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

The Neches River rose-mallow is endemic to relatively open habitat in the Pineywoods (or Timber belt) of east Texas, within Cherokee, Houston, Harrison, and Trinity Counties, and has been introduced into Nacogdoches and Houston Counties. It is known from seasonally or regularly inundated sloughs, oxbows, terraces, sand bars, and bottomlands, with hydric alluvial soils (loamy to clayey). An open canopy is typical, but plants also grow in partial sun. Sites are both perennial and intermittent wetlands with water levels between sites varying due to their proximity to water, amount of rainfall, and floodwaters. Intermittent wetlands are inundated during the winter months but become dry during the summer months (USFWS 2013).

This perennial species dies back to the ground every year and resprouts from the base; however, the plant still maintains aboveground stems. Longevity of the species is unknown, but it may be long-lived. Cross-pollination (pollen transfer between distinct individuals) occurs within populations, and the species has high reproductive potential (fecundity). Flowering occurs between June and August, sometimes into late October; the blooming period may only last 1 day. The species produced an average of 50 fruits per plant, but seed viability and survivorship are not known. Potential pollinators of the Neches River rose-mallow may include, but are not limited to, the common bumblebee (*Bombus pensylvanicus*), Hibiscus bee (*Ptilothrix bombiformis*), moths, and the scentless plant bug (*Niesthrea louisianica*) (USFWS 2013, 2018).

Neches River rose-mallow seeds are likely dispersed by flowing water. Methods of upstream seed dispersal are unknown, however, avian species may facilitate this process (USFWS 2013).

The natural geographic range is within Trinity, Houston, Harrison, and Cherokee counties, Texas, on state highway rights-of-way (ROWs), as well as private and Federal lands. To date, there are 8 natural, extant sites within the species' geographic range with planned introductions on Federal and private property (USFWS 2018).

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of Neches River rose-mallow, 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, encroachment of nonnative and native woody species into wetlands, altered hydrology, bridge and road construction projects, conversion of wetlands to silvicultural uses, herbicide use, habitat damage from trampling by feral hogs and cattle, mammalian herbivory, and climate change (USFWS 2018). Many sites where the species occurs are now compromised by herbicide overspray (USFWS 2013). We considered all these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as mining activities, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, Neches River rose-mallow was planted on private land at the Port Jefferson History and Nature Center (Marion County, Texas) in 2013 (L. Gray pers. comm. 2014, USFWS 2018). In addition, the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife (PFW) program initiated an introduction with about 200 plants in 2014 on private land at Winston 8 Ranch, Nacogdoches County, Texas. In 2016, plants were flowering, and in 2017, several plants were 5-6 feet tall and flowering (J. Reid, pers. comm. 2017, USFWS 2018).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as encroachment of nonnative and native woody species into wetlands, altered hydrology, bridge and road construction projects, conversion of wetlands to silvicultural uses, herbicide use, habitat damage from trampling by feral hogs and cattle, and mammalian herbivory. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of sloughs, oxbows, terraces, sand bars, and bottomlands 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 threatened, has a restricted range, and relatively few populations, the vulnerability of the species is considered high.

Risk

We do not anticipate the Neches River rose-mallow will occur on Enlist use sites, indicating exposure to on-field spray application is unlikely to occur. We expect very few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that can cause high levels of adverse effects, spatially refined runoff exposure models indicate that a portion of locations within the runoff zone are not likely to experience runoff EECs that cause more than low levels of adverse effects. Thus, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

Based on our current knowledge of the Neches River rose-mallow's life history, we do not anticipate individuals will occur on corn, cotton, or soybean fields, indicating that on-field exposure to spray application is unlikely to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

The Neches River rose mallow is expected to occur in runoff areas directly adjacent to Enlist pesticide use sites. 0.73% of the species range overlaps runoff areas adjacent to corn, cotton, and soybean fields (Table 7).

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

Crop	On-field (%)	Runoff zone (%)
Corn	0.25	0.43
Cotton	0.21	0.31
Soybean	0.05	0.11
Total[3]	0.47	0.73

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. We expect exposure to corn, cotton, and soybean runoff can cause 58-86% growth inhibition and up to 1% mortality (i.e., 1 in 100 exposed individuals) (Table 8). We consider this a high magnitude of effect as growth inhibition can be high enough to cause substantial mortality. Even if mortality rates are low, growth effects are likely severe enough to impede plant recovery from herbivory, disease, or other environmental stressors.

[3] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 8. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.028	58	0.05% (1 in 2000 exposed individuals)
Cotton	0.053	86	1% (1 in 100 exposed individuals)
Soybean	0.029	61	0.001% (1 in 100,000 exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 22% of corn, 13% of cotton, and 19% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 9).

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 growth effects (i.e., no more than 25% growth inhibition).

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	273	60	22
Cotton	270	34	13
Soybean	156	29	19

Thus, while we already expect only a few individuals are likely to experience any exposure to Enlist herbicides, we anticipate that even fewer individuals are likely to experience more than low levels of adverse growth effects. Thus, the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals are likely to occur on Enlist herbicides use sites, indicating that on-field exposure to spray application is unlikely. Only 0.73% of the species range overlaps with runoff areas, indicating that few individuals are likely to experience any exposure to Enlist pesticides. While runoff EECs may result in high levels of adverse growth effects, spatially refined runoff exposure models indicate that a portion of locations within the runoff zone are not

likely to experience runoff EECs high enough to cause more than low levels of adverse growth effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Neches River rose-mallow. As discussed below, although the vulnerability is high, we expect very few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The Neches River rose-mallow is listed as threatened, and only 8 populations exist in a restricted range. Two populations on private land are somewhat protected through management by Port Jefferson History and Nature Center and Winston 8 Ranch. Additionally, threats such as encroachment of nonnative and native woody species into wetlands, altered hydrology, bridge and road construction projects, conversion of wetlands to silvicultural uses, herbicide use, habitat damage from trampling by feral hogs and cattle, and mammalian herbivory, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our current understanding of the Neches River rose-mallow's life history, we do not anticipate individuals will occur in corn, cotton, or soybean fields, indicating that exposure to spray application is very unlikely. Only a 0.73% of the species range overlaps with potential runoff areas, indicating that very few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause high levels of adverse growth effects, spatially refined runoff models indicate that a large portion of locations within the runoff zone are not likely to experience runoff EECs that will cause more than low levels of adverse growth effects. Thus, the overall risk of adverse effects to the species is low.

In summary, we expect very few individuals will experience exposure to Enlist One and Enlist Duo, and of those exposed, very few are likely to experience more than low levels of adverse effects. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Neches River rose-mallow.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for Texas Golden Gladecress and Threatened Status for Neches River Rose-Mallow. Federal Register 78(176):56026-56069.

U.S. Fish and Wildlife Service (USFWS). 2018. Recovery Outline for Neches River rose-mallow (*Hibiscus dasycalyx*). Houston, Texas. 26 pp.

Integration and Synthesis Summary: Flowering Plants - Alabama canebrake pitcher-plant

Scientific Name:	Common Name:	Entity ID:
Sarracenia rubra ssp. alabamensis	Alabama canebrake pitcher-plant	994

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 Action is not likely to jeopardize the continued existence of the Alabama canebrake pitcher-plant. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 06-14-2016 *– Wherever found*

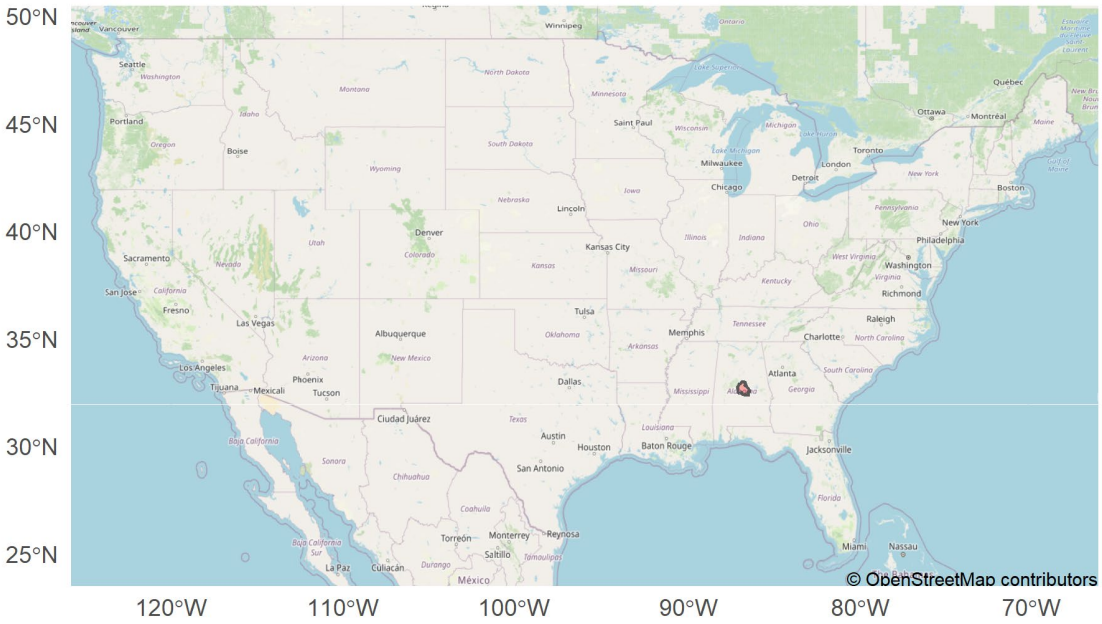

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Figure 4. Range map of Alabama canebrake pitcher-plant (red polygon overlay). Range map accessed on August 12, 2022*,* at https://ecos.fws.gov/ecp/species/1846.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in

the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered
Recommendation 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: Stable, with some populations decreasing and others likely increasing
States within the range: AL
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes

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

The Alabama canebrake pitcher plant is a rare rhizomatous herb and inhabits two distinct habitat types that share similar floristic composition. Currently, the Alabama canebrake pitcher-plant is endemic to Alabama, having been documented from Autauga, Chilton, and Elmore Counties (USFWS 2018). The majority of sites are characterized as hillside seepage bogs, permanently saturated areas that attain their greatest development where an impervious layer of clay lies in close proximity to the ground surface. Precipitation, once reaching this clay zone, becomes restricted and is gradually propelled along a sloping gradient until surfacing further downslope. The other habitat type occurs in association with bottomland or streamside vegetation. Unlike the foregoing habitat, moisture conditions are generally maintained with greater connection to topography and precipitation amounts (USFWS 2018). Bottomland and streamside populations generally contain a greater proportion of woody species and giant cane (*Arundinaria gigantea*) (USFWS 2012). The species is most vigorous in open bogs and declines when the habitat becomes overgrown with woody vegetation. This is a carnivorous plant that catches more flying insects, than crawling insects, likely due to the species' relatively tall stature (USFWS 2018).

Seedling recruitment was reported to be absent from the majority of populations, further inhibiting recovery efforts, as well as long-term viability and evolutionary potential. Because the species can reproduce vegetatively, seedling recruitment may not be paramount at sites experiencing light to moderate levels of fire exclusion; however, vegetative reproduction may not compensate for mortality or the lack of sexual reproduction at some sites (USFWS 2012). Likely pollinators are small bumblebees (*Bombus* spp.) which have a flight distance of 1 mile; at distances greater than 1 mile, pollen flow (and consequent gene flow) is restricted by the inability of pollinators to traverse this distance (USFWS 2018). Previous studies correlate seedling recruitment and population dynamics in relation to site differences, with seedling recruitment greater on sites with higher soil moisture content as opposed to drier sites.

Short-term trends indicate that the species has remained stable, despite the recent loss of one small population and apparent local population declines at some sites which are likely offset by population increases at the largest sites. As of 2018, there were seven natural, extant populations of this species (3 in Autauga County and 4 in Chilton County) where a population is considered distinct if separated by at least 1 mile from nearest known neighbors; no new populations have

been discovered since 2012. Individual subpopulations range in size from 3 or 4 plants to well over 200 and all populations are privately owned. Only 3 populations are comprised of 100 or more individuals, while 2 populations have fewer than 10 individuals. Several attempts to augment and establish populations are known but information on sites is limited and their contribution to recovery is uncertain.

Three populations receive formal protection from adverse habitat modification: one site owned by The Nature Conservancy (TNC) represents one of the finest occurrences known for the species and the other two are protected by easements. Another high-quality site with a large population is owned by the Boy Scouts of America (BSA). Currently, BSA is working with TNC to manage and protect this population. The remaining populations are privately owned, and several of these private landowners have entered into non-binding agreements with the Service and TNC to manage and maintain the plants (Martin 2008, Byrd 2011, Tassin in litt. 2011c, as cited in USFWS 2018).

Environmental Baseline

Habitat degradation and destruction from urban development and incompatible land use have contributed to the present condition of the Alabama canebrake pitcher plant, 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, gravel excavation, agriculture, livestock management, altered hydrology, fire exclusion, the invasion of exotic plant species, and climate change (USFWS 2012, 2018). In addition, one small population was recently lost, possibly due to incompatible road right-of-way maintenance, such as herbicide application (Byrd 2016, as cited in USFWS 2018). We considered all of these activities in the environmental baseline for the 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, three populations receive formal protection from adverse habitat modification: one site owned by TNC represents one of the finest occurrences known for the species and the other two are protected by easements (USFWS 2018). Another high-quality site with a large population is owned by the BSA (USFWS 2018). Currently, BSA is working with TNC 6 to manage and protect this population. The remaining populations are privately owned, and several of these private landowners have entered into non-binding agreements with the Service and TNC to manage and maintain the plants (Martin 2008, Byrd 2011, Tassin *in litt.* 2011c, as cited in USFWS 2018).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as development, gravel excavation, agriculture, livestock management, altered hydrology, fire exclusion, and the invasion of exotic plant species. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of hillside seepage bogs and bottomland or

streamside vegetation 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 relatively few populations, the vulnerability of the species is considered high.

Risk

We do not anticipate the Alabama canebrake pitcher-plant is likely to occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely to occur. We expect only a few individuals are likely to experience runoff exposure. Runoff EECs may occasionally be high enough to cause moderate to high levels of adverse effects, however spatially refined runoff model results indicate that most locations within the runoff zone are not likely to experience runoff EECs that will cause more than low levels of adverse effects. Thus, the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

Based on our knowledge of the Alabama canebrake pitcher-plant's life history, we do not anticipate individuals will occur on corn, cotton, or soybean fields. Thus, on-field exposure to spray application is unlikely to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Alabama canebrake pitcher-plant will occur on runoff areas directly adjacent to Enlist pesticide use sites. 3.39% of the species range overlaps with corn, cotton, and soybean runoff areas (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	1.51
Cotton	0	1.49
Soybean	0	1.9
Total[4]	0	3.39

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn, cotton, and soybean runoff can cause 50-86% growth inhibition and up to 0.01% mortality (i.e., 1 in 10,000 exposed individuals) (Table 11). We consider this a high magnitude of effect as EECs may cause growth effects severe enough to impede plant recovery from herbivory, disease, or other environmental stressors.

Table 11. Highest estimated environmental concentabletrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.035	70	0.01% (1 in 10,000 exposed individuals)
Cotton	0.02	41	<0.0001% (<1 in a million exposed individuals)
Soybean	0.016	29	<0.0001% (1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 22% of corn, 13% of cotton, and 19% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 12).

[4] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

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 growth effects (i.e., no more than 25% growth inhibition).

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	273	60	22
Cotton	270	34	13
Soybean	156	29	19

Thus, while we expect only a few individuals are likely to experience runoff exposure, we anticipate an even fewer number of individuals are likely to experience more than low levels of adverse growth effects. Thus, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals will occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely to occur. 3.39% of the species range overlaps with potential runoff areas, indicating that, at most, only a few individuals are likely to experience runoff exposure. While EECs in runoff may occasionally be high enough to cause moderate to high magnitudes of adverse growth effects to exposed individuals, spatially refined runoff models indicate that a portion of locations within the runoff zone are not likely to experience runoff EECs that will cause more than low levels of adverse growth effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Alabama canebrake pitcher plant. As discussed below, although the vulnerability is high, we expect very few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The Alabama canebrake pitcher plant is listed as endangered, and only 7 populations exist in a restricted range. Three populations on private land are fully protected through management by The Nature Conservancy and two population easements. Threats such as development, gravel excavation, agriculture, livestock management, altered hydrology, fire exclusion, and the invasion of exotic plant species are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our understanding of the Alabama canebrake pitcher-plant's life history, we do not anticipate individuals will occur on corn, cotton, or soybean fields, and, thus, on-field exposure to spray application is unlikely. We expect only a few individuals are likely to be exposed off-field to runoff as only 3.39% of the species range overlaps with potential runoff areas. While runoff EECs may occasionally cause moderate to high levels of adverse growth effects, spatially refined runoff model results indicate that not all locations within the overlap area are likely to experience runoff EECs that will cause more than low levels of adverse growth effects to individuals. Thus, we expect the overall risk of adverse effects to the species is low.

In summary, while runoff exposure to Enlist One and Enlist Duo to individuals may occur, resulting in potentially high levels of adverse effects, these impacts are expected to be highly localized, affecting only a few individuals at most. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing adverse effects will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Alabama canebrake pitcher plant.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1992. Alabama Canebrake Pitcher Plant Recovery Plan. Jackson, Mississippi. 21 pp.

U.S. Fish and Wildlife Service (USFWS). 2012. Alabama Canebrake Pitcher-Plant (*Sarracenia rubra* ssp. *alabamensis*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Mississippi Ecological Services Field Office Jackson, Mississippi. 13 pp.

U.S. Fish and Wildlife Service (USFWS). 2018. Alabama Canebrake Pitcher Plant (*Sarracenia rubra* ssp. *alabamensis*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Mississippi Field Office, Jackson, Mississippi. 33 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. Recovery Plan for Alabama Canebrake Pitcher Plant. Amendment 1. Atlanta, Georgia. 7 pp.

Integration and Synthesis Summary: Flowering Plants - Godfrey's butterwort

Scientific Name:	Common Name:	Entity ID:
Pinguicula ionantha	Godfrey's butterwort	982

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 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 Action is not likely to jeopardize the continued existence of the Godfrey's butterwort. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 02-15-2022 *– Wherever found*

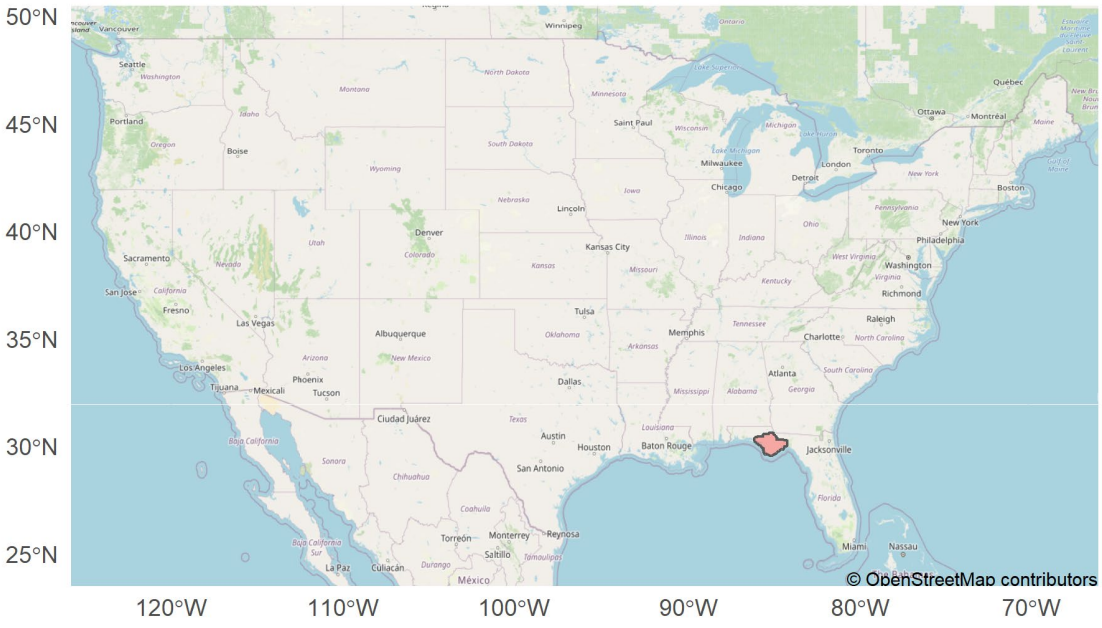

Figure 5. Range map of Godfrey's butterwort (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/6805.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened
Recommendation for Status from Latest 5-Year Review: No change
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (numerous)
Species Trends: Unknown population trends
States within the range: FL
Critical Habitat designated: None
Pesticides noted in USFWS documents: No

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

Godfrey's butterwort is a member of the bladderwort family (Lentiulariaceae), a small family of carnivorous plants. Members of this genus use sticky, glandular leaves to trap and digest insects (USFWS 2009). It is unclear what benefit the plant derives from this carnivory.

The species inhabits open, acidic soils of seepage bogs on gentle slopes, deep quagmire bogs, ditches, and depressions in grassy pine flatwoods and grassy savannas, often occurring in shallow standing water. Specifically, it is found between a lower elevation habitat dominated by pond cypress (*Taxodium ascendens*) overstory and a slightly higher elevation pine flatwoods dominated by an overstory of longleaf pine (*Pinus palustris*) (USFWS 2009).

The flowers rise from late February to April according to temperatures. Flowers are most likely abiotically pollinated via wind.

Godfrey's butterwort is found in Bay, Calhoun, Franklin, Gulf, Liberty, and Wakulla counties in the panhandle of Florida (USFWS 2018). Current survey information indicates an increase in the number of known populations. Survey information shows 22 (33%) of the 66 Element Occurrences (EOs) appear to be extirpated due to development and/or habitat modification (USFWS 2018).

Environmental Baseline

Habitat degradation and destruction from commercial timber production, urban development, and fire management and suppression have contributed to the present condition of the Godfrey's butterwort, 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, pulpwood production in the outer Coastal Plain in the Apalachicola Basin, coastal real estate and road development, overcollection, saltwater inundation caused by hurricanes, and sea

level rise as a result of climate change (USFWS 2018). We considered all these activities in the environmental baseline for the species.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction (from commercial timber production, urban development, and fire management and suppression), as well as other threats such as pulpwood production in the outer Coastal Plain in the Apalachicola Basin, Coastal real estate and road development, and overcollection. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of bogs, ditches, and depressions in grassy pine flatwoods and grassy savannas 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 development, habitat disturbance, modifications and other associated impacts, and we expect similar activities and impacts to occur in the future. Given that the species is threatened, has a restricted range, and numerous populations, the vulnerability of the species is considered medium.

Risk

We do not anticipate the Godfrey's butterwort will occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely. We expect only a few individuals are likely to experience exposure to Enlist herbicide runoff. While runoff EECs may occasionally cause moderate to high magnitudes of adverse effects to exposed individuals, spatially refined exposure models indicate that the majority of runoff events are not likely to cause more than low levels of effects. Thus, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

Based on our understanding of the Godfrey's butterwort's life history, we do not anticipate individuals will occur on corn, cotton, and soybean fields, and, thus, on-field exposure to spray application is unlikely to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Godfrey's butterwort will occur in runoff areas directly adjacent to Enlist pesticide use sites. 0.93% of the species range will overlap with corn, cotton, and soybean runoff areas (Table 13).

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

Crop	On-field (%)	Runoff zone (%)
Corn	0	0.22
Cotton	0	0.6
Soybean	0	0.33
Total[5]	0	0.93

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn, cotton, and soybean runoff can cause 29-74% growth inhibition and up to 0.05% mortality (i.e., 1 in 2000 exposed individuals) (Table 14). While the mortality rate is low, we consider the effect to growth moderate to severe, as this impact may still reduce long-term survival as individuals may have decreased capacity to recover from herbivory, disease, or other environmental stressors.

Table 14. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.038	74	0.05% (1 in 2000 exposed individuals)
Cotton	0.016	29	<0.0001% (<1 in a million exposed individuals)
Soybean	0.018	35	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 27% of corn, 82% of cotton, and 75% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 15).

[5] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

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 growth effects (i.e., no more than 25% growth inhibition).

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	171	46	27
Cotton	179	147	82
Soybean	194	146	75

Thus, we expect that within the small portion of the species range that overlaps with potential runoff areas, only a small portion of locations are likely to experience more than low levels of adverse growth effects. Thus, the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals will occur on Enlist herbicide use sites, and, thus, on-field exposure to spray application is unlikely to occur. As only 0.93% of the species range overlaps with potential runoff areas, we expect, at most, only a few individuals are likely to experience exposure. Runoff EECs may occasionally be high enough to cause moderate to high magnitudes of adverse growth effects, however, spatially refined exposure models indicate that the majority of cotton and soybean runoff scenarios are not likely to experience runoff EECs that would result in more than low levels of adverse effects. While a large proportion of corn runoff scenarios may cause more than low levels of adverse effects, we expect only a few individuals may be exposed through corn application runoff given the very low level of overlap between the species range and corn runoff areas. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Godfrey's butterwort. As discussed below, although the vulnerability is medium, we expect very few individuals will experience more than low levels of adverse effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of

individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The Godfrey's butterwort is listed as threatened, and 44 EOs appear to exist in a restricted range. Threats such as pulpwood production in the outer Coastal Plain in the Apalachicola Basin, Coastal real estate and road development, and overcollection, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is moderately vulnerable.

Based on our current understanding of the Godfrey's butterwort's life history, we do not expect individuals are likely to occur on corn, cotton, or soybean fields, indicating that on-field exposure to spray application is likely to occur. Only 0.93% of the species' range overlaps with potential runoff areas, indicating that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that can cause moderate to high magnitudes of adverse growth effects to exposed individuals, spatially refined runoff model results indicate that the majority of locations within the runoff zone are not likely to experience runoff EECs that would cause more than low levels of adverse growth effects. Given that we expect only a few individuals will likely be exposed and that even fewer individuals are likely to experience more than low levels of adverse effects, we expect the overall risk of adverse effects to the species is low.

In summary, while some individuals may experience runoff exposure, which may result in moderate to high magnitudes of adverse effects, these impacts are expected to be highly localized, affecting only a few individuals at most. While the species is moderately vulnerable, we do not expect the very small number of individuals experiencing effects will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Godfrey's butterwort.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1994. Recovery Plan for Four Plants of the Lower Apalachicola Region, Florida: *Euphorbia telephioides* (Telephus spurge), *Macbridea alba* (white birds-in-a-nest), *Pinguicula jonantha* (Godfrey's butterwort), and *Scutellaria floridana* (Florida skullcap). Atlanta, Georgia. 32 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. *Pinguicula ionantha* Godfrey's butterwort 5-Year Review: Summary and Evaluation. Southeast Region Panama City Field Office, Panama City, Florida. 22 pp.

U.S. Fish and Wildlife Service (USFWS). 2018. *Pinguicula ionantha*, Godfrey's butterwort, 5-Year Review: Summary and Evaluation. Panama City Field Office, Panama City, Florida. 26 pp.

Integration and Synthesis Summary: Flowering Plants - Pondberry

Scientific Name:	Common Name:	Entity ID:
Lindera melissifolia	Pondberry	960

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 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 Action is not likely to jeopardize the continued existence of the pondberry. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 08-17-2021 *- Wherever found*

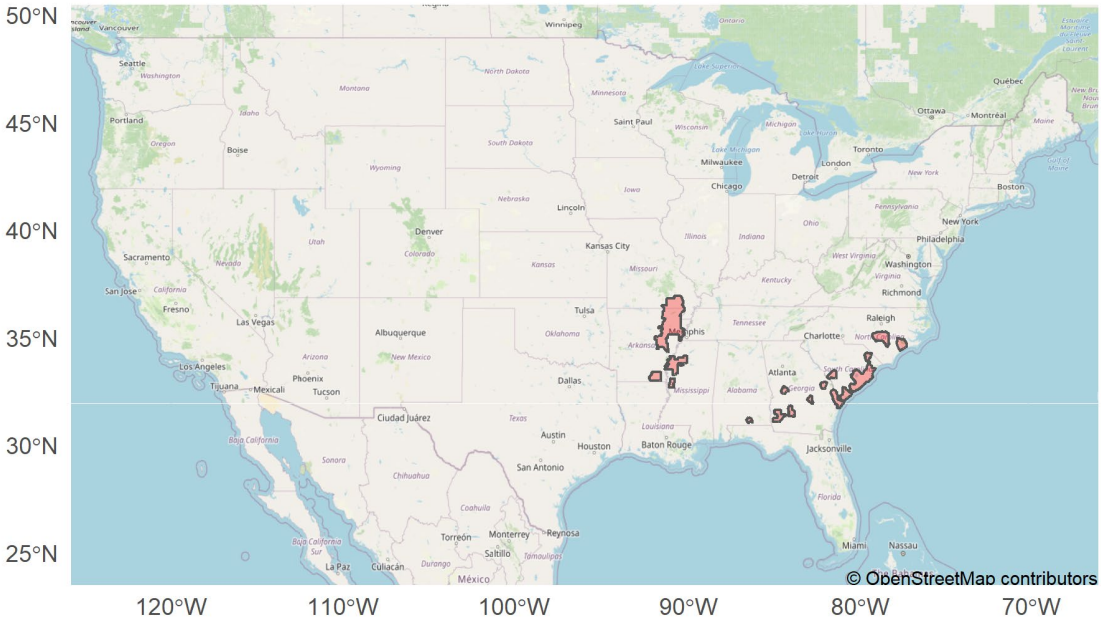

Figure 6. Range map of pondberry (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/1279.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species 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 widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) - one or more populations declining
States within the range: AL, AR, GA, MO, MS, NC, SC
Critical Habitat designated: None
Pesticides noted in USFWS documents: No

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

The pondberry is a deciduous aromatic shrub found within seasonally flooded wetlands that broadly include riverine bottomland hardwood forests and geographically isolated wetlands in the Atlantic and Gulf Coastal Plains and Mississippi Alluvial Valley of the southeastern United States. It can occur in seasonally flooded wetlands such as floodplain/bottomland hardwood forests and forested swales, on the bottoms and edges of shallow seasonal ponds in old dune fields, along the margins of ponds and depressions in pinelands, around the edges of sinkholes in coastal areas with karst topography, and along the borders of Sphagnum bogs. Four primary types of geographically isolated wetlands are known to support pondberry populations and include Carolina bays, limestone or limesink ponds, sand ponds, and lowland sand prairie depressions (USFWS 2014). The species can apparently occupy a variety of habitats as long as hydrological requirements are met.

The pondberry is dioecious (separate male and female plants) and insect pollinated. Flowering occurs from February to March (USFWS 2014), with fruiting from late summer to the fall (Tucker 1984, USFWS 1993). Seeds are tolerant of prolonged flooding and may not be able to form a seed bank without seasonal floods. The seeds do not germinate while submerged, but readily germinate once they are no longer submerged (USFWS 2014).

Dispersal mechanisms of pondberry remain poorly understood. Pondberry's bright red fruits suggest that animals (including black bears) may play an important role in the dispersal of the species. While numerous animals have been associated with pondberry plants, only the hermit thrush (*Catharus guttatus*) has been confirmed as a dispersal agent (USFWS 2014).

Currently, there are 61 extant, natural pondberry populations in Alabama, Arkansas, Georgia, Mississippi, Missouri, North Carolina, and South Carolina (USFWS 2021). However, while new colonies and populations have been discovered since the species was listed, some have become extirpated across the range and others are in decline (USFWS 2021). Furthermore, repeated searches in recent years have failed to relocate one population in Arkansas, two populations and part of a third population in Georgia, and two populations in North Carolina. Searches in Florida and Louisiana have not relocated pondberry in these states since their initial discoveries. Thirteen populations and partial populations occur on State-owned or privately-owned lands and receive at least some protection from habitat destruction (USFWS 2021). An additional population on State-owned land in Arkansas was not relocated during recent searches. Another 22 populations occur on Federally owned lands and receive conservation considerations via sections 7 and 9 of

the Endangered Species Act. One population on Federally owned land in North Carolina has not been observed since its discovery in 2003. The remaining populations occur on privately-owned land and are not known to be protected or managed.

Environmental Baseline

Habitat conversion, degradation, and altered hydrology have contributed to the present condition of the pondberry, 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, excessive canopy closure, prolonged flooding, trampling by domestic cattle and hog disturbance, laurel wilt disease, the fungus-like pathogen, *Phytophthora cinnamomic*, and timber thinning operations (USFWS 2021). We considered all of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as mining activities and residential development, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, seven populations occur on private properties owned and managed by non-governmental conservation organizations and/or protected by conservation easements established under various mechanisms and authorities (USFWS 2021). In Arkansas, St. Francis Sunken Lands Wildlife Management Area (WMA) and Natural Area (NA) are home to two populations, while Swifton Sand Ponds NA and Wapanocca NWR are home to 1 protected population each. One population each, both of uncertain status, occur on private lands protected by conservation easements in Jackson and Woodruff counties (USFWS 2021).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat conversion, degradation, and altered hydrology, as well as other threats such as excessive canopy closure, prolonged flooding, trampling by domestic cattle and hog disturbance, laurel wilt disease, the fungus-like pathogen, *Phytophthora cinnamomic*, and timber thinning operations. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of seasonally flooded wetlands habitat that broadly include riverine bottomland hardwood forests 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 conversion, degradation, and altered hydrology, 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, widespread, and has numerous but declining populations, the vulnerability of the species is considered medium.

Risk

We do not anticipate individuals will occur on Enlist herbicide use sites, and, thus, on-field exposure to spray application is unlikely to occur. Based on overlap data, we expect more than a few individuals may experience runoff exposure off-field. However, we do not expect exposed individuals will experience more than low levels of adverse effects as we do not anticipate woody shrubs like the pondberry to be sensitive the Enlist herbicides. Thus, we expect the overall risk of adverse effects to the species is low. We describe our rationale in the sections below.

Extent of Exposure

Based on our understanding of the pondberry's life history, we do not anticipate individuals are likely to occur on corn, cotton, or soybean fields, and, thus, on-field exposure to spray application is unlikely. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the pondberry will occur on runoff areas directly adjacent to Enlist pesticide use sites. 7.42% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 16).

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

Crop	On-field (%)	Runoff zone (%)
Corn	0	4.2
Cotton	0	2.5
Soybean	0	4.92
Total[6]	0	7.42

Magnitude of effect

Effects to Growth and Mortality

Given that the only available toxicology data for Enlist pesticides in plant species are from studies employing herbaceous plants (at the seedling stage), we expect these estimates of magnitude of effect are greatly overestimated for larger woody plants such as the pondberry. As described in the main opinion (see the *Assumptions and Uncertainties* section), we do not expect plant types like woody plants and shrubs are as sensitive to Enlist pesticide active ingredients as

[6] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

herbaceous plants are. For instance, woody plants have larger biomass and would require a larger dose of pesticide to exhibit the same level of effects as those seen in herbaceous sapling greenhouse studies. Additionally, many of these plants have extensive energy stores within their tissues, which can facilitate faster recovery after injury or toxic effects. Older, established plants with established root systems or above ground features (e.g., trunks and stems) that are not actively growing are less susceptible to sublethal growth effects than young saplings that are used in greenhouse studies. Due to these factors, we do not expect concentrations of Enlist herbicides in runoff will be high enough to cause more than low levels of adverse growth effects to woody plants. Thus, we expect the magnitude of adverse effects to pondberries exposed to Enlist pesticide runoff will be, at most, low.

Risk Summary

We do not anticipate individuals will occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely to occur. While 7.42% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience exposure, we do not expect exposure will result in more than low levels of adverse growth effects given that the pondberry is a woody shrub. We do not expect woody shrubs like the pondberry are sensitive to Enlist herbicides. Thus, we expect the overall risk adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the pondberry. As discussed below, although the vulnerability is medium, we do not expect individuals will experience more than low levels of adverse effects from the Action. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The pondberry is listed as endangered, and while it occurs in a restricted range, there are currently 61 extant, natural pondberry populations. Threats such as habitat conversion, degradation, altered hydrology, excessive canopy closure, prolonged flooding, trampling by domestic cattle and hog disturbance, laurel wilt disease, the fungus-like pathogen, *Phytophthora cinnamomic*, and timber thinning operations, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is moderately vulnerable.

Based on our current understanding of the pondberry's life history, we do not anticipate individuals are likely to occur on corn, cotton, or soybean fields, indicating that on-field exposure to spray application is likely to occur. 7.42% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. However, we do not anticipate exposed individuals will experience more than low levels of adverse growth effects as we do not expect woody shrubs, such as the pondberry, are

likely sensitive to Enlist herbicides. Thus, while a moderate proportion of individuals of the species may experience exposure, we do not think any individual will experience more than low levels of adverse effects. Thus, the overall risk of adverse effects to the species is low.

In summary, while more than a few individuals may be exposed to Enlist One and Enlist Duo runoff, we do not anticipate any individual is likely to experience more than low levels of adverse effects. While the species is moderately vulnerable, we do not expect the level of effect to individuals will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the pondberry.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1993. Recovery Plan for Pondberry (*Lindera melissifolia*). Atlanta, Georgia. 56 pp.

U.S. Fish and Wildlife Service (USFWS) 2014. Pondberry (*Lindera melissifolia*) 5-Year Review: Summary and Evaluation. Southeast Region, Mississippi Field Office, Jackson, Mississippi. 42 pp.

Environmental Protection Agency (EPA) 2016. Chapter 1: Draft Chlorpyrifos Problem Formulation for ESA Assessment. Attachments 1-11, 1-12, 1-13, 1-14, 1-15, 1-20 and 1-21.

U.S. Fish and Wildlife Service (USFWS) 2021. Pondberry (*Lindera melissifolia*) 5-Year Review: Summary and Evaluation. South Atlantic–Gulf and Mississippi Basin Regions, Mississippi Field Office, Jackson, Mississippi. 24 pp.

Integration and Synthesis Summary: Flowering Plants - Green pitcher-plant

Scientific Name:	Common Name:	Entity ID:
Sarracenia oreophila	Green pitcher-plant	819

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 Action is not likely to jeopardize the continued existence of the green pitcher-plant. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 11-21-2017 *– Wherever found*

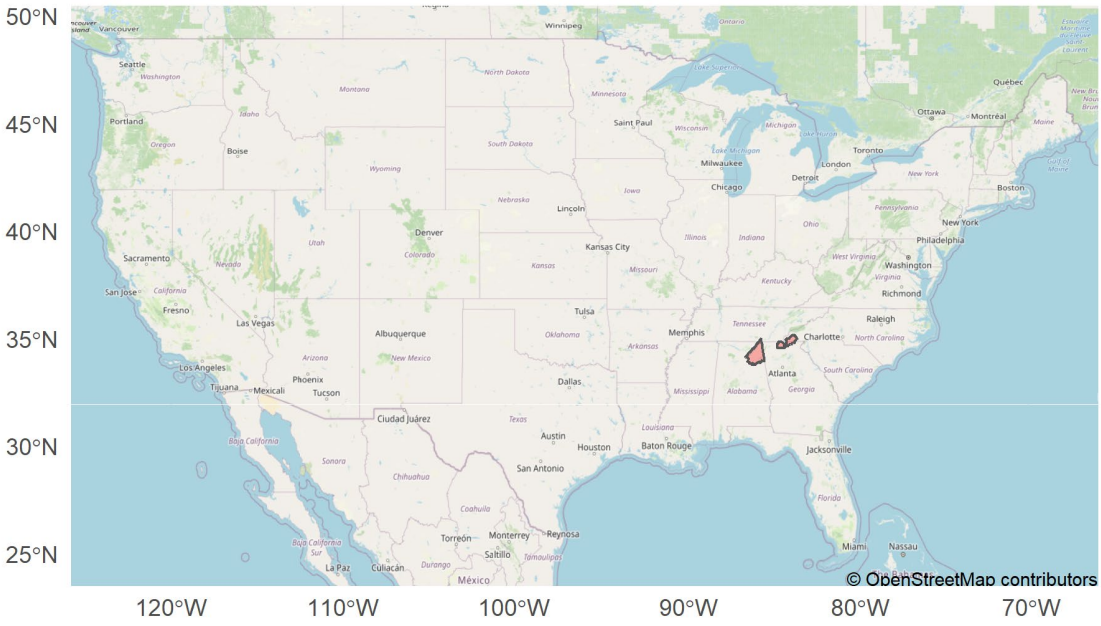

Figure 7. Range map of Green pitcher-plant (red polygon overlay). Range map accessed on August 11, 2022, at https://ecos.fws.gov/ecp/species/2896.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered
Recommendation 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: AL, GA, NC, TN
Critical Habitat designated: None
Pesticides noted in USFWS documents: No

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

The green pitcher-plant is a carnivorous herb arising from moderately branched rhizomes. Most of the extant populations of this species occur in the Coosa Valley and Plateau Regions of the Cumberland Plateau in northeastern Alabama (Harper 1943, as cited in USFWS 1994). Within this area, the natural vegetation is described by many authors as mixed mesophytic (medium moisture conditions) forest and oak-hickory forest (Braun 1951, Kuchler 1964; both as cited in USFWS 1994). The habitats of extant populations vary somewhat with populations found in moist upland areas and others along boggy, sandy streambanks.

The green pitcher-plant reproduces both sexually and asexually; however, asexual reproduction (via rhizomes) is the principal mode of reproduction observed in the extant populations (Troup and McDaniel 1980, McDaniel 1991; both as cited in USFWS 1994). Poor site conditions may be a contributing factor to the lack of seedling recruitment. The pollinator for the species is the queen bumblebee (*Bombus*), with *B. pennsylvanicus* being the most commonly encountered species in the Alabama populations (Folkerts 1992, as cited in USFWS 1994).

Seed dispersal is poorly understood for this species. However, a study of a related, wide-spread pitcher plant species, *Sarracenia purpurea*, indicates that seed dispersal distance from parent plants is typically only a few inches (Ellison and Parker 2002). These authors further suggest that water may facilitate dispersal over longer distances for *Sarracenia* species. Indeed, flooding events are thought to be responsible for the establishment of some green pitcher plant colonies (Folkerts 1992). For example, flooding may have transported seeds from upland bog colonies to suitable streambanks within the Little River watershed (Emanuel 1998) (USFWS 2013).

Based on the provisional population definition presented in the 2014 5-year review (i.e., populations are considered distinct when plants are separated from their nearest neighbors by at least 1 mile), there are currently 13 extant, natural populations known, which is a decline from

15 in 2014 (USFWS 2014, 2020). Currently, eight populations or portions of populations are found on public or non-governmental conservation lands and, as such, these populations receive enhanced protections and conservation considerations (USFWS 2014, 2020). The populations occurring on conservation lands include, two on DeSoto State Park (DSP; Alabama), three on Little River Canyon National Preserve (LRCNP; Alabama), and three on The Nature Conservancy preserves (TNC; Alabama, Georgia, and North Carolina). Several sites in Alabama also continue to receive some conservation considerations under voluntary conservation agreements with the Service.

Environmental Baseline

Habitat degradation and destruction from development have contributed to the present condition of the green pitcher-plant, 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, over-collection, inadequacy of existing regulatory mechanisms, genetics, climate change, cattle and domestic animal disturbance, and inappropriate fire regime (USFWS 2014, 2020). We considered all these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as mining activities, transmission lines, dredging/excavation, shoreline protection, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, both Auburn University's Davis Arboretum and Huntsville Botanical Gardens maintain small safeguarding collections of green pitcher plants (Thompson 2018, USFWS 2020). Recently, the Alabama Plant Conservation Alliance (APCA) has made attempts to augment DeSoto State Park's (DSP) local green pitcher plant populations by undertaking experimental outplantings of juvenile plants on State lands in cooperation with the Alabama Department of Conservation and Natural Resources (ADCNR), Auburn University's Davis Arboretum, and the Huntsville Botanical Gardens. These efforts used progeny from local genotypes maintained in safeguarding collections of ABG and were supported in part by funding from the Service's section 6 grants program (Yawn and Thompson 2018; Thompson, pers. comm. 2020, USFWS 2020). Continued monitoring is needed to determine the short- and long-term success of these outplantings, and provide valuable insight to inform any future population augmentation and/or establishment projects.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as development, over-collection, cattle and domestic animal disturbance, and inappropriate fire regime. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of moist upland within mixed mesophytic forest and oak-hickory forest 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.

Similarly, we anticipate that actions designed to benefit the species will continue. For example, the Atlanta Botanical Garden (ABG) continues to maintain and expand the most extensive ex situ (off-site) safeguarding collection of green pitcher plants in cultivation (Dr. Emily Coffey pers. comm. 2020, USFWS 2020).

Overall Vulnerability: High

In summary, past activities have impacted the species through development and habitat disturbance 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 relatively few populations, the vulnerability of the species is considered high.

Risk

We do not anticipate the green pitcher-plant will occur on Enlist pesticide use sites, and, thus, on-field exposure to spray application is unlikely to occur. Overlap data indicates that, at most, only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause moderate to high magnitudes of adverse effects to exposed individuals, spatially refined runoff model results indicate that most locations within the runoff zone are not likely to experience more than low levels of adverse effects. Thus, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

We do not expect the green pitcher-plant's species range will overlap with corn, cotton, or soybean fields (Table 17). Thus, individuals are not likely to experience direct exposure through contact with spray application. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the green pitcher-plant will occur on runoff areas directly adjacent to Enlist pesticide use sites. 4.65% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 17).

Table 17. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	2.7
Cotton	0	0.87
Soybean	0	3.79
Total[7]	0	4.65

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn, cotton, and soybean runoff can cause 41-71% growth inhibition (Table 18). At most, we expect 1 in 10,000 individuals will die as a direct result of runoff exposure. Despite the low mortality rate, effects to growth inhibition range from moderate to severe, which may reduce the capacity for recovery from herbivory, disease, or other environmental stressors.

Table 18. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.036	71	0.01% (1 in 10,000 exposed individuals)
Cotton	0.03	63	0.01% (1 in 10,000 exposed individuals)
Soybean	0.02	41	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 6% of corn, 37% of cotton, and 49% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 19).

[7] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 19. 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 growth effects (i.e., no more than 25% growth inhibition).

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	825	53	6
Cotton	323	118	37
Soybean	1346	656	49

Thus, we expect that within the small portion of the species range that overlaps with potential runoff areas, only a subset of locations within that portion are likely to experience more than low levels of adverse growth effects. As such, we expect even fewer individuals are likely to experience adverse effects and we anticipate the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals will occur on Enlist herbicide use sites, and, thus, on-field exposure to spray application is unlikely to occur. 4.65% of the species' range overlaps with potential runoff areas, indicating that, at most, only a few individuals are likely to experience exposure. While some locations within the runoff zone may experience runoff EECs high enough to cause moderate to high magnitudes of adverse growth effects to exposed individuals, we do not expect all runoff scenarios will result in such high levels of adverse effects. Given that we only expect a few individuals are likely to experience runoff exposure, and that not all runoff events will cause high levels of adverse growth effects, we anticipate even fewer individuals are likely to experience more than low levels of adverse effects. As such, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the green pitcher-plant. As discussed below, although the vulnerability is high, we expect, at most, only a few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The green pitcher-plant is listed as endangered, and only 13 extant populations known to exist in a restricted range. Threats such as development, over-collection, cattle and domestic animal disturbance, and inappropriate fire regime, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on their life history, we do not anticipate individual green pitcher-plants will occur on corn, cotton, and soybean fields, and, thus, exposure to on-field spray application is unlikely. Overlap data indicates that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that could cause moderate to high magnitudes of adverse growth effects, spatially refined runoff model results indicate that not all runoff scenarios will result in EECs that would cause more than low levels of adverse growth effects. Given that we expect only a few individuals are likely to be exposed and that even fewer individuals are likely to experience more than low levels of adverse effects, we expect the overall risk of adverse effects to the species will be low.

In summary, while runoff exposure to Enlist One and Enlist Duo may occur, which may occasionally result in potentially high magnitudes of adverse effects to exposed individuals, these impacts are expected to be highly localized, affecting only a few individuals at most. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the green pitcher-plant.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1979. Endangered and Threatened Wildlife and Plants; Determination that *Sarracenia oreophila* is an Endangered Species. Federal Register 44(185):54922-54923.

U.S. Fish and Wildlife Service (USFWS). 1993. Green pitcher-plant (*Sarracenia oreophila*) Recovery Plan. Prepared by Green Pitcher Plant Recovery Team Dennis Jordan, Leader Revised by Cary Norquist, U.S. Fish and Wildlife Service Jackson, Mississippi for the Southeast Region Atlanta, Georgia. December 12, 1994. 24 pp.

U.S. Fish and Wildlife Service (USFWS). 2014. Green pitcher-plant (*Sarracenia oreophila*) 5-Year Review: Summary and Evaluation. South Atlantic–Gulf and Mississippi Basin Integrated Regions. Southeast Legacy Region. Mississippi Field Office Jackson, Mississippi. 34 pp.

U.S. Fish and Wildlife Service (USFWS). 2020. Green pitcher-plant (*Sarracenia oreophila*) 5-Year Review: Summary and Evaluation. South Atlantic–Gulf and Mississippi Basin Integrated Regions. Southeast Legacy Region. Mississippi Field Office Jackson, Mississippi. 9 pp.

Integration and Synthesis Summary: Flowering Plants - Sensitive joint-vetch

Scientific Name:	Common Name:	Entity ID:
Aeschynomene virginica	Sensitive joint-vetch	875

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 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 Action is not likely to jeopardize the continued existence of sensitive joint-vetch. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 06-23-2022 *– Wherever found*

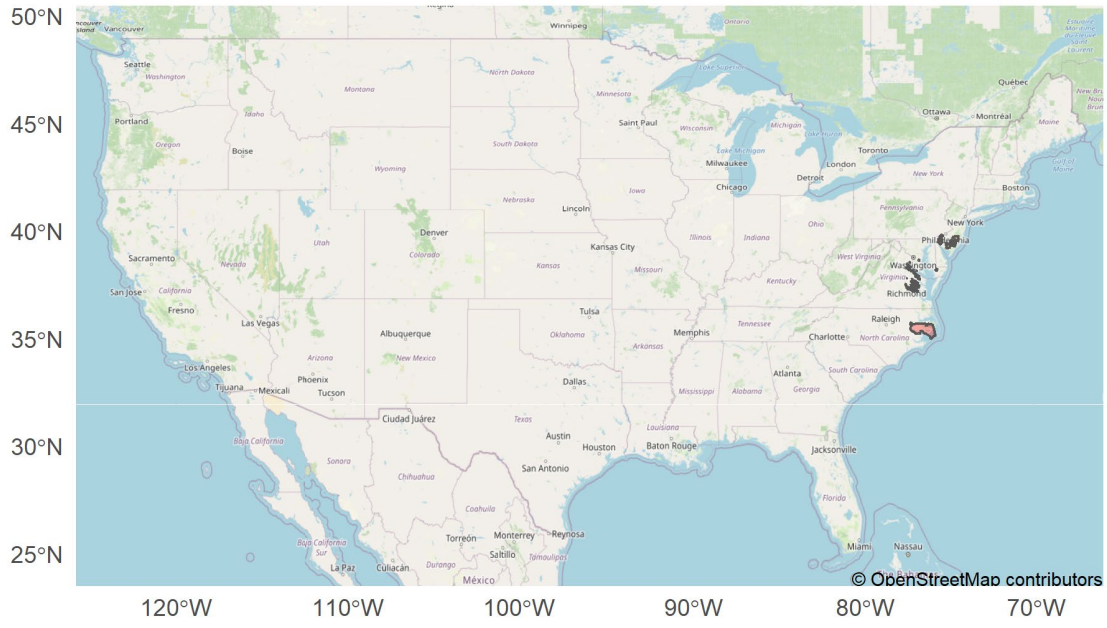

Figure 8. Range map of Sensitive joint-vetch (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/855.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in

the action area, and a discussion of how these aspects of the biology of the species 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 widespread or wide-ranging
Number of Populations: Multiple populations (numerous)
Species Trends: Declining population(s) - one or more populations declining
States within the range: DE, MD, NC, NJ, VA
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Herbicides

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

The sensitive joint vetch is an annual legume native to the eastern United States. The majority of plants are found in natural tidal marsh habitats, but also in a few documented cases of a pocket marsh wetland, the edge of a moist soybean field, a mowed grassy strip between a manmade drainage channel and dirt road, ditches and wet fields. Plants usually grow within 2 m of low water mark on raised banks in peaty, sandy or gravelly substrates. The species occurs in fresh to slightly brackish tidal river systems, within the intertidal zone where populations are flooded twice daily.

Germination begins in late May to early June. Plants begin flowering in July, continuing through September; fruits are produced simultaneously from July to late October. Limited pollinator observations of small bumblebees have been made visiting the flowers. Establishment of seedlings may be restricted by deposition of flotsam on the riverbank and dense stands of perennial species such as *Peltandra virginica* and *Pontederia cordata*. However, most of the area were joint-vetch is found is composed of annual species which die back, presumably leaving many available germination sites. Plants have been known from a site in NJ for at least 9 years, so as long as conditions remain the same, the species seems to maintain itself adequately. Some self-pollination is possible.

The species relies on abiotic seed dispersal, possibly by floating on water. Fruits disseminate as individual articles and have been observed to float, however the length of buoyancy is unknown. Plants consistently reappear (observed in NJ & MD) in the same place indicating limited dispersal, or at least some seed remaining in place as a seed bank.

The 1995 Recovery Plan (USFWS 1995) lists 10 sensitive joint-vetch extant populations (Maryland: 3, New Jersey: 1, Virginia: 6). Due to highly variable population numbers typical for annual species, coupled with the lack of consistent monitoring at many sites in Virginia, and lack of standardized monitoring protocol among the states, an accurate assessment of abundance and population trends is difficult to compile (USFWS 2013). Minimum numbers counted or estimated in a given year since 1991 have ranged from 1,580 – 24,073 (USFWS 2013). Totals in both 1991 and 2010 were close to 8,000 plants, and no clear decline in numbers of plants is evident, although plants likely occur in fewer locations rangewide. Overall, there has been a

trend toward contraction of the range, but discovery of some additional populations within the known range, such as those in the James River, Virginia, represent new information on the status and distribution (USFWS 2012). Most populations of sensitive joint-vetch continue to be unprotected on private lands, although additional finds on Federal and state lands have brought more of the species populations under some measure of protection.

Environmental Baseline

Habitat degradation and destruction from urban development, dredging, and invasive species have contributed to the present condition of the sensitive joint-vetch, 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, sedimentation, dams, filling activities, boating activities, shoreline stabilization and structural development, road and bridge construction, commercial and residential development, water withdrawal projects, changes in water quality, agricultural practices, mining, timber harvest, over-visitation to sensitive joint-vetch sites, declines in muskrat populations, sea level changes (possibly in conjunction with natural cycles), and plant collection (USFWS 1995, 2013). In addition, the North Carolina Natural Heritage cites herbicide use (beside roads, edges of farm fields, and in utility corridors) as a main threat (USFWS 2013). We considered all of these activities in the environmental baseline for the 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 Nature Conservancy (TNC) owns and protects approximately 85% of the land where the Manumuskin River, New Jersey population occurs (B. Allen, TNC, pers. comm. 2011, as cited in USFWS 2013). In addition, a major portion of the large population on the Pamunkey River in Virginia, lies within the Vandell Natural Area Preserve, owned and managed by TNC.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as urban development, dredging, invasive species, sedimentation, dams, filling activities, boating activities, shoreline stabilization, road and bridge construction, water withdrawal projects, changes in water quality, agricultural practices, mining, timber harvest, over-visitation to sensitive joint-vetch sites, declines in muskrat populations, and plant collection. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of sandstone glades and saline prairie 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: Medium

In summary, past and current activities have impacted the species through development, habitat disturbance, modifications 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 relatively wide-ranging, and has multiple populations, the vulnerability of the species is considered medium.

Risk

We do not anticipate individuals will occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely to occur. Overlap data indicates that more than a few individuals may be exposed to runoff. While runoff exposure may occasionally result in moderate levels of adverse effects, spatially refined runoff models indicate that the majority of locations in the runoff zone will not experience more than low levels of adverse effects. Thus, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of Exposure

The sensitive joint-vetch's species range does not overlap with corn, cotton, or soybean fields, and, thus, on-field exposure to spray application is unlikely to occur (Table 20**)**. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the sensitive joint-vetch will occur on runoff areas directly adjacent to Enlist pesticide use sites. 6.53% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 20).

Table 20. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	4.15
Cotton	0	2.39
Soybean	0	4.13
Total[8]	0	6.53

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn, cotton, and soybean runoff can cause 45-50% growth inhibition in exposed individuals (Table 21). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of

[8] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effects.

Table 21. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.022	45	<0.0001% (<1 in a million exposed individuals)
Cotton	0.024	50	<0.0001% (<1 in a million exposed individuals)
Soybean	0.023	48	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 65% of corn, 48% of cotton, and 54% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 22).

Table 22. 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 growth effects (i.e., no more than 25% growth inhibition).

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	571	370	65
Cotton	209	100	48
Soybean	1030	556	54

Thus, we expect that while more than few individuals may experience runoff exposure, we expect only a few individuals will likely experience high enough EECs to cause more than low levels of adverse growth effects. Furthermore, given that the sensitive joint-vetch typically occurs in marshes subject to tidal flow regimes, we anticipate that the magnitude of effect described above are likely overestimated. We expect tidal marshes will accumulate lower levels of Enlist pesticide active ingredients as the water flow dynamics will result in higher rates of pesticide movement out of the habitat. This high rate of pesticide transport is not captured within EPA's environmental fate modeling parameters, resulting in EEC estimates that are likely higher

than what the species is likely to experience. Thus, we expect that runoff exposure will cause low magnitudes of growth effect.

Risk Summary

We do not expect any on-field exposure will occur as the species' range does not overlap with corn, cotton, and soybean fields. 6.53% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause up to moderate levels of adverse growth effects to exposed individuals, we anticipate this will be an infrequent occurrence as most locations within the runoff zone are not likely to experience EECs that will cause more than low levels of adverse growth effects. As such, we anticipate only a few individuals of those that are exposed are likely to experience adverse effects. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Furthermore, we anticipate increased transport of pesticide residues out of the sensitive joint-vetch's habitat from regular tidal flow that would further decrease the likelihood of adverse effects occurring. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the sensitive joint-vetch. As discussed, although the vulnerability is medium, we expect only a few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The sensitive joint-vetch is listed as threatened, and ten populations exist in a widespread range. Threats such as urban development, dredging, invasive species, sedimentation, dams, filling activities, boating activities, shoreline stabilization, road and bridge construction, water withdrawal projects, changes in water quality, agricultural practices, mining, timber harvest, over-visitation to sensitive joint-vetch sites, declines in muskrat populations, and plant collection, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is moderately vulnerable.

We do not expect any on-field exposure will occur on Enlist herbicide use sites as the species range does not overlap with corn, cotton, or soybean fields. 7.42% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause moderate levels of adverse growth effects, spatially refined runoff model results indicate that the majority of locations within the runoff zone are not likely to experience more than low levels of adverse growth effects. Furthermore, we expect that tidal flow within the species' preferred habitat will result in increased removal of pesticide residues, further reducing the risk of adverse effects

occurring. As such, while we expect more than a few individuals will experience runoff exposure, we anticipate that, at most, only a few individuals will experience more than low levels of adverse effects.

In summary, while individuals may be exposed to Enlist One and Enlist Duo, resulting in adverse effects, these impacts are expected to be highly localized, affecting only a few individuals at most. While the species is moderately vulnerable, we do not expect the very small number of individuals experiencing adverse effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the sensitive joint-vetch.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1992. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Sensitive Joint-vetch (*Aeschynomene virginica*). Federal Register 57(98): 21569-21574.

U.S. Fish and Wildlife Service (USFWS). 1995. Sensitive Joint-Vetch (*Aeschynomene virginica*) Recovery Plan. Hadley, Massachusetts. 55 pp.

U.S. Fish and Wildlife Service (USFWS). 2013. Sensitive Joint-Vetch (*Aeschynomene virginica*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, Virginia 46 pp.

EPA 2016. Chapter 1: Draft Chlorpyrifos Problem Formulation for ESA Assessment. Attachments 1-11, 1-12, 1-13, 1-14, 1-15, 1-20 and 1-21.

Integration and Synthesis Summary: Flowering Plants - Brooksville bellflower

Scientific Name:	Common Name:	Entity ID:
Campanula robinsiae	Brooksville bellflower	653

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 Action is not likely to jeopardize the continued existence of Brooksville bellflower. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 04-25-2022 *– Wherever found*

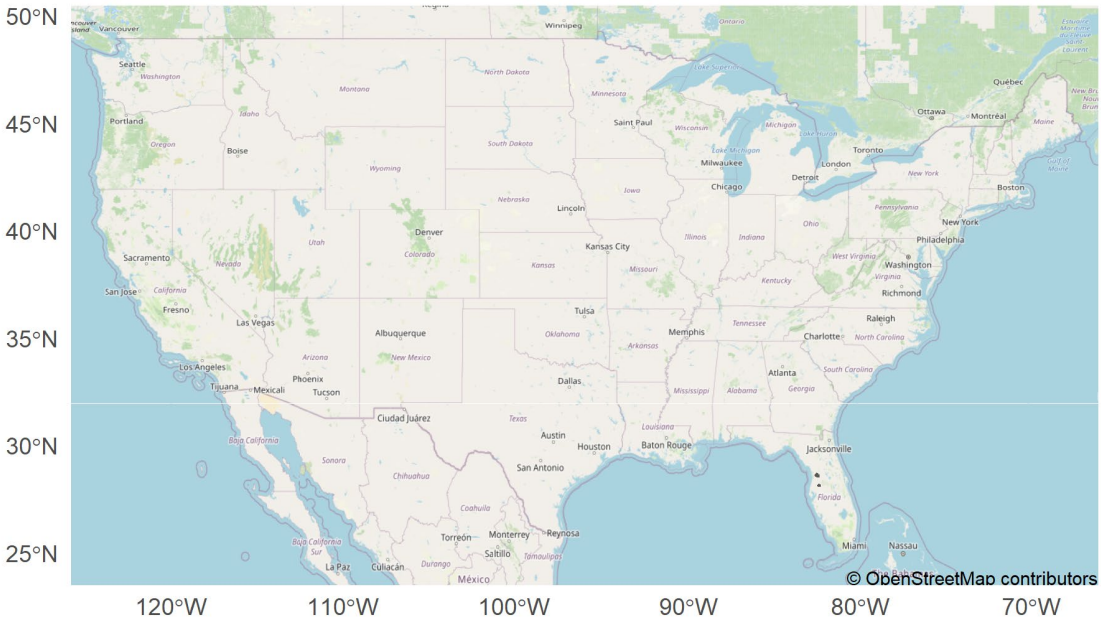

Figure 9. Range map of Brooksville bellflower (red polygon overlay). Range map accessed on August 11, 2022, at https://ecos.fws.gov/ecp/species/5809.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered
Recommendation 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: FL
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Herbicides

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

Brooksville bellflower is a member of the bellflower family (Campanulaceae) that occurs at pond margins, in wet prairies, or in seepage areas in adjacent hardwood forests (USFWS 1994). The plant may be submerged for part of its life, which may affect its growth. Brooksville bellflower was originally found in a seepage area on the north facing slope of Chinsegut Hill surrounded by pasture used for animal husbandry. It has since been found within an oak/palm hydric hammock along the edge of an elongated maidencane (*Panicum hemitomom*) marsh at Burns Prairie (Laundry 1996). Typically, this species is found along the margins of ponds and marshes with fluctuating water levels and moist seepage areas, both surrounded by pastures.

Flowering specimens have been collected March-April and the species is capable of self-pollination. Insects and birds are also potential pollinators. Seeds germinate in winter or spring, and seed production occurs while flowering continues (EPA 2016). It was determined that water levels from rainfall rather than time of year may be a critical factor controlling germination (Williams 1998, USFWS 2010). Fruit dispersal potentially occurs via abiotic factors, birds, and mammals (EPA 2016).

The Brooksville bellflower is only found in Hernando and Hillsborough Counties, where there are six extant populations (Burns Prairie, Croom-Bell Heaven, Croom-Power Line Road, and Hillsborough River State Park #1, #2, and #4), all on public land along wet prairies, pond margins, or seepage areas (USFWS 2019). Most of the Burns Prairie population occurs on land owned by Florida Agricultural and Mechanical University (FAMU) and the southern extent is owned by the Florida Fish and Wildlife Conservation Commission (FWC). Less than 3 miles from Burns Prairie are two other populations that have not had plants in several years due to habitat degradation (Chinsegut Hill) and development (Young). In 2015, several plants were found in the Croom Tract of Withlacoochee State Park (WSF) in Hernando County along a power line road (Croom-Power Line Road). A year later, another population was found along a pond margin a tenth of a mile away (Croom-Bell Heaven) (Peterson, BTG pers. comm. 2018b).

These populations are located approximately 5 miles southeast of the other Hernando County sites. Approximately 40 miles south of all other known sites are four populations within Hillsborough River State Park (HRSP #1-4). The HRSP populations were found starting in 2006 along pond margins and wetlands within HRSP, all within approximately 0.4 miles of each other. Surveyors have not found plants in one of the populations since 2009. These populations are much lower in elevation than the Hernando County sites. From 2016- 2018 three populations consistently had more than three hundred plants: Burns Prairie, Croom-Bell Heaven, and HRSP #2. The Brooksville bellflower is declining (2009 Recovery Data Call as cited in USFWS 2019).

Environmental Baseline

Habitat degradation and destruction from residential and agricultural land development have contributed to the present condition of the Brooksville bellflower, 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, lack of habitat management, development of the land surrounding protected sites, altered hydrology, increased runoff containing fertilizers and herbicides, human population growth, trampling from cattle, poor water quality from storm water runoff, and the lack of mowing or maintaining grasses (USFWS 2019). In addition, development of the land surrounding protected lands may alter hydrology by increasing runoff to Brooksville bellflower sites (USFWS 2019). This runoff may also contain fertilizers and herbicides that may affect growth and germination of the plants. Brooksville bellflower occurs in the Central Region of Florida, which is projected to experience the greatest population growth in the state in the near future. By 2070, the percentage of developed land is expected to double from 25% in 2010 to almost 50% (Carr and Zwick 2016, as cited in USFWS 2019). We considered all these activities in the environmental baseline for the species.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as residential and agricultural land development, lack of habitat management, altered hydrology, increased runoff containing fertilizers and herbicides, human population growth, trampling from cattle, poor water quality from storm water runoff, and the lack of mowing or maintaining grasses. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of wetlands adjacent to hardwood forest 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. Given that the species is endangered, has a restricted range, and relatively few populations, the vulnerability of the species is considered high.

Risk

Based on our knowledge of their life history, we do not anticipate the Brookesville bellflower will occur on Enlist herbicide use sites and thus are not likely to experience on-field exposure to spray application. Overlap data indicates that, at most, only a few individuals will experience runoff exposure. Runoff EECs may occasionally reach levels that can cause low to moderate levels of adverse effects to individuals, however, spatially refined exposure models indicate that the majority of runoff events are not likely to cause more than low levels of effects to exposed individuals. Thus, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

Based on their life history, we do not anticipate the Brooksville bellflower will occur on corn, cotton, or soybean fields. Thus, the species will not likely experience direct exposure through contact with spray application. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Brooksville bellflower may occur in runoff areas directly adjacent to Enlist pesticide use sites. 0.05% of the species range overlaps with corn runoff areas (Table 23).

Table 23. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0.01	0.05
Cotton	0	0
Soybean	0	0
Total[9]	0.01	0.05

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn runoff may cause up to 24-44% growth inhibition (Table 24). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effects.

[9] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 24. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.021	44	<0.0001% (<1 in a million exposed individuals)
Cotton	NA	NA	NA
Soybean	NA	NA	NA

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 exposure. EPA's Tier 3 geographic distribution models show that 84% of corn runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 25).

Table 25. 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 growth effects (i.e., no more than 25% growth inhibition).

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	44	37	84
Cotton	NA	NA	NA
Soybean	NA	NA	NA

Thus, we expect that within the small portion of the species range that overlaps with potential runoff areas, only subset of locations within are likely to experience more than low levels of adverse growth effects. Thus, the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals are likely to occur on Enlist herbicide use sites, indicating that on-field exposure is unlikely to occur. Only 0.05% of the species' range overlaps with potential runoff areas, indicating that few individuals are likely to experience exposure. Those that are exposed may experience low to moderate magnitudes of adverse growth effects, but spatially refined runoff exposure modeling results indicate that the majority of runoff scenarios are not

likely to result in more than low levels of adverse growth effects. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Brooksville bellflower. As discussed below, although the vulnerability is high, we expect very few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects will occur.

The Brooksville bellflower is listed as endangered, and only 6 extant populations exist in a restricted range. Threats such as residential and agricultural land development, lack of habitat management, altered hydrology, increased runoff containing fertilizers and herbicides, human population growth, trampling from cattle, poor water quality from storm water runoff, and the lack of mowing or maintaining grasses, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is moderately vulnerable.

Based on our knowledge of the Brookville bellflower's life history, we do not anticipate individuals will occur in corn, cotton, or soybean fields, indicating that on-field exposure to spray application is unlikely to occur. Only 0.05% of the species' range overlaps with potential runoff areas, indicating that, at most, only a few individuals are likely to experience any exposure. Furthermore, spatially refined runoff model results indicate that the majority of locations within the runoff zone are unlikely to experience runoff EECs that would result in more than low levels of adverse growth effects. Therefore, we expect the overall risk of adverse effects to the species is low.

In summary, while exposure to Enlist One and Enlist Duo may result in adverse effects to a few individuals, we expect that only a small subset of those individuals are likely to experience more than low levels of adverse effects as these impacts are expected to be highly localized. While the species is moderately vulnerable, we do not expect that the very small number of individuals that may experience growth effects will impact the species as a whole. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Brooksville bellflower.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1989. Endangered and Threatened Wildlife and Plants; Endangered Status for Four Florida Plants. Federal Register 54(143):31190-31196.

U.S. Fish and Wildlife Service (USFWS). 1994. Recovery Plan for Brooksville Bellflower (*Campanula robinsiae*) and Cooley's Water-willow (*Justicia cooleyi*). Southeast Region. Atlanta, Georgia. June 20, 1994. 40 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. Brooksville Bellflower (*Campanula robinsiae*). 5-Year Review: Summary and Evaluation. Jacksonville Ecological Services Field Office. Southeast Region. Jacksonville, Florida. 36 pp.

Integration and Synthesis Summary: Flowering Plants - Canby's dropwort

Scientific Name:	Common Name:	Entity ID:
Oxypolis canbyi	Canby's dropwort	976

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 Action is not likely to jeopardize the continued existence of the Canby's dropwort. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 04-26-2019 *- Wherever found*

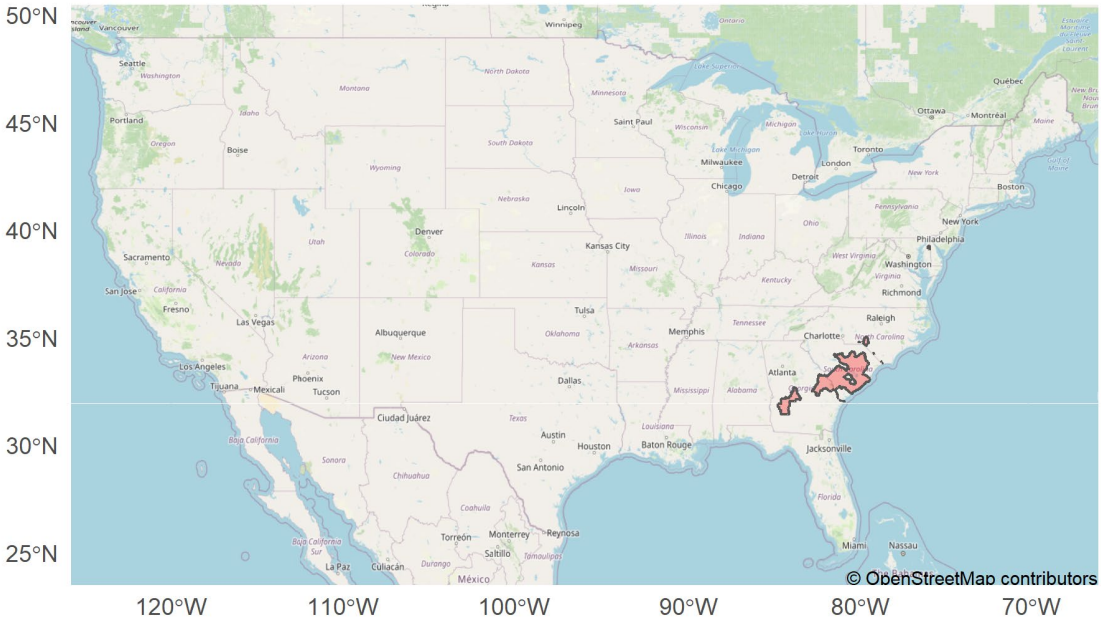

Figure 10. Range map of Canby's dropwort (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/7738.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species 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 (numerous)
Species Trends: Declining population(s) - one or more populations declining
States within the range: DE, GA, MD, NC, SC
Critical Habitat designated: None
Pesticides noted in USFWS documents: No

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
Canby's dropwort is a rare perennial herb native to coastal plains in the east coast. Historically, Canby's dropwort occurred in Delaware, Maryland, North and South Carolina, and Georgia. Today, Canby's dropwort only occurs in three states: Maryland, South Carolina, and Georgia. The species has been found in a variety of coastal plain habitats prone to long periods of inundation, including cypress ponds, grass-sedge dominated Carolina bays, wet pine savannahs, shallow pineland ponds and cypress-pine swamps or sloughs. The largest and most vigorous populations reported occur in open bays or ponds which are flooded throughout most of the year and which have little or no canopy cover. Many sites are on a sandy loam or loam soil which is underlain by a clay layer. Preferred soil types are similar in that they have a medium to high organic content, high water table, and are deep, poorly drained, and acidic. Historically, fire was a key element maintaining the open nature of the habitat at many sites.

Existing populations are maintained mainly through asexual reproduction. This species is strongly clonal, reproducing vegetatively by means of stoloniferous rhizomes (plants connected by horizontal stems). Stems also become decumbent (lie on the ground) and root at the nodes, especially in drier sites where there is little or no water to support the stems. The flowers can be either unisexual or bisexual. Bisexual flowers may facilitate some self-pollination; however, the flowers' male and female organs mature at separate times, which is indicative of some degree of outcrossing, or the need for pollen transport to separate individuals. The potential for outcrossing may be higher in those flower clusters which produce inner male flowers and outer female flowers. The vectors of seed dispersal are not well understood, but at least some seed dispersal is by wind (USFWS 1990).

Approximately 40 occurrences are believed extant, mostly in South Carolina and Georgia (North Carolina and Maryland have 1 occurrence each). An additional 16 occurrences are ranked "failed to find," "historical," or "unknown" (NatureServe 2015, as cited in the Status of the Species

account). In Georgia, at least three occurrences have “thousands” of plants, and at least four more have several hundred to a thousand; others are smaller (25-250) or of unknown size. In South Carolina, one occurrence is described as “extremely large”, three others as “very large”, and one additional as “fairly large”; remaining occurrences are described as “good size”, “fair size”, or “small”, or are of unknown size. The Maryland occurrence fluctuated between 14 and 82 plants over nine years of detailed monitoring. The North Carolina occurrence has had very few plants (e.g., 2 individuals) observed in recent years, although it was larger in the past (NatureServe 2015, as cited in the Status of the Species account).

There is one disjunct population in the northeast, located in Queen Anne’s County, Maryland. The remaining extant Canby’s dropwort populations occur in the Southeast in South Carolina and Georgia (USFWS 2022).

The Canby’s dropwort has eighteen extant populations, including one population that has been introduced. Efforts are underway to reintroduce Canby’s dropwort at the Big Cypress Meadow, NC. There are eleven populations (five in South Carolina, five in Georgia, and one in Maryland) that are currently protected and managed to some degree by landowners or cooperating agencies. This is an increase of three populations from the 2015 5-year review. Several of these populations are not self-sustaining due to lack of management or hydrological degradation. Currently, only five Canby’s dropwort populations are self-sustaining populations (USFWS 2022).

Environmental Baseline

Habitat degradation and destruction primarily from agriculture and silviculture have contributed to the present condition of the Canby’s dropwort, 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, ditching and draining of wetland areas, reduced frequency, depth, and duration of surface water, lowered the groundwater table, changed vegetative composition, invasion by shrubs, pine plantings, logging, and lack of regular fires (USFWS 2022). We considered all these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as residential development, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, there are eleven populations that are at least partially protected via conservation easements, owned by The Nature Conservancy, or managed by a natural resources agency (USFWS 2015). In addition, in 1989 the Maryland Natural Heritage Program, in cooperation with The Nature Conservancy and the center for Plant Conservation brought in two of the three surviving plants in Maryland into cultivation in the hope of preserving and propagating this genotype for eventual reintroduction to suitable sites in

the Delmarva (Delaware/Maryland) area (Bartgis, personal communication, 1989; as cited in USFWS 1990).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as ditching and draining of wetland areas, reduced frequency, depth, and duration of surface water, lowered groundwater table, changed vegetative composition, invasion by shrubs, pine plantings, logging, and lack of regular fires. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of coastal plains with long periods of inundation 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 development, habitat disturbance, modifications 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, is neither widespread or constrained, and has one or more declining populations, the vulnerability of the species is considered high.

Risk

We do not anticipate the Canby's dropwort is likely to occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely. Overlap data indicates that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause up to moderate magnitudes of growth effects, spatially refined runoff model results indicate the majority of runoff events will not likely experience runoff EECs that will cause more than low levels of effects. As such, we anticipate only a few individuals are likely to be significantly impacted by the Action. Therefore, we expect the overall risk of adverse effects to the species to be low. We discuss our rationale in the sections below.

Extent of exposure

Based on our knowledge of the Canby dropwort's life history, we do not expect individuals will occur on corn, cotton, or soybean fields. Thus, individuals will not likely experience direct exposure through contact with spray application. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Canby's dropwort will occur in runoff areas directly adjacent to Enlist pesticide use sites. 8.47% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 26).

Table 26. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	4.15
Cotton	0	3.75
Soybean	0	4.73
Total[10]	0	8.47

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn and cotton runoff may cause up to 35-48% growth inhibition (Table 27). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effects.

Table 27. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.019	37	<0.0001% (<1 in a million exposed individuals)
Cotton	0.023	35	<0.0001% (<1 in a million exposed individuals)
Soybean	0.018	48	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 59% of corn, 63% of cotton, and 50% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 28).

[10] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 28. 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 growth effects (i.e., no more than 25% growth inhibition).

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	2576	1523	59
Cotton	2712	1716	63
Soybean	4298	2139	50

Thus, while we expect more than a few individuals are likely to experience runoff exposure, we anticipate that, at most, only a few individuals are likely to experience more than low levels of adverse growth effects. As such, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not expect individual Canby's dropwort are likely to experience exposure to spray application as they are not likely to occur on corn, cotton, or soybean fields. 8.47% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause up to moderate levels of adverse growth effects to exposed individuals, spatially refined runoff exposure modeling results indicate that the majority of runoff scenarios are not likely to cause more than low levels of effects that are not likely to appreciably affect the long-term survival of exposed individuals. Thus, we expect, at most, only a few individuals will experience moderate adverse growth effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species to be low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Canby's dropwort. As discussed below, although the vulnerability is high, we expect, at most, only a few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be adversely affected over the duration of the Action, we do not expect species-level effects will occur.

The Canby's dropwort is listed as endangered, and approximately 9 populations are known to exist in a range that is neither constrained nor widespread. Threats such as ditching and draining of wetland areas, reduced frequency and depth and duration of surface water, lowered the groundwater table, changed vegetative composition, invasion by shrubs, pine plantings, logging, and lack of regular fires, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our current knowledge of the Canby's dropwort's life history, we do not expect individuals will occur in corn, cotton, and soybean fields, and thus, are not likely to experience exposure to spray application. 8.47% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause up to moderate levels of effects to exposed individuals, spatially refined runoff model results indicate that most locations within the runoff zone are not likely to experience runoff EECs that would result in more than low levels of adverse growth effects. Thus, while more than a few individuals may be exposed, we expect, at most, only a few individuals will experience adverse growth effects. Therefore, we expect the overall risk of adverse effects to the species is low.

In summary, while runoff exposure to Enlist One and Enlist Duo may occur in more than a few individuals, we expect most individuals are not likely to experience runoff EECs that cause more than low levels of adverse effects. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing adverse effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Canby's dropwort.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service. 1990. Canby's Dropwort Recovery Plan. Atlanta, Georgia. 25 pp; NatureServe. 2015. NatureServe Central Databases. Arlington, Virginia.

U.S. Fish and Wildlife Service. 2010. Canby's Dropwort (*Oxypolis canbyi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service. Southeast Region South Carolina Ecological Services Field Office, Charleston, South Carolina. 17 pp.

U.S. Fish and Wildlife Service. 2015. Canby's Dropwort (*Oxypolis canbyi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service. Southeast Region South Carolina Ecological Services Field Office, Charleston, South Carolina. 22 pp.

U.S. Fish and Wildlife Service. 2022. Canby's Dropwort (*Oxypolis canbyi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service. Southeast Region South Carolina Ecological Services Field Office, Charleston, South Carolina. 13 pp.

Integration and Synthesis Summary: Flowering Plants – Cooley's meadowrue

Scientific Name:	Common Name:	Entity ID:
Thalictrum cooleyi	Cooley's meadowrue	852

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 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 Action is not likely to jeopardize the continued existence of the Cooley's meadowrue. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 04-15-2022 *– Wherever found*

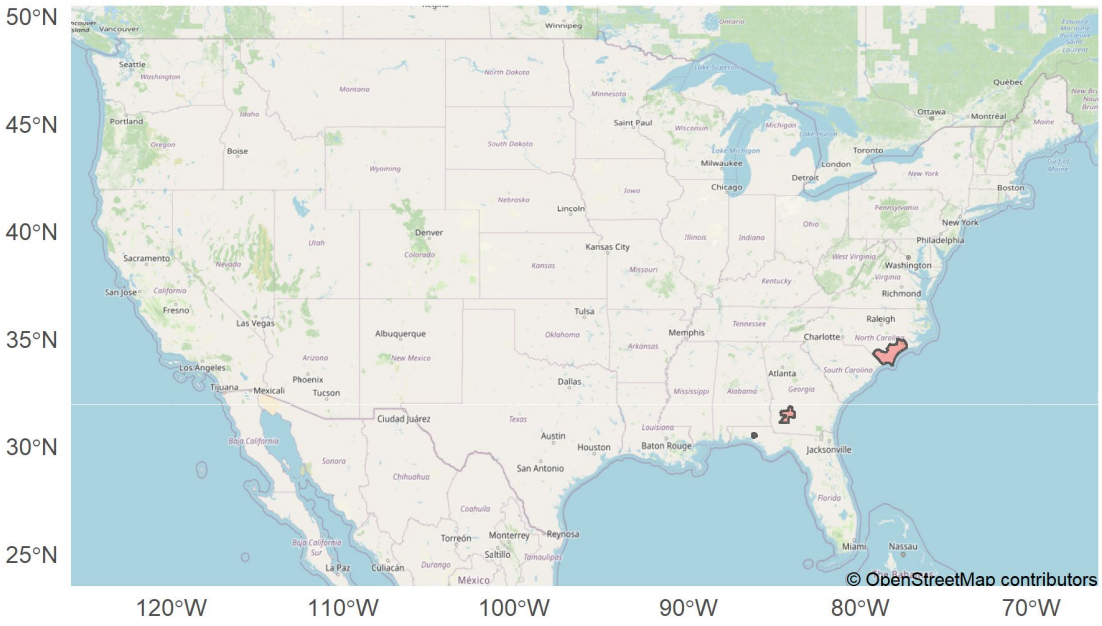

Figure 11. Range map of Cooley's meadowrue (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/3281.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in

the action area, and a discussion of how these aspects of the biology of the species 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: Unknown population trends
States within the range: FL, GA, NC
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Herbicides

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

The Cooley's meadowrue is a rare perennial herb endemic to the Southeastern coastal plain in North Carolina, Georgia, and Florida. Habitat for the species includes sunny, moist places such as open, savanna-like forest edges and clearings, wet savannas over calcareous clays, and transitions between wet savannas and non-riverine swamp forests. Soils are basic, sandy loams. The Cooley's meadowrue is usually associated with some type of disturbance, e.g., clearings, the edges of frequently burned savannas, power line right-of ways which are maintained either by fire or mowing, and roadside edges. Sufficient moisture is critical to plant vigor and reproductive effort. This plant occupies a narrow hydrological niche, where soil is moist to saturated but water does not stand above the soil surface.

Cooley's meadowrue flowers from mid- June to early July. The winged, single-seeded fruits mature in August and September, but the seed life is presumably short. A dioecious species, it has separate male and female flowers that are wind- and insect-pollinated. It is also possible that the species propagates by breaking off and dispersing vegetative parts in aquatic habitat.

Cooley's meadowrue is extant at nine populations comprising a total of 32 sites or subpopulations (USFWS 2020). Current populations are known to occur in 9 counties: Brunswick, Columbus, New Hanover, Onslow, and Pender counties in North Carolina, Dougherty, and Worth counties in Georgia, and Walton and Washington counties in Florida (USFWS 2009, 2020). Since the 2009 5-year review (USFWS 2009), several new element occurrences (Eos) have been found in NC, including one entirely new population and four Eos that expand the size of a known population (USFWS 2020). One new population was discovered in Worth County, GA. Currently, state natural heritage programs recognize 19 extant populations (10 in NC, 8 in GA and 1 in FL). Of these, 10 populations (6 in NC, 3 in GA and 1 in FL) have some level of protection, and are either owned and/or managed for conservation by state agencies or private conservation organizations (USFWS 2020).

Six populations consisting of a total of seven subpopulations are protected on conservation lands in North Carolina, Georgia, and Florida. Five subpopulations, comprising four populations have been protected in North Carolina. One population in Georgia is protected by The Nature Conservancy and the only known population in Florida occurs on the Nokuse Plantation and is in

an area protected by a conservation easement (Amy Jenkins, Botanist, Florida Natural Area Inventory, pers. comm. as cited in USFWS 2020).

Environmental Baseline

Habitat modification and destruction have contributed to the present condition of the Cooley's meadowrue, 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, land clearing for agriculture, fire or other disturbance suppression, forestry/logging activities, mining and development, wetland draining (for development and road construction), highway construction, and sites located within utility rights-of-way are threatened by herbicide use or mowing during critical growth periods (USFWS 2020). We considered all of these activities in the environmental baseline for the 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, two mostly intact savannas, including the site with the largest population, are owned wholly or in part by The Nature Conservancy. These two sites (Lanier Quarry and Myrtle Head Savanna) are being managed to maintain open savannas by controlled burns, although the patchwork nature of land ownership at Lanier Quarry makes effective burning difficult (USFWS 1994). In addition, The Nature Conservancy has used fire to maintain the Florida site; the owners and power company managers have cooperated in curtailing site preparation activities and herbicide use (Steve Gatewood. Florida Field Office, The Nature Conservancy, personal communication, 1992; as cited in USFWS 1994).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as land clearing for agriculture, fire or other disturbance suppression, forestry/logging activities, mining and development, draining (for development and road construction), high construction, and herbicide use or mowing during critical growth periods. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of Southeastern coastal plan, wet, savanna-like forest edges and clearings 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 development, habitat disturbance, modifications 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 range that is neither widespread nor constricted, and one or more declining populations, the vulnerability of the species is considered high.

Risk

We do not anticipate individual Cooley's meadowrue are likely to occur on Enlist herbicide use sites, indicating that exposure to spray application is unlikely to occur. Overlap data indicates that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause up to moderate magnitudes of adverse effects, spatially refined runoff model results indicate that the majority of runoff events will not cause more than low levels of effects. As such, we anticipate only a few individuals are likely to be adversely impacted by the Action. Therefore, we expect the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

Based on our current understanding of the Cooley's meadowrue's life history, we do not expect individuals will occur in corn, cotton, or soybean fields. Therefore, we do not expect individuals are likely to experience on-field exposure to spray application. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Cooley's meadowrue will occur in runoff areas immediately adjacent to Enlist pesticide use sites. 6.93% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 29).

Table 29. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	4.15
Cotton	0	2.78
Soybean	0	4.04
Total[11]	0	6.93

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn and cotton runoff may cause up to 37-50% growth inhibition (Table 30). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effects.

[11] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 30. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.024	50	<0.0001% (<1 in a million exposed individuals)
Cotton	0.019	37	<0.0001% (<1 in a million exposed individuals)
Soybean	0.023	47	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 56% of corn, 66% of cotton, and 59% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 31).

Table 31. 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 growth effects (i.e., no more than 25% growth inhibition).

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	576	325	56
Cotton	463	306	66
Soybean	789	538	59

Thus, while more than a few individuals are likely to experience runoff exposure, we anticipate, at most, only a few individuals are likely to experience more than low levels of adverse growth effects. Therefore, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate on-field exposure to spray application is likely to occur as we do not anticipate individual Cooley's meadowrue are likely to occur on Enlist herbicide use sites. 6.93% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals may experience runoff exposure. While runoff EECs may occasionally reach levels that can cause moderate levels of adverse growth effects, spatially refined runoff exposure

models indicate that the majority of runoff scenarios are not likely to cause more than low levels of effects that are not likely to adversely affect the long-term survival of exposed individuals. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. We consider the overall risk of adverse effects to the species to be low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Cooley's meadowrue. As discussed below, although the vulnerability is high, we expect only a few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate small numbers of individuals will be adversely affected over the duration of the Action, we do not expect species-level effects will occur.

The Cooley's meadowrue is listed as endangered, and only 19 extant populations are known to exist in a range that is neither constrained nor widespread. Threats such as land clearing for agriculture, fire or other disturbance suppression, forestry/logging activities, mining and development, draining (for development and road construction), high construction, and herbicide use or mowing during critical growth periods, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our current understanding of the Cooley's meadowrue's life history, we do not anticipate individuals are likely to occur in corn, cotton, or soybean fields, indicating that exposure to spray application is unlikely to occur. We expect more than a few individuals are likely to experience runoff exposure as 6.93% of the species' range overlaps with potential runoff areas. While runoff EECs may occasionally reach levels that may cause moderate levels of adverse growth effects, spatially refined runoff model results indicate that the majority of locations within the runoff zone are unlikely to experience runoff EECs that will cause more than low levels of adverse growth effects to exposed individuals. As such, while more than a few individuals may experience exposure, the majority of individuals exposed will experience only low levels of adverse effects. Thus, we expect the overall risk of adverse effects to the species will be low.

In summary, while more than a few individuals are likely to experience runoff exposure, impacts are expected to be highly localized, resulting in more than low levels of adverse effects to only a few individuals at most. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing adverse growth effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Cooley's meadowrue.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1994. Cooley's Meadowrue Recovery Plan. U.S. Fish and Wildlife Service, Atlanta. Georgia. 29 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. Cooley's Meadowrue (*Thalictrum cooleyi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region, Ecological Services. Raleigh, North Carolina. 20 pp.

U.S. Fish and Wildlife Service (USFWS). 2020. Cooley's Meadowrue (*Thalictrum cooleyi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region, Ecological Services. Raleigh, North Carolina. 30 pp.

Integration and Synthesis Summary: Flowering Plants – Decurrent false aster

Scientific Name:	Common Name:	Entity ID:
Boltonia decurrens	Decurrent false aster	891

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 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 Action is not likely to jeopardize the continued existence of the decurrent false aster. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 11-19-2020 *– Wherever found*

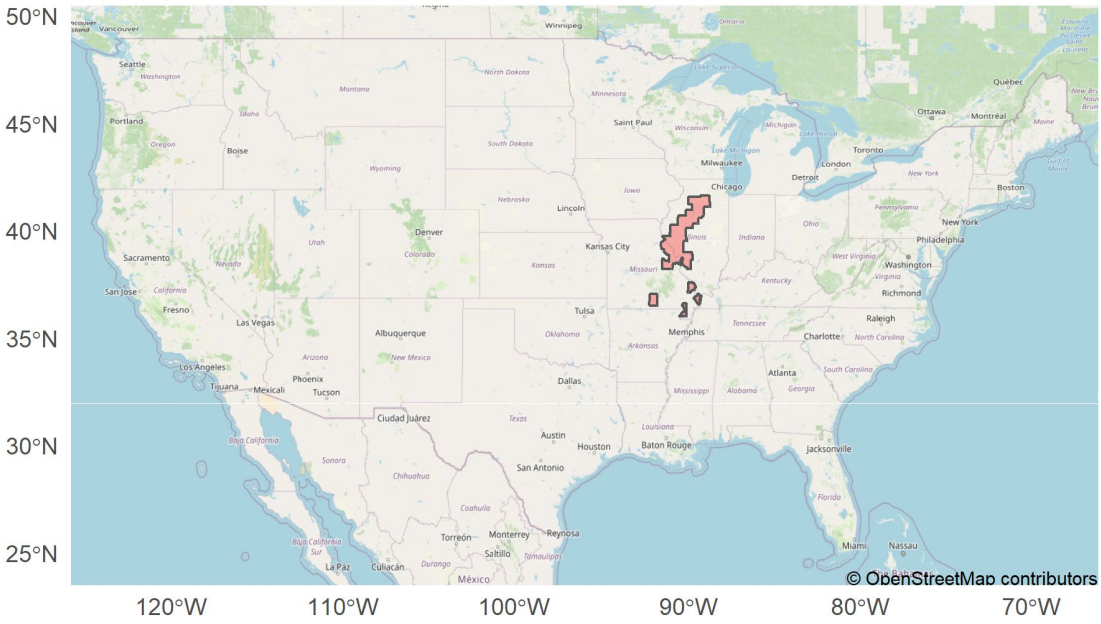

Figure 12. Range map of decurrent false aster (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/7705.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species 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: Unknown population trends
States within the range: IL, MO
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Herbicides

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

The decurrent false aster is a species endemic to the Illinois River System that relies on flood pulses to maintain populations and suitable habitat and is a perennial plant of open wetland habitats. The species colonizes periodically disturbed riverine moist soil habitats. In general, sites where the species is successful in reproducing sexually and maintaining a self-sustaining population are characterized by moist, sandy soil and regular disturbance, preferably periodic flooding, which maintains open areas with high light levels. Analysis of 19th-century habitat data taken from herbarium sheets indicates that natural habitat was the shores of lakes and the banks of streams, including the Illinois River. In these habitats, regular flooding prevented succession, allowing sunlight to reach the seedlings. The decurrent false aster is still occasionally found in these natural habitats, but it is now primarily restricted to disturbed lowland areas, where it appears to be dependent on human activities (mowing, cultivation) for survival.

The decurrent false aster reproduces vegetatively through shoots formed from a basal rosette. The species primarily relies on outcrossing (transport of pollen from one individual plant to another) for successful reproduction, but some self-fertilization can occur. The decurrent false aster blooms from August through October throughout its range. Germination and seedling establishment do not occur where the soil surface is shaded, such as in places where natural succession has been uninterrupted for a period of 3 – 5 years. It is considered a perennial plant but also exhibits annual and biennial lifecycles (USFWS 2012). Achenes (one-seeded fruits) float and are often dispersed by flowing water (USFWS 1990).

The survey dataset that currently exists for the decurrent false aster consists of a list of 68 known sites throughout its range at which the plant has been observed at least once since 1984 (USFWS 2020). Surveys indicate that more than twelve geographically distinct populations exist on lands already owned and permanently protected by the Illinois Department of Natural Resources (ILDNR) and the Service (USFWS, unpublished data, 2012). Given the intermittent nature of surveys for the species, current population trends are unknown, however, the decurrent false

aster was found at least once at more than half of the historically documented sites, and that the number of plants at a site often varied drastically, which is consistent with historical data (USFWS 2020). Like the numbers of populations, numbers of individuals also fluctuate greatly from year to year. Larger stands sometimes have several thousand plants in good years, occasionally exceeding 10,000.

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of the decurrent false aster, 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, flood-control measures, agricultural use of marginal river-bottom land, increased siltation of floodwater, herbicide use for crop weed control, marina construction, hybridization, and prolonged flooding (USFWS 1990, 2020). We considered all these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as mining activities, and have also contributed to the condition of the environmental baseline for the species in the action area. In some consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the species.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as flood-control measures, agricultural use of marginal river-bottom land, increased siltation of floodwater, herbicide use for weed control, marina construction, hybridization, and prolonged flooding. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of periodically disturbed riverine moist soil 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: 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, has a range that is neither widespread or constricted, and has unknown population trends, the vulnerability of the species is considered medium.

Risk

We do not anticipate the decurrent false aster will occur on-field, and thus is not likely to experience on-field exposure to spray application. Overlap data indicates that more than a few

individuals may experience exposure. While runoff EECs may cause up to moderate levels of adverse effects, spatially refined runoff exposure models indicate that not all locations within the runoff zone are likely to experience such high levels of exposure. Thus, we expect only a few individuals will be adversely affected, indicating that the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

Based on our current knowledge of the decurrent false aster's life history, we do not anticipate individuals are likely to occur on corn, cotton, or soybean fields. Thus, we do not expect individuals are likely to be exposed to spray application. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the decurrent false aster will occur on runoff areas immediately adjacent to Enlist pesticide use sites. 8.1% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 32).

Table 32. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	7.5
Cotton	0	0.42
Soybean	0	7.68
Total[12]	0	8.1

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn and cotton runoff may cause up to 43-50% growth inhibition (Table 33). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effects.

[12] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 33. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.023	48	<0.0001% (<1 in a million exposed individuals)
Cotton	0.024	50	<0.0001% (<1 in a million exposed individuals)
Soybean	0.021	43	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 48% of corn, 35% of cotton, and 49% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 34).

Table 34. 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 growth effects (i.e., no more than 25% growth inhibition).

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	4434	2109	48
Cotton	81	28	35
Soybean	5444	2668	49

Thus, while more than a few individuals are likely to experience runoff exposure, we anticipate that only a small subset of those exposed individuals are likely experience more than low levels of adverse growth effects. Furthermore, the decurrent false aster primarily occurs in riparian habitat that are regularly flooded. Exposure in these riparian systems will likely be lower than what EPA's models indicate as periodic flooding and permanently flowing water likely increase the rate of transportation of pesticide residues out of the aster's habitat. Thus, we further expect that only a few individuals are likely to experience more than low levels of adverse growth effects. As such, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individual decurrent false asters will occur in Enlist herbicide use sites, indicating that exposure to spray application is unlikely to occur. 8.1% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that can cause up to moderate levels of adverse growth effects, spatially refined runoff models indicate that a substantial portion of the runoff zone will not experience EECs that will ever cause more than low levels of adverse growth effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Furthermore, we anticipate that the characteristics of the decurrent false aster's habitat (e.g., permanent flowing riparian areas that flood intermittently) will increase the removal of pesticide residues, further decreasing the likelihood of adverse effects occurring. Therefore, we expect, at most, only a few individuals will experience adverse growth effects and that the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the decurrent false aster. As discussed below, although the vulnerability is medium, we expect only a few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate more than a few individuals will experience exposure, we expect only a small number of individuals will experience more than low levels of adverse effects. Thus, we do not expect species-level effects will occur.

The decurrent false aster is listed as threatened, and only 68 extant populations are known to exist in a range that is neither constrained nor widespread. Threats such as flood-control measures, agricultural use of marginal river-bottom land, increased siltation of floodwater, herbicide use for weed control, marina construction, hybridization, and prolonged flooding, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is moderately vulnerable.

Based on our current understanding of the decurrent false aster's life history, we do not anticipate individuals will occur in corn, cotton, or soybean fields, indicating that on-field exposure to spray application is likely to occur. 8.1% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause up to moderate levels of adverse growth effects, we anticipate that these effects will be infrequent and highly localized as spatially refined runoff models indicate that a substantial portion of the runoff zone will not experience runoff EECs that cause more than low levels of adverse growth effects. Furthermore, we anticipate the specific habitat of the decurrent false aster, which features permanent flowing water and periodic

flooding, would increase pesticide residue removal rates, further decreasing the likelihood of adverse effects occurring. Thus, we expect the overall risk of adverse effects to the species is low.

In summary, while more than a few individuals are likely to experience exposure, impacts are expected to be highly localized, resulting in more than low levels of effects to only a few individuals at most. While the species is moderately vulnerable, we do not expect the very small number of individuals experiencing adverse effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the decurrent false aster.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1990. Decurrent False Aster Recovery Plan. U.S. Fish and Wildlife Service, Twin Cities, Minnesota. 26 pp.

U.S. Fish and Wildlife Service (USFWS) 2012. Decurrent False Aster (*Boltonia decurrens*) 5-Year Review: Summary and Evaluation. Midwest Region Rock Island Ecological Services Field Office, Moline, Illinois. 16 pp.

U.S. Fish and Wildlife Service (USFWS) 2020. Decurrent False Aster (*Boltonia decurrens*) 5-Year Review. Illinois-Iowa Field Office, Moline, Illinois. 14 pp.

Integration and Synthesis Summary: Flowering Plants – Mohr's Barbara's buttons

Scientific Name:	Common Name:	Entity ID:
Marshallia mohrii	Mohr's Barbara's buttons	764

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 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 Action is not likely to jeopardize the continued existence of the Mohr's Barbara's buttons. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 6-10-2020 *– Wherever found*

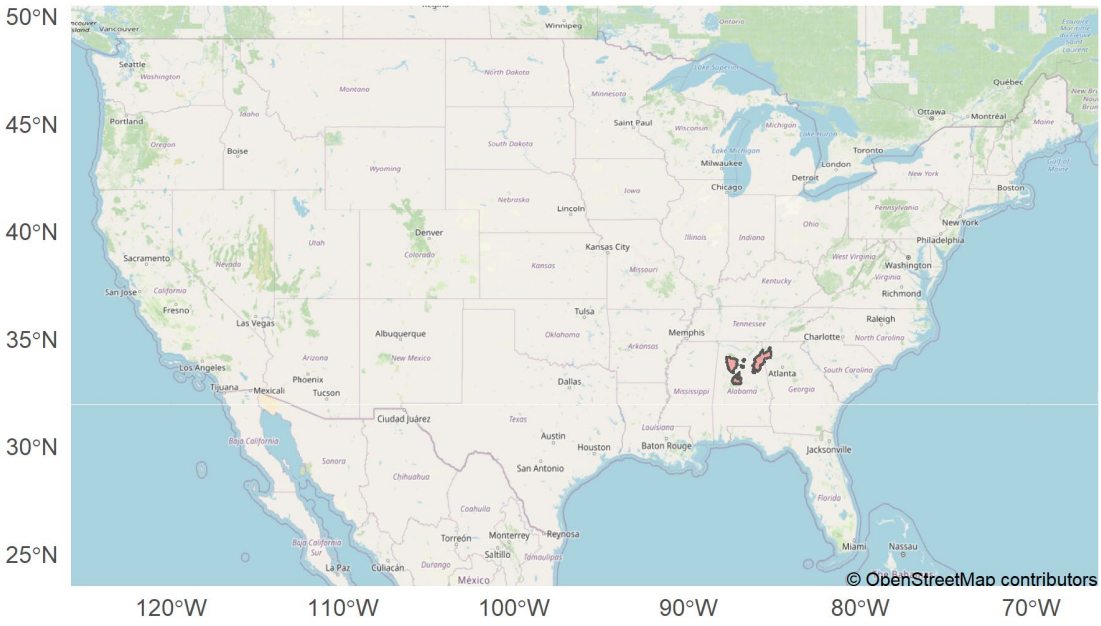

Figure 13. Range map of Mohr's Barbara's buttons (red polygon overlay). Range map accessed on August 11, 2022, at https://ecos.fws.gov/ecp/species/7610.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened
Recommendation for Status from Latest 5-Year Review: No change
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (numerous)
Species Trends: Stable, with some populations decreasing and others likely increasing
States within the range: AL, GA
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Pesticides
Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Mohr's Barbara's button is a perennial herb and a member of the sunflower family. The habitat is moist prairie-like openings in woodlands, along shale-bedded streams, and meadows. The soils are sandy clays, which are alkaline, high in organic matter, and seasonally wet. Most currently known populations occur on soils of the Conasauga-Firestone Association. Plants occur in full sun or partial shade in a grass-sedge community (USFWS 1991, NatureServe 2015).The habitat is moist prairie-like openings in woodlands, along shale-bedded streams, and meadows.

This species appears to be an obligate outcrosser (Watson and Estes 1990, as cited in USFWS 1991). Reproduction is abiotic and by insect. Flowering occurs in mid-June, with fruiting in July to August. As a means of avoiding self-pollination, flowers on a given plant produce pollen before that plant's stigmas become receptive (EPA 2016). Seeds are probably dispersed by birds and other small mammals (EPA 2016).

In 1991, Mohr's Barbara's button was known from 15 sites in Alabama and 7 sites in Georgia. Currently, the species is considered extant in 19 populations and extirpated from an additional 8 known populations (USFWS 2022). Of the species' 19 extant populations, only 8 receive some protections (e.g., protection from habitat loss, habitat management), because they are located on Federal, State, or non-governmental conservation lands. Most occurrences of Mohr's Barbara's buttons receive no protections or conservation considerations.

Environmental Baseline

Habitat degradation and destruction associated with clearing, conversion, and agricultural activities have contributed to the present condition of the Mohr's Barbara's button, 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, logging, incompatible and inadequate land management, inadequate fire regimes, invasive species, and

climate change (USFWS 2022). In addition, recent road widening and indiscriminate use of herbicides to maintain road shoulders may have eliminated Mohr's Barbara's buttons plants along County Road 65 in Bibb County, Alabama (M. Scott Wiggers, Botanist, Service, pers. obs., August 2017; as cited in USFWS 2022), that were discovered in the 1990s. Such indiscriminate use of herbicide application has resulted in the extirpation of other sensitive plants elsewhere along County Road 65 (Schotz, pers. comm., December 8, 2021; as cited in USFWS 2022). We considered all of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as mining, electrical line transmission activities, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, 8 populations all occurring in the Ridge and Valley physiographic region currently receive some protections on Federal, State, or non-governmental conservation organization lands (USFWS 2022). This includes one population on private land in Cherokee County, Alabama that is protected through a long-term Cooperative Agreement (USFWS 1991).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as logging, incompatible and inadequate land management, inadequate fire regimes, and invasive species. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of moist prairie-like 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: Medium

In summary, past activities have impacted the species through habitat degradation and destruction and other associated impacts, and we expect similar activities and effects to occur in the future. Some activities, such as those associated with a Cooperative Agreement as described above have provided varying degrees of protection for the species. Given that the species is threatened, has a restricted range, numerous populations but most receive no protection, and shows some populations decreasing and others likely increasing, the vulnerability of the species and its critical habitat is medium.

Risk

We do not anticipate the Mohr's Barbara's buttons will occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is likely to occur. Overlap data indicates that only a few individuals are likely to experience any exposure. While runoff EECs may occasionally be high enough to cause moderate to high levels of adverse effects, we anticipate most locations within the runoff zone are not likely to experience such high levels of exposure.

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

Extent of exposure

Based on our knowledge of the species' life history, we do anticipate individuals will occur on corn, cotton, and soybean fields. Therefore, we do not anticipate on-field exposure to spray application is likely to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Mohr's Barbara's buttons will occur on runoff areas directly adjacent to Enlist pesticide use sites. 2.71% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 35).

Table 35. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	1.43
Cotton	0	0.83
Soybean	0	1.88
Total[13]	0	2.71

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn and cotton runoff may cause up to 38-73% growth inhibition (Table 36). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effects.

Table 36. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.037	73	0.05% (1 in 2000 exposed individuals)

[13] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Cotton	0.03	62	0.001% (1 in 100,000 exposed individuals)
Soybean	0.019	38	<0.0001% (<1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 9% of corn, 47% of cotton, and 58% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 37).

Table 37. 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 growth effects (i.e., no more than 25% growth inhibition).

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	693	63	9
Cotton	543	255	47
Soybean	1084	633	58

Thus, while we expect only a few individuals are likely to experience any exposure to Enlist herbicides, we anticipate even fewer individuals are likely to experience more than low levels of adverse growth effects. Therefore, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals are likely to occur on-field, and, thus, exposure to spray application is unlikely. 2.71% of the species' range overlaps with potential runoff areas, indicating that only a few individuals are likely to experience exposure. While runoff EECs may occasionally cause up to moderate to high levels of adverse growth effects, spatially refined runoff model results indicate a high proportion of runoff events are not likely to experience such high levels of exposure. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Mohr's Barbara's button. As discussed below, although the vulnerability is medium, we expect very few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, while we anticipate only a small number of individuals will be exposed, we expect even fewer individuals are likely to experience more than low levels of adverse effects. Thus, we do not expect species-level effects will occur.

The Mohr's Barbara's button is listed as threatened, and 19 extant populations exist in a restricted range. Threats such as logging, incompatible and inadequate land management, inadequate fire regimes, and invasive species, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is moderately vulnerable.

Based on our current understanding of the species' life history, we do not anticipate individuals will occur on corn, cotton, and soybean fields, indicating that on-field exposure to spray application is unlikely to occur. 2.71% of the species' range overlaps with potential runoff areas, indicating that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause moderate to high levels of adverse growth effects, spatially refined runoff model results indicate that most locations within the runoff zone are not likely to experience such high levels of exposure. As such, we anticipate that only a small number of individuals are likely to experience more than low levels of adverse growth effects resulting from the Action. Thus, we expect the overall risk of adverse effects to the species is low.

In summary, we expect few individuals are likely to experience exposure, and even fewer individuals are likely to experience more than low levels of adverse effects as these impacts are expected to be highly localized. While the species is moderately vulnerable, we do not expect the very small number of individuals experiencing effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Mohr's Barbara's button.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1991. Recovery Plan for Mohr's Barbara's Buttons. U.S. Fish and Wildlife Service, Jackson, Mississippi. 15 pp.

U.S. Fish and Wildlife Service (USFWS) 2016. Mohr's Barbara's Buttons (*Marshallia mohrii*) 5-Year Review: Summary and Evaluation. Southeast Region Mississippi Field Office Jackson, Mississippi. 29 pp.

U.S. Fish and Wildlife Service (USFWS) 2022. Mohr's Barbara's Buttons (*Marshallia mohrii*) 5-Year Review: Summary and Evaluation. Southeast Region Mississippi Field Office Jackson, Mississippi. 13 pp.

Integration and Synthesis Summary: Flowering Plants – Pecos (=puzzle =paradox) sunflower

Scientific Name:	Common Name:	Entity ID:
Helianthus paradoxus	Pecos (=puzzle =paradox) sunflower	558

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 Action is not likely to jeopardize the continued existence of the Pecos sunflower. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 8-14-2018 *– Wherever found*

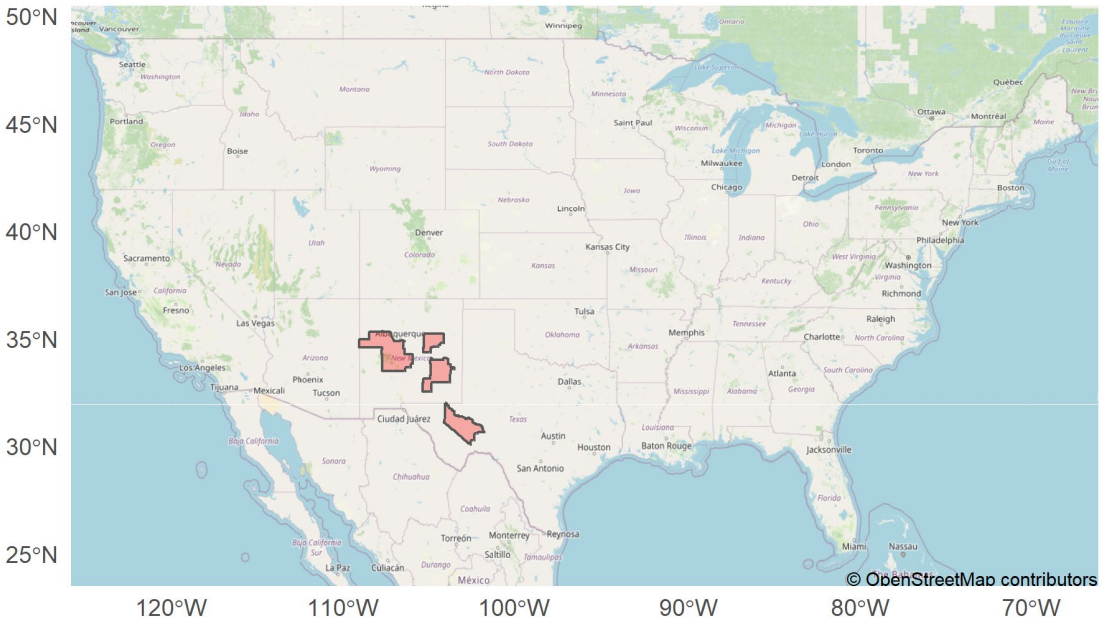

Figure 14. Range map of Pecos sunflower (red polygon overlay). Range map accessed on August 11, 2022, at https://ecos.fws.gov/ecp/species/7211.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species 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 (few)
Species Trends: Unknown population trends
States within the range: NM, TX
Critical Habitat designated: Yes
Pesticides noted in USFWS documents: No

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

The Pecos sunflower is the only sunflower in the Southwest United States that requires permanent wetlands for its survival. Pecos sunflowers grow in saline soils that are permanently saturated. Areas that maintain these conditions are very rare in the dry regions of New Mexico and Texas and are commonly called cienegas (desert wetlands) associated with springs. However, the required conditions may also be found at stream margins and at the margins of impoundments. The Pecos sunflower is intolerant of habitats that are too wet at the surface and prefers soils that are relatively dry at the surface and wet in the lower root zone (Bush 2006) (USFWS 2015). Populations tend to grow in crowded patches of dozens or even thousands of individuals (USFWS 2005). The cienega climax community has been described as mid-elevation, 3,280 to 6,561 feet. Disturbance regimes, such as fire or tillage, which eliminate vegetation thatch and expose bare ground surface tend to increase Pecos sunflower cover and productivity (Van Auken and Bush 2004, New Mexico Forestry Division 2008).

The Pecos sunflower is an annual plant that must re-establish each population by seeds produced during preceding years. It is annual plant that germinates in the spring, and flowers and makes seed from late August through October (USFWS 2015). Pollination vectors for the Pecos sunflower have not been studied. However, most radiate-headed plants in the aster family are generalists in attracting a variety of insect pollinators (USFWS 2005). No specific research has been conducted on the reproduction of this species, however, the reproductive biology is likely to be very similar to that of the common sunflower, *H. annuus*. Limited seed mobility restricts the ability of the Pecos sunflower to disperse to other suitable habitats or away from habitat that becomes unsuitable (USFWS 2015).

There are seven populations scattered throughout eastern New Mexico and the adjacent Trans-Pecos region of western Texas (Roth 2019, as cited in NatureServe 2022). There are five populations in New Mexico and two in Texas. Within those populations there are a total of 25 sites (similar to subpopulations). In New Mexico, the five populations are known from 22 sites: 2

near the town of Grants, 1 along the Rio San Jose on the Laguna Indian Reservation, 8 in or near the town of Santa rosa, and 11 in the pecos River Valley from just north of Roswell to just north of Dexter. The 2 Grants' sites are near the San Jose River and separated from the Laguna population by approximately 73 km. The 8 Santa Rosa sites occur within a 10 square kilometer area. Ten of the 11 Pecos River sites occur within a 36 km stretch of the Pecos River Valley. In Texas, the two populations are known from three sites: 2 along Diamond Y Creek north of Fort Stockton, and 1 at East Sandia Springs near Balmorhea. The two Diamond Y sites are within 5 km of each other. The Diamond Y and East Sandia Springs Preserves are within 80 km of each other. The Texas sites are approximately 241 km south of the most southerly New Mexico site.

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of the Pecos sunflower, 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, lowering water tables, potential failure of spring flow, exotic plants, water contamination, increased temperatures, and climate change (USFWS 2015). We considered all these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as mining activities, vegetation management, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, an isolated stand of Pecos sunflowers is managed to benefit the species on the Pueblo of Laguna (USFWS 2015). This population consists of several thousand plants, has persisted for at least 7 out of 10 years, and is managed under a plan specifically to protect and benefit Pecos sunflowers (USFWS 2008b; Marek 2012a, b; all as cited in USFWS 2015). This site is on undeveloped land along the Rio San Jose near the Valencia-Bernalillo County line and does not appear to be at risk of aquifer depletion, because there do not appear to be any groundwater wells in the area (New Mexico Office of the State Engineer 2007, USFWS 2008a; all as cited in USFWS 2015). The Pueblo of Laguna has also developed a management plan to preserve Pecos sunflower stands along the Rio San Jose on the Laguna Reservation (USFWS 2008b). This plan was adopted by the Pueblo of Laguna in 2008 (Resolution # 01-08).

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as lowering water tables, potential failure of spring flow, exotic plants, and water contamination. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of cienegas (desert wetlands) associated with springs 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 threatened, has few populations and a range that is neither widespread or constricted, and has unknown population trends, the vulnerability of the species is considered high.

Risk

We do not anticipate individuals are likely to occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely to occur. Overlap data indicates that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that can cause high levels of adverse effects, we anticipate the majority of locations within the runoff zone are not likely to experience exposure at levels that would result in more than low levels of adverse effects. Thus, we anticipate the overall risk of adverse effects to the species is low. We discuss our rationale in the sections below.

Extent of exposure

There is no overlap between the range of the Pecos sunflower and Enlist herbicide use sites, and as such we do not expect on-field exposure to spray application to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Pecos sunflower will occur on runoff areas directly adjacent to Enlist pesticide use sites. 0.19% of the species range overlaps with corn and cotton runoff areas (Table 38).

Table 38. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	0
Cotton	0	0.1
Soybean	0	0
Total[14]	0	0.19

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to cotton runoff may cause up to 62% growth inhibition (Table 39). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a high magnitude of effects.

Table 39. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	NA	NA	NA
Cotton	0.03	62	0.001% (1 in 100,000 exposed individuals)
Soybean	NA	NA	NA

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 exposure. EPA's Tier 3 geographic distribution models show that 67% of cotton runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 40).

[14] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

Table 40. 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 growth effects (i.e., no more than 25% growth inhibition).

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	NA	NA	NA
Cotton	273	182	67
Soybean	NA	NA	NA

Thus, while we expect only a few individual Pecos sunflowers will likely experience any exposure, we anticipate even fewer numbers of individuals are likely to experience more than low levels of adverse growth effects. Therefore, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not anticipate individuals will occur on Enlist herbicide use sites and are thus unlikely to experience on-field exposure to spray application. Only 0.91% of the species' range overlaps with potential runoff areas, indicating that very few individuals are likely to experience any exposure. While runoff EECs may occasionally be high enough to cause high levels of adverse growth effects, we anticipate most areas within the runoff zone will not likely experience exposure at levels high enough to cause more than low levels of adverse effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we anticipate the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Pecos sunflower. As discussed below, although the vulnerability is high, we expect very few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we anticipate only a small number of individuals are likely to experience more than low levels of adverse effects. Thus, we do not expect species-level effects will occur.

The Pecos sunflower is listed as threatened, and only 7 extant populations known to exist in a range that is neither constrained nor widespread. Threats such as lowering water tables, potential

failure of spring flow, exotic plants, and water contamination, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our current understanding of the Pecos sunflower's life history, we do not anticipate individuals are likely to occur in corn, cotton, or soybean fields. As such, we do not expect on-field exposure to spray application is likely to occur. Only 0.19% of the species' range overlaps with potential runoff areas, indicating that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally be high enough to cause high levels of adverse growth effects, spatially refined runoff model results indicate that the majority of locations within the runoff zone are not likely to experience exposures high enough to cause more than low levels of adverse effects. Therefore, we anticipate the overall risk of adverse effects to the species is low.

In summary, while we expect a few individuals will experience any exposure to Enlist One and Enlist Duo, the resulting impacts are expected to be highly localized, and only a small number of individuals are likely to experience more than low levels of adverse effects. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing adverse effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Pecos sunflower.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 2005. Pecos Sunflower (*Helianthus paradoxus*) Recovery Plan. Albuquerque, New Mexico. 39 pp.

U.S. Fish and Wildlife Service (USFWS) 2015. Pecos Sunflower (*Helianthus paradoxus*) 5-Year Review: Summary and Evaluation. New Mexico Ecological Services Field Office Albuquerque, New Mexico. 43 pp.

NatureServe. 2020. *Helianthus paradoxus* Pecos Sunflower. Electronic source accessed on December 19, 2022 at https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.139880/Helianthus_paradoxus.

Integration and Synthesis Summary: Flowering Plants – Rough-leaved loosestrife

Scientific Name:	Common Name:	Entity ID:
Lysimachia asperulaefolia	Rough-leaved loosestrife	967

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 Action is not likely to jeopardize the continued existence of the rough-leaved loosestrife. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 4-9-2020 *– Wherever found*

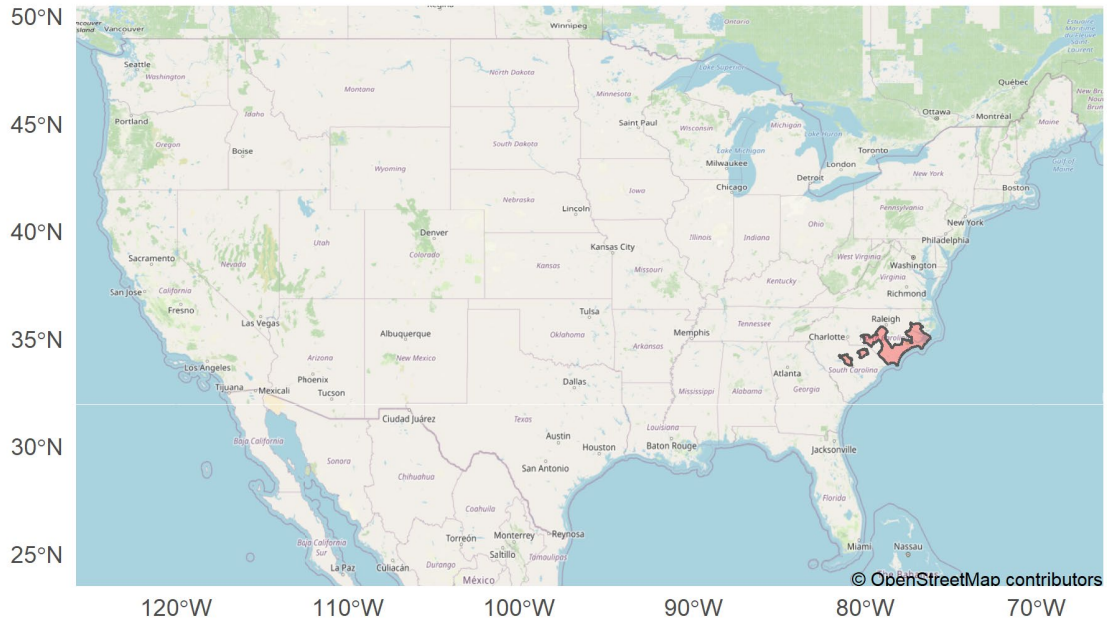

Figure 15. Range map of rough-leaved loosestrife (red polygon overlay). Range map accessed on August 12, 2022, at https://ecos.fws.gov/ecp/species/2747.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in

the action area, and a discussion of how these aspects of the biology of the species 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 (numerous)
Species Trends: Unknown population trends
States within the range: NC, SC
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Herbicides

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

The rough-leaved loosestrife is a rare perennial herb endemic to the coastal plain and sandhills of North and South Carolina. Rough-leaved loosestrife occurs most often in ecotones (transitions) between longleaf pine uplands and pond pine pocosins (low, wooded, swampy areas) in moist, sandy or peaty soils with low vegetation that allows for abundant sunlight to the herb layer (USFWS 1993). Fire is primarily responsible for maintaining low vegetation in these ecotones which have been documented to occur between habitat types. This species often spreads from the ecotone into the open edges of bordering habitats, for example into longleaf pine savannas and low shrub communities of Carolina bays. Other habitats and community types in which it has been found Include low pocosin, high pocosin, wet pine flatwoods, pine savanna, streamhead pocosin, and sandhill seep, as well as creek flood basins, pond and lake margins, boggy seeps and meadows, boggy pools in shrub pocosins, and disturbed areas such as roadside depressions, powerline rights-of-way, firebreaks, and trails. In the NC Sandhills, the species prefers to be in lower parts of the ecotone, well within the shrub zone, even when such ecotones are well-burned.

The first spring shoots of rough-leaved loosestrife appear in late March or early April and flowering begins in late May and extends through mid to late June. The rough-leaved loosestrife is an obligate out-crossing species (requires pollen transfer between distinct individuals), pollinated by solitary bees: most of the pollinators are in the genus *Dialictus*. The species appears to have a reproductive strategy based largely on rhizomatous growth, and therefore does not depend upon sexual reproduction and seedlings for short-term survival (USFWS 1995).

Since 2000, land managers have monitored sub-populations at 62 different sites within nine population centers (USFWS 2021). Currently, the species is believed to be extant in 12 NC counties. Despite intensive surveys throughout the coastal plain and sandhills of SC, this species is only known from Fort Jackson Army Base in Richmond County. Currently, state natural heritage programs recognize 53 extant populations or principal Eos (52 in NC and one in SC) (USFWS 2021). Since the 2014 5-Year Review, natural heritage program records indicate that the ranks of three populations have improved while six populations declined, indicating that those populations have fewer stems than previously observed, or possibly even disappeared.

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of the rough-leaved loosestrife, 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 and commercial development, road construction, wetland draining/filling, silviculture, herbicide use, herbivory, fire suppression, and climate change (USFWS 2021). Furthermore, sites located within utility and transportation rights-of-way are threatened by herbicide use or mowing during critical growth periods (USFWS 2021). We considered all of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as vegetation and resource management activities, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, for many years much of the best rough-leaved loosestrife habitat and most of the thriving populations known were in the 15,000-acre Green Swamp Nature Preserve, which is owned and managed by the North Carolina chapter of The Nature Conservancy (USFWS 1995). The Nature Conservancy intentionally managed the preserve to benefit rough-leaf loosestrife and has conducted research and monitoring activities for many years. Rough-leaved loosestrife also occurs on another Nature Conservancy preserve, Southwest Ridge, where monitoring and prescribed burning began in 1990 (M. Bucher, North Carolina Nature Conservancy, personal communication, 1994; as cited in USFWS 1995). It is expected that The Nature Conservancy's stewardship program will continue to manage the preserves for the benefit of rough-leaved loosestrife, other rare species, and the natural community which is their habitat.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as residential and commercial development, road construction, wetland draining/filling, silviculture, herbicide use, herbivory, and fire suppression. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of coastal plain and sandhills 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 habitat degradation and destruction, modifications 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 range that is neither widespread nor constricted, has numerous populations with unknown trends, the vulnerability of the species is considered high.

Risk

We do not expect any on-field exposure to spray application is likely as the species range does not overlap with Enlist herbicide use sites. Overlap data indicates that more than a few individuals are likely to experience runoff exposure. While EECs may occasionally reach levels that can cause moderate levels of adverse effects, we anticipate the majority of locations within the runoff zone are not likely ever to experience more than low levels of adverse effects. Thus, the overall risk of adverse effects to the species is low. We describe our rationale in detail in the sections below.

Extent of exposure

There is no overlap between the species range and Enlist herbicide use sites (Table 41), indicating that exposure to on-field spray application is unlikely to occur. As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the rough-leaved loosestrife will occur on runoff areas directly adjacent to Enlist pesticide use sites. 7.32% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 41).

Table 41. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	4.53
Cotton	0	2.34
Soybean	0	4.98
Total[15]	0	7.32

Magnitude of effect

Effects to Growth and Mortality

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn and cotton runoff may cause up to 29-50% growth inhibition (Table 42). While direct mortality is unlikely to occur, we anticipate some reductions in long term survival may occur as this level of growth effect may impede

[15] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a moderate magnitude of effect.

Table 42. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.016	29	0.00001 (< 1 in a million exposed individuals)
Cotton	0.020	40	0.00005 (< 1 in a million exposed individuals)
Soybean	0.024	50	0.00001 (< 1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 73% of corn, 67% of cotton, and 54% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 43).

Table 43. 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 growth effects (i.e., no more than 25% growth inhibition).

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	1325	967	73
Cotton	987	664	67
Soybean	2276	1222	54

Thus, while we expect more than a few individuals will likely experience runoff exposure, we anticipate that only a few individuals will likely experience exposures that result in more than low levels of adverse growth effects. Therefore, we expect the overall risk of adverse growth effects or mortality to the species is low.

Risk Summary

We do not anticipate individuals will occur on Enlist herbicide use sites, indicating that on-field exposure to spray application is unlikely to occur. 7.32% of the species' range overlaps with potential runoff areas, indicating that more than a few individuals are likely to experience runoff

exposure. While runoff EECs may occasionally cause up to moderate levels of adverse growth effects, spatially refined runoff model results indicate that most locations within the runoff zone are not likely to experience more than low levels of adverse growth effects. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the rough-leaved loosestrife. As discussed below, although the vulnerability is high, we expect few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. While we expect more than a few individuals are likely to experience exposure, we anticipate that only a few individuals are likely to experience more than low levels of adverse growth effects. Thus, we do not expect species-level effects will occur.

The rough-leaved loosestrife is listed as endangered, and only 53 extant population are known to exist in a range that is neither constrained nor widespread. Threats such as residential and commercial development, road construction, wetland draining/filling, silviculture, herbicide use, herbivory, and fire suppression, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

Based on our understanding of the rough-leaved loosestrife's life history, we do not expect individuals are likely to occur on corn, cotton, and soybean fields, indicating that on-field exposure to spray application is unlikely to occur. There is a moderate extent of overlap between the species range and potential runoff areas, indicating that more than a few individuals are likely to experience exposure. While runoff EECs in these areas may occasionally reach levels that may cause moderate levels of adverse growth effects, spatially refined runoff model results indicate that the majority of locations within the runoff zone are not likely to experience runoff EECs that would cause more than low levels of adverse growth effects. As such, we anticipate impacts to the species will be highly localized and likely cause more than low levels of adverse growth effects for only a few individuals. Therefore, we expect the overall risk of adverse effects to the species is low.

In summary, while more than a few individuals are likely to experience exposure to Enlist One and Enlist Duo, resulting impacts are expected to be highly localized and adversely affect only a few individuals at most. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing adverse effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the rough-leaved loosestrife.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1995. Rough-leaved Loosestrife Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 32 pp.

U.S. Fish and Wildlife Service (USFWS). 2014. Rough-leaved Loosestrife (*Lysimachia asperulaefolia*), 5-Year Review Summary and Evaluation. U.S. Fish and Wildlife Service. Raleigh, North Carolina. 41 pp.

U.S. Fish and Wildlife Service (USFWS). 2021. Rough-leaved Loosestrife (*Lysimachia asperulaefolia*), 5-Year Review Summary and Evaluation. U.S. Fish and Wildlife Service. Raleigh, North Carolina. 42 pp.

Integration and Synthesis Summary: Flowering Plants – Virginia sneezeweed

Scientific Name:	Common Name:	Entity ID:
Helenium virginicum	Virginia sneezeweed	1028

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 Action is not likely to jeopardize the continued existence of the Virginia sneezeweed. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 03-16-2020 *– Wherever found*

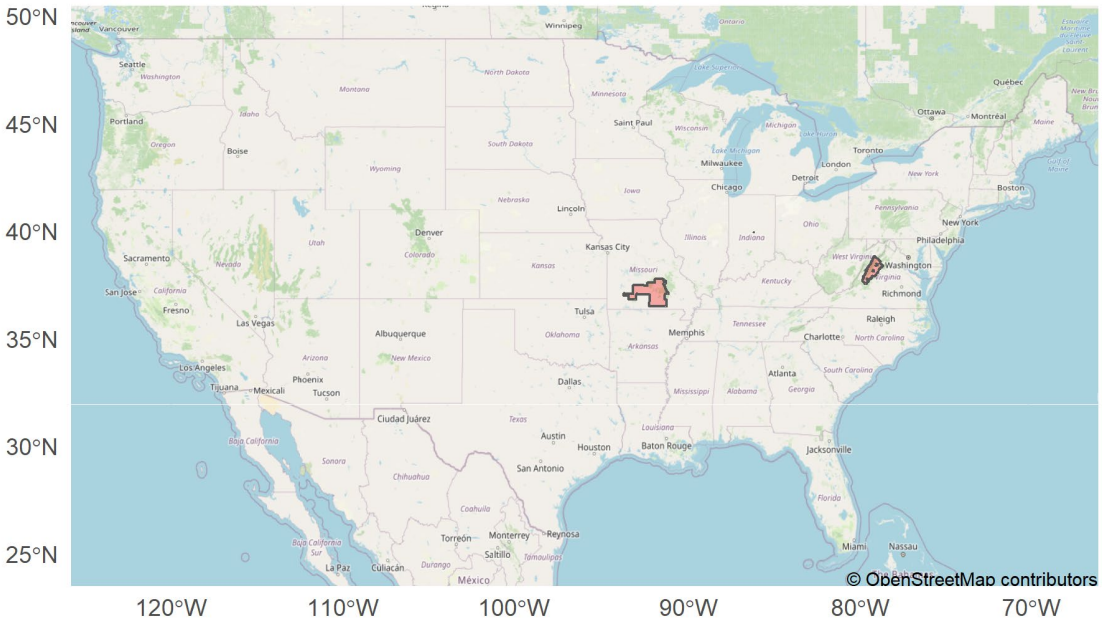

Figure 16. Range map of Virginia sneezeweed (red polygon overlay). Range map accessed on August 26, 2022, at https://ecos.fws.gov/ecp/species/6297.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Threatened
Recommendation for Status from Latest 5-Year Review: Delisting
Distribution: Species/Populations neither constrained or widespread
Number of Populations: Multiple populations (numerous)
Species Trends: Unknown population trends
States within the range: IN, MO, VA
Critical Habitat designated: None
Pesticides noted in USFWS documents: No

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

In Virginia, Virginia sneezeweed is a wetland plant restricted to shallow, seasonally inundated ponds (which are in or near sinkholes) in Augusta and Rockingham Counties, Virginia (Blake 1936; Roe 1977; Harvill et al. 1986). The pond basins in which this species occurs are usually flooded from January to July. The substrate at most Virginia sneezeweed sites consists of poorly drained, acidic, low fertility Purdy silt loams (USDA 1979) underlain by gray clays and dolomitic bedrock (Werner 1966; Rader 1967). The level of disturbance present at the sinkhole ponds includes relatively undisturbed ponds surrounded by forest, more meadow-like habitats around farm ponds actively used by cattle, a backyard seasonal wetland maintained in an open state by the landowner, a seasonally wet mowed lawn, and a seasonal wetland degraded by severe cattle trampling and an ongoing attempt to fill the site. In Missouri it is found on sinkhole pond margins and wet meadows in the Ozark Highlands (Rimer and McCue 2005). The plant has been found to prefer open growing conditions and is found in a variety of sites in addition to the less disturbed sinkholes and wet meadows including rural airports, roadside ditches, and cattle ranches (R. Rimer and J. Summers, pers. comm. 2005). It appears to be less confined to discrete wetlands in Missouri and can occur in a temporarily wet portion of a hayfield or in roadside ditches (Tim Smith pers. comm.) (NatureServe 2015). Virginia sneezeweed exhibits high tolerance to mechanical disturbance. Surprisingly, it appears to benefit from grazing. The stems and leaves of this species are extremely bitter in taste and apparently unpalatable, thus selective grazing by cattle may eliminate competing plants (John Knox, pers. obs.).

The Virginia sneezeweed flowers from early July to October, with peak flowering occurring in late July to early August at most sites. The pollination biology has not been studied in detail; however, cursory observations conducted at Kennedy Mountain Meadow suggest that the primary insect pollinators are bees, wasps (Hymenoptera: Apidae, Halictidae, Sphecidae), butterflies (Lepidoptera: Hesperiidae and Lycaenidae, among others), and hoverflies (Diptera: Syrphidae) (C. Williams, pers. obs.). During favorable years at Kennedy Mountain Meadow,

approximately one quarter of the population may flower (Knox and Williams 1988). Flowering appears to correlate with water availability during late spring and early summer, a critical period for bolting and flower formation (Knox et al. 1987). Seasonal water fluctuation, particularly inundation, is probably a key factor affecting recruitment and maintenance of populations (J. Knox unpubl. Data).

When Virginia sneezeweed was listed in 1998, 25 populations had been identified at 30 sites in the Shenandoah Valley of VA, and a single disjunct population was suspected in Missouri although not confirmed (USFWS 2020). The single disjunct population was confirmed to be Virginia sneezeweed, and additional surveys were conducted in Missouri resulting in numerous discoveries of the species (Simurda and Knox 2000, Simurda et al. 2005; both as cited in USFWS 2020). The best available information currently indicates the existence of 76 Element occurrences (Eos) of Virginia sneezeweed across 3 states; this represents a significant increase in spatial distribution (redundancy, representation) and abundance (resilience) from the 25 known populations in 2 counties in VA at the time of listing (USFWS 2020).

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of the Virginia sneezeweed, 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, disruptions of hydrologic regimes, agriculture, residential land development, logging, off road vehicles, repeated mowing before seed is set, invasive plants, and climate change (USFWS 2020). We considered all of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as land restoration activities, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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 Nature Conservancy has had a management agreement with the private owner for one of the Virginia sneezeweed sites (USFWS 2020). The agreement has lapsed and a new agreement is being renegotiated.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as disruptions of hydrologic regimes, agriculture, residential land development, logging, off road vehicles, repeated mowing before seed is set, and invasive plants. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of seasonally inundated pond 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 threatened, has a range that is neither widespread nor constricted, and numerous populations with unknown population trends, the vulnerability of the species is considered high.

Risk

We do not expect on-field exposure to spray application is likely as the species range does not overlap with Enlist herbicide use sites. Overlap data indicates that only a few individuals are likely to experience runoff exposure. Runoff EECs may occasionally reach levels that can cause high levels of adverse effects; however, spatially refined runoff exposure modeling indicates that these effects are likely highly localized and that not all locations within the runoff zone are likely to experience more than low levels of adverse effects. Thus, we expect the overall risk of adverse effects to the species is low. We describe our rationale in the following sections.

Extent of exposure

The Virginia sneezeweed's range does not overlap with corn, cotton, or soybean fields (Table 44). As the species is not expected to occur on-field, we expect runoff is the primary route of exposure.

We expect the Virginia sneezeweed will occur on runoff areas directly adjacent to Enlist pesticide use sites. 0.31% of the species range overlaps with corn and soybean runoff areas (Table 44).

Table 44. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	0	0.31
Cotton	0	0
Soybean	0	0.2
Total[16]	0	0.31

Magnitude of effect

Effects to Growth and Mortality

[16] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

We expect exposure to Enlist pesticides through runoff will result in growth effects, which, if severe enough, could result in acute mortality. Exposure to corn and cotton runoff may cause up to 59-62% growth inhibition (Table 45). While direct mortality is unlikely to occur, we anticipate reductions in long-term survival may occur as this level of growth effect may impede recovery from events such as herbivory, disease, or other environmental stressors. Thus, we consider this a high magnitude of effect.

Table 45. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	95th percentile EEC (lbs AI/acre)	Growth effects (% inhibition)	Magnitude of Mortality
Corn	0.030	62	0.001% (1 in 100,000 individuals exposed)
Cotton	NA	NA	NA
Soybean	0.026	54	0.0001% (1 in a million individuals exposed)

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 exposure. EPA's Tier 3 geographic distribution models show that 19% of corn and 38% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 46).

Table 46. 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 growth effects (i.e., no more than 25% growth inhibition).

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	471	88	19
Cotton	NA	NA	NA
Soybean	590	226	38

Thus, while we expect only a few individuals are likely to experience exposure to Enlist herbicides, we anticipate an even fewer number of individuals are likely to experience more than low levels of adverse growth effects. As such, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We do not expect the Virginia sneezeweed will occur on-field, indicating that exposure to spray application is not likely to occur. Only 0.31% of the species' range overlaps with potential runoff areas, indicating that few individuals are likely to experience any exposure. While runoff EECs may occasionally reach levels that can cause high levels of adverse growth effects, spatially refined runoff model results indicate that these effects are likely highly localized as a substantial number of locations within the runoff zone are not likely to experience more than low levels of exposure. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species will be low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Virginia sneezeweed. As discussed below, although the vulnerability is high, we expect very few individuals will experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we do not expect species-level effects will occur.

The Virginia sneezeweed is listed as threatened, and only 25 extant populations are known to exist in a range that is neither constrained nor widespread. Threats such as disruptions of hydrologic regimes, agriculture, residential land development, logging, off road vehicles, repeated mowing before seed is set, and invasive plants, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

We do not anticipate the Virginia sneezeweed will occur on Enlist herbicide use sites as there is no overlap between the species range and corn, cotton, or soybean fields. Only 0.3% of the species' range overlaps with potential runoff areas, indicating that, at most, only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that can result in high levels of adverse growth effects, spatially refined runoff model results indicate that many locations within the runoff area that are not likely to experience exposures that would cause more than low levels of adverse growth effects. Thus, we expect adverse effects to individuals would be highly localized in area and would affect only a small number of individuals. Therefore, we expect the overall risk of adverse effects to the species is low.

In summary, we expect only a few individuals are likely to experience any exposure to Enlist herbicides. While exposures may occasionally be high enough to cause high levels of adverse growth effects, we expect most runoff events will not cause such high levels of impacts to exposed individuals. As such, we expect impacts will be highly localized and that only a few individuals, at most, will experience more than low levels of adverse growth effects. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing

more than low levels of adverse growth effects will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Virginia sneezeweed.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 2000. Virginia Sneezeweed *(Helenium virginicum)* Recovery Plan. Technical/Agency Draft. Hadley, Massachusetts. 54 pp.

U.S. Fish and Wildlife Service (USFWS). 2020. Virginia Sneezeweed (*Helenium virginicum*) 5-Year Review Summary and Evaluation. U.S. Fish and Wildlife Service. Southwestern Virginia Field Office, Abingdon, Virginia. 35 pp.

Integration and Synthesis Summary: Flowering Plants – Spring Creek bladderpod

Scientific Name:	Common Name:	Entity ID:
Lesquerella perforata	Spring Creek bladderpod	568

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 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. Therefore, it is the Service's biological opinion that the Action is likely to jeopardize the continued existence of the Spring Creek bladderpod. We discuss our rationale for the species in the sections below.

Species Current Range

Last updated: 1-27-2018 *– Wherever found*

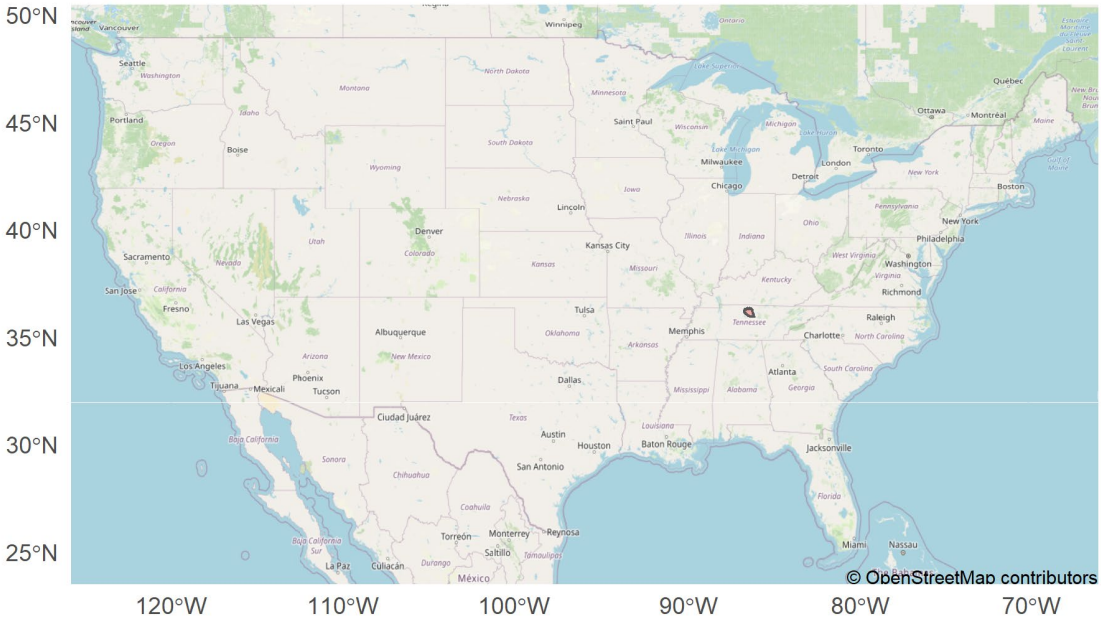

Figure 17. Range map of Spring Creek bladderpod (red polygon overlay). Range map accessed on August 11, 2022, at https://ecos.fws.gov/ecp/species/2012.

Vulnerability

Our consideration of the vulnerability of the species includes a summary of the status of the species, an overview of the environmental baseline for past and present impacts to the species in the action area, and a discussion of how these aspects of the biology of the species contribute to the overall vulnerability of the species.

Summary of Status

Status: Endangered
Recommendation 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: TN
Critical Habitat designated: None
Pesticides noted in USFWS documents: Yes, Herbicides

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

The Spring Creek bladderpod is a winter annual and is typically found growing in flood plains (USFWS 1996). It requires annual disturbance in order to complete its life cycle. Historically, this disturbance was probably provided by periodic flooding of the streams along which it occurred. This flooding is thought to have removed the perennial grasses and woody plants that quickly invade the flood plains without regular natural or artificial disturbance. Cultivation of annual crops, such as corn, provides an excellent means of artificially maintaining the habitat, provided there is no fall plowing and herbicide use is limited (USFWS 1996). In general, Spring Creek bladderpod is found on the Egam silty clay loam and Lindell silt loam soils that are occasionally flooded and occur along the floodplains (USFWS 2006). Campbell (1996, as cited in USFWS 2006) describe these soils as being deep, nearly level, moderately well drained and occurring on floodplains and in depressions. Flooding occurs occasionally, but is not long or frequent enough to seriously interfere with farming in the floodplain. Permeability is moderate and the available water capacity is high.

The spring Creek bladderpod germinates between September and early October, overwinters as a small rosette of leaves, and fully develops and flowers the following spring. Flowering usually occurs in March and April. The fruit splits open upon maturity in late April and early May, and the enclosed seeds are dispersed and lie dormant until autumn. The plant dies back soon after the fruits mature. Upon germination, the cycle starts over again.

The monitoring approach currently used for Spring Creek bladderpod does not permit statistical evaluation of trends over time (USFWS 2011). The data available do, however, indicate that abundance at a given site varies considerably over time. Qualitative evaluation of available data for 2019 compared to recent years indicates that 12 Element Occurrences (Eos) have increased or remained stable, 7 have decreased, and both increases and decreases have been observed within different portions of EO 11 (USFWS 2019). As of 2019, there are 23 extant occurrences of

Spring Creek bladderpod. Of the extant occurrences, 8 are located within the Spring Creek watershed, 11 within the Barton's Creek watershed, and 4 within the Cedar Creek watershed (USFWS 2019). One occurrence (EO 35) was discovered on U.S. Army Corps of Engineers lands in 2015. All other occurrences are located on privately or municipally owned land.

Environmental Baseline

Habitat degradation and destruction have contributed to the present condition of the Spring Creek bladderpod, 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, livestock grazing, conversion of its limited habitat to pasture, habitat encroachment by woody vegetation and herbaceous perennials, herbicide, and climate change (USFWS 2011, 2019). Furthermore, maintenance of fescue pasture or lawns and applications of winter cover crops and pre-emergent herbicides to agricultural fields are not conducive to annual germination, growth, and reproduction of Spring Creek bladderpod, but are prevalent land uses within the species' geographic range (USFWS 2019). We considered of these activities in the environmental baseline for the species. Some activities have been addressed by past consultations, such as electrical transmission land activities, and have also contributed to the condition of the environmental baseline for the species in the action area. In some of these consultations, as with this consultation on the registration of pesticides, measures have been incorporated as part of proposed federal actions that reduce the effects of these actions on the 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, three Spring Creek bladderpod populations in the Barton's Creek Watershed are protected by non-binding cooperative management agreements (USFWS 2011). Agreements were signed by Cracker Barrel Old Country Store, TRW Automotive, and by the City of Lebanon (USFWS 1999, 2000, 2001; all as cited in USFWS 2006). These agreements will provide management and protection for approximately 4,000 plants at these sites. Strategies generally include no land disturbances between September 15 and May 15 and light discing prior to September 15. Bush-hogging is permitted during the summer months.

Cumulative Effects

We anticipate that many of the non-Federal activities described above will continue into the future, including habitat degradation and destruction, as well as other threats such as development, livestock grazing, conversion of its limited habitat to pasture, habitat encroachment by woody vegetation and herbaceous perennials, and herbicide use. These activities are expected to result in increased mortality and/or decreased reproduction of individuals through direct crushing or removal of plants, or indirectly through the loss of flood plain 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

Vulnerability Summary

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 few populations with unknown trends, the vulnerability of the species is considered high.

Risk

We expect the Spring Creek bladderpod will occur on Enlist pesticide use sites as well as within runoff areas immediately adjacent to use sites. We anticipate individuals on-field will likely experience high magnitudes of adverse effects (i.e., acute mortality) while individuals in runoff areas are unlikely to experience more than low levels of adverse effects. A species-specific mitigation measure will likely reduce the likelihood of on-field exposure to a level that will result in low risk of adverse effects to the species overall. We describe our rationale in detail in the sections below.

Extent of exposure

The Spring Creek bladderpod is expected to occur on agricultural fields. 1.69% of its range overlaps with corn, cotton, or soybean fields, which indicates that direct exposure to Enlist One and Enlist Duo application is likely (Table 47).

We expect the Spring Creek bladderpod will also occur on runoff areas directly adjacent to Enlist pesticide use sites. 3.21% of the species range overlaps with corn, cotton, and soybean runoff areas (Table 47).

Table 47. Percent overlap between the species' range and Enlist herbicide application sites and runoff zone.

Crop	On-field (%)	Runoff zone (%)
Corn	1.04	2.15
Cotton	0.04	0.12
Soybean	1.65	3.09
Total[17]	1.69	3.21

Magnitude of effect

Effects to Growth and Mortality

[17] Total overlap uses either corn or soybean, whichever is higher, to avoid double counting overlap resulting from crop rotation practices.

We expect exposure to Enlist pesticides will result in adverse growth effects, which, if severe enough, could result in acute mortality. Given that Enlist pesticides are designed to cause mortality in non-GMO plants through spray application, we expect any individuals that occur on-field will experience mortality, which we consider a high magnitude of effect. In order to mitigate this on-field risk of adverse growth effect and/or mortality, EPA and the technical registrants have proposed a species-specific mitigation measure. A pesticide use limitation area will be set within the species range. In this use limitation area, applicators are not to apply Enlist pesticides before June. We expect this use limitation will sufficiently reduce the likelihood of exposure as the Spring Creek bladderpod is a winter annual species, which germinates, grows, flowers, and sets seed from fall to spring. Restricting applications of Enlist herbicides to only the months where seeds are dormant and the adults have died will avoid any exposure (both direct on-field exposure and off-field runoff exposure) during growing, flowering, and seed set stages.

Growth effects and potential mortality may also occur through runoff exposure. We expect runoff may contain up to 0.015-0.02 lbs AI/acre, which corresponds to a possible 25-40% reduction in growth. While we do not expect any acute mortality is likely to occur off-field, this level of growth effect may reduce long term survival by reducing an exposed individual's capacity for recovery from other stressors, such as herbivory, disease, or other environmental stressors.

Table 48. Highest estimated environmental concentrations (EECs) of Enlist pesticide active ingredients in runoff that are reasonably certain to occur, and the resulting growth and mortality effects associated with each crop type.

Crop	**95th percentile EEC (lbs AI/acre)**	**Growth effects (% inhibition)**	**Magnitude of Mortality**
Corn	0.02	40	<0.0001% (< 1 in a million exposed individuals)
Cotton	0.015	25	<0.0001% (< 1 in a million exposed individuals)
Soybean	0.016	26	<0.0001% (< 1 in a million exposed individuals)

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 exposure. EPA's Tier 3 geographic distribution models show that 60% of corn, 91% of cotton, and 84% of soybean runoff areas are not likely to experience runoff EECs that will cause more than low levels of growth effects throughout the duration of the action (Table 49).

Table 49. 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 growth effects (i.e., no more than 25% growth inhibition).

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	75	45	60
Cotton	60	55	91.7
Soybean	106	89	84

Thus, while we expect only a few individuals will experience runoff exposure, we anticipate an even fewer number of individuals will experience more than low levels of adverse growth effects resulting from runoff exposure. Considering this, in addition to the on-field mitigation measure described above, we expect the overall risk of adverse growth effects or mortality to individuals is low.

Risk Summary

We anticipate the Spring Creek bladderpod will occur on-field and is at risk of potentially high magnitudes of on-field effects resulting from exposure to spray application. However, we anticipate that the species-specific mitigation measure proposed by the EPA and technical registrants will reduce on-field exposure to a level that will not cause adverse growth effects or mortality. 3.21% of the species' range overlaps with runoff areas, indicating that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally cause low to moderate levels of adverse growth effects, we anticipate the majority of locations within the runoff zone are not likely to experience exposures that would cause more than low levels of adverse effects to exposed individuals. We do not expect these low levels of effect will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we expect the overall risk of adverse effects to the species is low.

Overall Risk from 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 Action, and the cumulative effects, it is the Service's biological opinion that the registration of Enlist One and Enlist Duo is not likely to jeopardize the continued existence of the Spring Creek bladderpod. As discussed below, while the vulnerability is high, we expect no more than a few individuals are likely to experience more than low levels of adverse growth effects from the Action. We do not expect these low levels of adverse effects will reduce reproduction or otherwise affect the distribution of individuals within the range. Thus, we anticipate a small number of individuals will be affected over the duration of the Action, and we do not expect species-level effects will occur.

The Spring Creek bladderpod is listed as endangered, and 23 extant populations are known to exist in a restricted range. All occurrences are located on privately or municipally owned land, except one which is found on U.S. Army Corps of Engineers lands. Three populations are protected by non-binding cooperative management agreements (USFWS 2011). Threats such as development, livestock grazing, conversion of its limited habitat to pasture, habitat encroachment by woody vegetation and herbaceous perennials, and herbicide, are expected to continue to impede the recovery of the species. Thus, we have determined that the species is highly vulnerable.

We anticipate the Spring Creek bladderpod is likely to occur on-field, where individuals are at risk of mortality. We anticipate the species-specific mitigation measure proposed by the EPA and technical registrants will prevent adverse growth effects and mortality to individuals occurring on-field and be protective of the species as a whole. Only 3.21% of the species' range overlaps with runoff areas, indicating that only a few individuals are likely to experience runoff exposure. While runoff EECs may occasionally reach levels that cause low to moderate levels of adverse growth effects, spatially refined runoff model results indicate that most locations within the runoff zone are not likely to experience runoff EECs that would cause more than low levels of adverse growth effects. Furthermore, the on-field mitigation measure would also reduce the amount of runoff leaving application sites, further decreasing the risk of adverse growth effects to individuals occurring in the runoff zone. Thus, we expect the overall risk of adverse effects to the species is low.

In summary, while individuals on- and off-field are likely to be exposed to Enlist One and Enlist Duo, we anticipate, with the implementation of required runoff mitigation measures and a proposed species-specific mitigation measure, only a few individuals are likely to experience more than low levels of adverse growth effects. While the species is highly vulnerable, we do not expect the very small number of individuals experiencing effects to growth will cause species-level effects. Thus, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Spring Creek bladderpod.

Species Conclusion: Not likely to jeopardize

References

U.S. Fish and Wildlife Service (USFWS). 1996. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for *Lesquerella perforata* (Spring Creek Bladderpod). Federal Register 61(247):67493-67497.

U.S. Fish and Wildlife Service (USFWS). 2006. Recovery Plan for *Lesquerella perforata* (Spring Creek Bladderpod). Atlanta, Georgia. 23 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Spring Creek bladderpod (*Lesquerella perforata*) 5-Year Review: Summary and Evaluation. Southeast Region. Cookeville Ecological Services Field Office. Cookeville, Tennessee. 14 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. Spring Creek bladderpod (*Lesquerella perforata*) 5-Year Review: Summary and Evaluation. Appendix B: Summary of new information

obtained since the 2011 5-year Review. Tennessee Ecological Services Field Office. Cookeville, Tennessee. 13 pp.