Integration and Synthesis Summary for Plants

Plants in Plants in Terrestrial or Riparian Habitats with Risk of Exposure from Sugarcane, Guava, and Macadamia Nuts

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

The species in this I&S appendix were grouped together as they occur in similar types of habitats (i.e., terrestrial and riparian habitats) and were predicted by EPA to be exposed to similar concentrations of atrazine from registered uses, including potential exposure from sugarcane, guava, or macadamia nut. Most of these species have low exposure to atrazine due to the factors described in the tables or individual rationales below, in combination with reductions in atrazine spray drift and runoff resulting from implementation of conservation measures added to the product label (including those developed during this consultation through the Herbicide Strategy[1]) and conservation measures that will be implemented through Pesticide Use Limitation Areas (PULAs) in EPA's Bulletins Live! Two (see Conservation Measures section below). For most species in this Appendix, we anticipate exposures in the habitats where these species occur are at low enough levels where the label measures (including the 15- and 170-feet spray drift buffers and three runoff points) adequately reduce atrazine concentrations to levels where effects are expected to be low. Some species in this Appendix need species-specific conservation measures (i.e., six runoff points total, implemented through PULAs) for certain atrazine uses (i.e., sugarcane, guava, and macadamia) as the general label allows higher application rates for these uses and the species are anticipated to experience higher levels of runoff exposure in areas where these uses occur.

Vulnerability

For the plant species that we or EPA determined are "likely to be adversely affected" by the proposed action, we considered several factors for each listed plant to determine the current vulnerability of that species to additional stressors. This effort allows us to consider whether a species' current condition is stable, moving toward recovery, or moving toward further decline. In general, we expect the species' vulnerability to additional stressors to be higher if they are

[1] https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365

near extinction, far from recovery, or moving toward further decline than if their condition is stable or improving. We also identify which species are most (and least) susceptible to additional stressors in general based on information from species listing and recovery documents, or other sources as cited and considered in the Status of the Species and Critical Habitat section of this Opinion (Appendix B).

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

We scored each of the six vulnerability components with high, medium, or low scores. We assigned a high vulnerability ranking to a species if all vulnerability components were scored as high, a mixture of medium and high, or if a threatened species was recommended for uplisting to endangered status in the most recent 5-year status review or proposed rule. We assigned a medium vulnerability ranking if a species' scores were all medium, a mix of high, medium, and low, or a mix of high and low (unless the species has been recommended for uplisting or delisting). We assigned a low vulnerability ranking to species with only low scores, a mixture of low and medium scores, or if the species was recommended for delisting. Considerations regarding specific aspects of the species' vulnerability or beyond what was included in the vulnerability ranking were applicable in our jeopardy analyses for some species depending on unique aspects of their vulnerability factors, recovery needs, or life history. This information is reflected in the rationales for conclusion below.

Exposure

We anticipate listed plant species will be exposed to atrazine primarily through direct contact, either as a result of exposure to pesticide applications on-site or in off-site areas through off-field transport via spray drift or runoff. Atrazine is moderately mobile in water and is relatively

[2] The number will vary in value and importance by species and in some cases is unknown. In general, species with a greater number of populations have greater representation, will be more resilient, and when distributed geographically, will have greater redundancy. Conversely, species with fewer populations, in general, have less representation, are less resilient, and have less redundancy.

[3] https://ecos.fws.gov/ecp/

persistent in the environment relative to other pesticides, indicating that off-site transport, particularly through runoff, may result in exposure to listed species in areas far from use sites.

Exposure to Agricultural Uses

Atrazine has several registered agricultural uses (see Appendix 1-4 of EPA's Biological Evaluation) in the coterminous United States. We characterize the expected level of exposure using overlaps between the species' ranges and agricultural areas where atrazine is registered for use (i.e., overlap data; including a 305-m off-site transport area adjacent to use sites), past atrazine usage data (when available; the amount and location where atrazine has been used in the past), any species-specific considerations such as life history information (e.g., habitat preferences), and existing protections or conservation actions (e.g., existing label measures, conservation measures from the action agency). Species with greater than 10% overlap between their range and agricultural atrazine use sites are assigned a high overlap score, species with 5-10% overlap are assigned a medium overlap score, and species with less than 5% overlap are assigned a low overlap score. In addition to range overlaps with atrazine use sites, we considered past atrazine usage data within a species' range to determine how much of a species' range we expect to be treated with each year of the proposed action. Except where otherwise noted, usage data is provided by EPA applying data from their National and State Summary Use and Usage Matrix, as described in the Usage Analysis section of this Opinion. Species with usage data that indicate a large portion of their range (>10%) is treated with atrazine each year are assigned a high usage score. Species that have a medium portion of their range (5-10%) treated with atrazine each year are assigned a medium usage score, and species where data indicate a low portion of their range (<5%) is treated with atrazine each year are assigned a low usage score.

We determine the overall exposure ranking by qualitatively considering both the total overlap and total usage, as well as any additional exposure considerations that might modify the level of exposure likely to occur. When overlap and usage scores are the same, we assign the overall exposure ranking the same score (e.g., if both overlap and usage is high, the overall exposure ranking is high). In cases where overlap is high and usage is medium or when overlap is medium and usage is low, we use the overlap score as the overall exposure ranking to maintain conservative exposure assumptions. As usage is a subset of overlap, the overlap score will always be greater than the usage score. In cases where overlap is high, but usage is low, we anticipate a moderate portion of the range may be treated over the duration of the proposed action even if only a small portion of the range is treated in any given year (particularly if the areas treated occur in different locations each year), leading to an overall exposure ranking of medium. For species where there are additional exposure considerations, we adjust the overall exposure ranking to reflect this additional information, as appropriate.

Agricultural uses of atrazine include labeled uses for corn, vegetables and ground fruit (i.e., sweet corn), sod, orchards (i.e., guava and macadamia nut), other grains (including sugarcane and sorghum), and fallow fields only within the coterminous United States.

Exposure to Non-Agricultural Uses

In addition to agricultural uses, atrazine is registered for use on non-agricultural turf, including residential lawns and golf course turf. UDLs for non-agricultural uses sites that represent turf tend to be less defined than those for agricultural UDLs and are less likely to accurately represent the actual footprint of these use sites on the landscape. As such, we assess exposure of species to all non-agricultural uses of atrazine in a qualitative manner, considering the life history of species, methods of application, atrazine usage, and any existing conservation measures to reduce drift and runoff or otherwise limit exposure to species. To facilitate this analysis, for every species in this Appendix, we reviewed species' documents (e.g., Status of the Species (Appendix B), 5-year reviews, Species Status Assessments, recovery plans, listing rules) to determine if the species could occur on or near non-agricultural atrazine use sites (i.e., residential areas where lawns or golf courses are likely present) and the manner in which they may rely on these sites.

Depending on region, cool-season, warm-season, or a combination of turf grass species are managed on golf courses and lawns. Cool-season grasses grow best in cooler conditions, and warm-season grasses thrive in hot, dry weather (USDA, 2004); there is a transition zone across the U.S. where either category of turf grasses may be planted based on microclimate conditions. Exposure to triazines will kill cool-season grasses, but warm-season grasses can tolerate exposure to atrazine. As such, EPA estimated where in the U.S. only cool-season grasses are exclusively used in turf based on the U.S. Department of Agriculture's plant hardiness zone map as atrazine use is not expected in these areas (USDA, 2023). Because hardiness zones will change over time with environmental conditions, EPA created a static map based on the hardiness zones where they expect warm- and cool-season grasses are grown based on the most recent data mapped (i.e., 1991-2020). EPA determined zones 1a-6a represent cool-season grasses (i.e., white areas) and zones 6b-13b may include warm-season grasses (i.e., black areas) (Figure 1). We expect the cool- and warm-season grass assessment to apply to all turf, including residential, commercial, and golf course turf. We refer to EPA's cool-season map in species assessments where relevant, particularly if a species occurs exclusively in the cool-season zone where we expect atrazine will not be used on turf and no exposure will occur from this use.

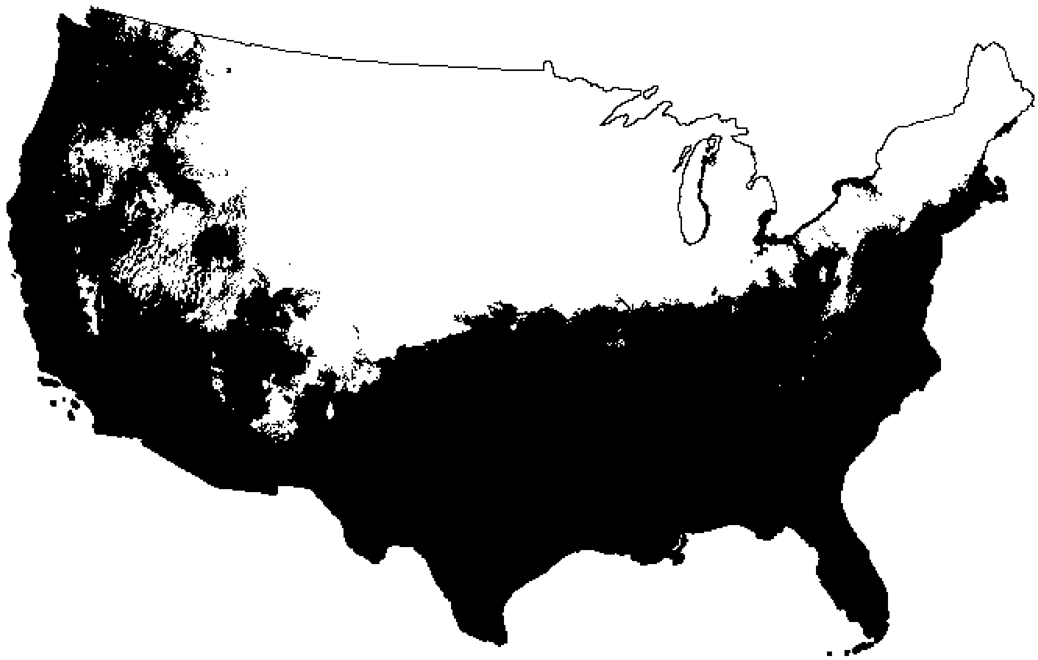

Figure 1. Map showing where cool-season grasses (white areas) and warm-season grasses (black areas) are used on turf across the continental U.S.

Particularly for residential and commercial turf uses, qualitative usage information obtained by EPA from the National Association of Landscape Professionals (NALP) indicate that atrazine is no longer commonly used on residential or commercial turf due to preferential use of newer herbicides. If atrazine were used on residential or commercial turf, it would be applied during the fall and spring as a pre-emergent. In addition, commercial and residential applicators typically apply herbicides with hand-held equipment that release course droplets, limiting the potential for spray drift.

Particularly for golf course turf uses, we obtained qualitative usage information directly from the Golf Course Superintendents Association of America (GCSAA) and an academic turf scientist that indicate that atrazine is used to control winter annual broadleaf and annual bluegrass weeds on golf courses. They are applied as a pre-emergent in early fall and early winter to fairways and roughs, which make up approximately 30% of a golf course's acreage. Triazines are not applied to tee boxes or greens, which make up an additional 6% of golf course acreage. Most applications are made at rates lower than what is on the label (i.e., 1 lbs. AI./A spray). These applications are made only once or twice a year, 45-60 days apart. In general, golf courses typically apply herbicides using dedicated ground equipment with a low boom height (as per the label), and golf course superintendents make use of several tools to monitor soil moisture before any applications are made to help ensure turf and soil conditions do not lead to off-target movement of herbicides. In addition, riparian buffer zones are often used on golf courses between all water features to reduce off target movement (Golf Course Superintendents Association of America [GCSAA], pers. comm., 2025). The no-till methodology and continuous cover of a turf grass area inherent in managing golf course turf are equivalent to additional run-off mitigations (i.e., equivalent to six points on EPA's mitigation menu), and we considered them in our assessment.

For most species in this Appendix, we anticipate that non-agricultural uses will not meaningfully add to the overall level of anticipated exposure considered in our analysis of agricultural uses. Due to runoff and spray drift considerations described above, off-site exposure is not expected to result in effects to most species in this Appendix. In addition, we expect most listed species' habitat requirements preclude them from occupying non-agricultural use sites where atrazine may be used. For species whose habitat is known or presumed to occur in non-agricultural use sites of atrazine, we consider, individually and qualitatively, the extent and manner of non-agricultural atrazine usage within the species' range to generally determine whether a small, moderate, or large number of individuals are likely to be exposed and the expected level of adverse effects from non-agricultural exposure of atrazine.

References:

GCSAA (Golf Course Superintendents Association of America). 2025. Personal communication with USFWS HQ staff.

USDA. 2004. Comparing warm-season and cool-season grasses for erosion control, water quality, and wildlife habitat. Natural Resources Conservation Service, U.S. Department of Agriculture. 5 pp.

USDA. 2023. Plant Hardiness Zone Map. Agricultural Research Service, U.S. Department of Agriculture. Accessed from https://planthardiness.ars.usda.gov/ on August 20, 2025.

Toxicity

We characterize the expected toxic effect to species based on the anticipated level of direct and indirect[4] adverse effects to individuals. Our analysis of toxicity assumes individuals are exposed to atrazine at levels estimated by EPA's environmental exposure modeling and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Direct effects are based on the anticipated level of mortality and sublethal effects (e.g., reduced growth) likely to occur in exposed individuals. Indirect effects are based on the impact a listed species is

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

likely to experience when the organisms they rely on, such as those that act as pollinators or seed dispersers, are exposed to atrazine and experience adverse effects.

Given that herbicides like atrazine are designed to control plants, we assume listed plant species are sensitive to atrazine exposure. In general, we anticipate individuals exposed to atrazine are likely to experience direct adverse effects in the form of reduced biomass and growth, which, in severe cases, would result in mortality of individuals. Based on the available toxicity data in plants for atrazine, we use the HC_{05} (i.e., the exposure concentration where we expect more than 95% of plant species would not experience measurable impacts) for biomass at seedling emergence and compare that to the estimated environmental concentration (EEC) of atrazine for each listed species to determine the anticipated level of adverse effects atrazine. In contrast, available toxicity data indicate that animal species, including potential pollinators and seed dispersers of listed plant species, are not likely to experience mortality from atrazine exposure, suggesting that indirect adverse effects are not likely to occur to listed plant species.

Conservation Measures

The technical registrants have previously agreed to substantial conservation measures that were incorporated into EPA's 2021 BE. These conservation measures include the following:

- Prohibit use in Hawaii, Alaska, and the Territories,
- Prohibit use on roadsides, shelterbelts, Conservation Reserve Program (CRP) land, conifers (including Christmas tree plantings), timber and forestry, and miscanthus and other perennial bioenergy crops,
- Prohibit application via mechanically pressurized handguns to macadamia nuts, sweet corn, and guava,
- Restrict "fallow" uses on all labels to the following scenarios and geographies only:
    - Wheat-corn-fallow and wheat-fallow-wheat in CO, KS, ND, NE, SD, and WY,
    - Wheat-sorghum-fallow in AR, CO, GA, IL, KS, LA, MS, MO, NE, NM, NC, OK, SD, and TX
- Reduce the single maximum application rate of turf, granular formulations to 2.0 lbs. AI/A, and reduce the single maximum application rate of turf, sprays to 1.0 lb. AI/A,
- Restrict applications made by backpack-spray to landscape turf to spot treatments only,
- Restrict applicators from applying atrazine products to the same sorghum acre,
- Require all applications to use coarse or coarser droplet sizes,
- Require an in-field downwind buffer of 15-ft for all ground applications (from the edge of all streams and rivers as well as the high-tide line for all estuarine/marine environments, and from threatened and endangered species critical habitat and/or species locations)
- Prohibit all ground applications when wind speeds exceed 10 miles per hour at the application site,

- For ground boom applications, only apply with the release height recommended by the manufacturer, but no more than 4-ft above the ground or crop canopy,
- Require an in-field downwind buffer of 150-ft for all aerial applications (from the edge of all streams and rivers as well as the high-tide line for all estuarine/marine environments, and from threatened and endangered species critical habitat and/or species locations),
- If the windspeed is 10 miles per hour or less, applicators must use ½ swath displacement upwind at the downwind edge of the field. When the windspeed is between 11-15 miles per hour, applicators must use ¾ swath displacement upwind at the downwind edge of the field,
- If the windspeed is greater than 10 mph, the boom length must be 65% or less of the wingspan for fixed wing aircraft and 75% or less of the rotor diameter for helicopters. Otherwise, the boom length must be 75% or less of the wingspan for fixed-wing aircraft and 90% or less of the rotor diameter for helicopters,
- Prohibit all aerial applications when wind speeds exceed 15 miles per hour at the application site,
- Restrict aerial applications from releasing spray at a height greater than 10-ft above the ground or vegetative canopy unless a greater application height is necessary for pilot safety,
- Prohibit aerial applications of non-liquid formulations,
- Prohibit all applications during temperature inversions.

While these conservation measures are impactful and contribute to reducing the level of exposure and adverse effects to listed species, EPA and the Service anticipate substantial risk of adverse effects to many listed species remain after incorporating these measures into the proposed action.

Herbicide Strategy Conservation Measures

As part of the atrazine ESA consultation with the Service, EPA is implementing the final Herbicide Strategy to inform and identify any necessary conservation measures where EPA's analysis indicated there was a risk of population level effects to listed species. The measures identified by EPA, and committed to by the technical registrants, include:

- a standard 170-foot wind-directional spray drift buffer for aerial applications[5] (not in addition to the buffers the technical registrants committed to previously), and

[5] Note: The 170-foot aerial buffer replaces the 150-foot aerial buffer agreed to before implementation of the Herbicide Strategy.

- a minimum of three runoff mitigation points[6] necessary in all areas where atrazine is used, as well as additional runoff mitigation points (i.e., six points total) for certain atrazine uses limited to certain geographic areas when required to protect specific listed species.

In addition to the conservation measures identified through EPA's Herbicide Strategy, in the course of this consultation the technical registrants have also committed to additional measures for specific registered uses of atrazine to reduce exposure to listed species, including:

- Reduce the maximum annual application rate for field corn from 2.5 lbs. AI/A to 2.0 lbs. AI/A,
- For sweet corn uses, adopt one of the following:
    - Do not apply atrazine to sweet corn from August 15th to November 1st; when applied during other times of the year, use as a pre-emergent up to 2.0 lbs ai/acre.
    - With no timing restrictions for use, use as pre-emergent up to 1.25 lbs ai/acre followed by post-emergent 0.75 lbs ai/acre.
- Restrict "corn" in wheat-corn-fallow rotations to "field corn" meaning "wheat-field corn-fallow rotations",
- Off-label all uses in California except for Imperial County, and
- Add the restriction "Do not apply atrazine products during rain or when soils are saturated or above field capacity" to all formulations.

The spray drift buffers will be placed on the general label and will apply to all uses of atrazine. EPA's Herbicide Strategy provides applicators with options to reduce the distance of this buffer by using other spray drift reduction strategies that we anticipate will result in an equivalent reduction in spray drift entering non-target habitats as stated buffers. These measures and the degree to which applicators can reduce buffers by employing them are described in EPA's Herbicide Strategy and EPA's Ecological Mitigation Support Document to Support Endangered Species Strategies. These documents are provided in Appendix A-1.

Based on EPA's analyses, the required spray drift conservation measures described above (from the current label, those from implementation of the Herbicide Strategy, and additional measures committed to through consultation for specific registered atrazine uses) will reduce spray drift from entering species' habitats by >95%. The Service anticipates that this reduction will minimize off-site transport of atrazine from spray drift to a level where no more than low levels of effects are likely to occur to most listed plants.

As stated above, all agricultural labels will include a requirement for applicators to achieve three points of runoff mitigation, as described in the Herbicide Strategy, for all agricultural uses. EPA's Herbicide Strategy provides applicators with various options to reduce runoff and erosion

[6] Ecological Mitigation Support Document to Support Endangered Species Strategies

and assigns points to each option based on its effectiveness. Applicators must implement sufficient mitigation points to meet the label requirement. Applicators can achieve the required points using the conservation measures identified on EPA's Mitigation Menu website[7]. The menu provides a suite of options, including relief points for certain field characteristics and likelihood for pesticide transport.

We expect implementation of the required runoff and erosion reduction measures to minimize off-site transport of atrazine to habitats of listed species. EPA's analyses indicated that the general label requirement of three runoff mitigation points will reduce estimated environmental concentrations of atrazine in runoff by up to an order of magnitude (i.e., up to 90% reduction, in other words reduce pesticide loading to one-tenth of pre-runoff mitigation levels).

In cases where EPA has identified additional runoff measures are needed, additional points (up to six points total) will be required. EPA will communicate where additional runoff mitigation points are needed and for what specific atrazine uses through their Bulletins Live! Two online platform, which all applicators are required to check before making pesticide applications. In areas requiring up to six runoff mitigation points total, EPA expects estimated environmental concentrations of atrazine will decrease by up to two orders of magnitude (i.e., reduce pesticide loading to one-one hundredth of pre runoff mitigation levels; 99% reduction).

For all the species in this document, we expect that the runoff and mitigation measures will reduce exposure concentrations to within one order of magnitude of the exposure level where 95% of plant species are not likely to experience measurable adverse effects. We anticipate this level of mitigation will protect listed plant species by reducing the number of individuals exposed (by reducing the extent of off-site transport of atrazine residues) and reducing the level of adverse effects that will occur to exposed individuals (by reducing estimated exposure concentrations).

Summary of Conclusions for Plants in Terrestrial or Riparian Habitats with Risk of Exposure from Sugarcane, Guava, and Macadamia Nuts

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of atrazine with conservation measures, and the cumulative effects, it is the Service's biological opinion that the registration of atrazine, as proposed, is not likely to jeopardize the continued existence of the 27 plant species in this Appendix.

In our analysis below, some species that had the same or very similar rationales for their conclusions were grouped together, to increase efficiency and avoid repetition. Relevant information and data unique to each individual species was considered when assigning species to

[7] Mitigation Menu website: https://www.epa.gov/pesticides/mitigation-menu

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

Species with low agricultural exposure informed by low past usage of all herbicides from the USDA's Census of Agriculture and low likelihood of non-agricultural exposure

The species in Table 1 were grouped together as we anticipate they will experience low levels of exposure to atrazine based on available data from the USDA's Census of Agriculture (CoA). Therefore, our concern for adverse effects is low. While we present some specific information about the species below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 1. Species with low agricultural exposure informed by low past usage of all herbicides from the USDA's Census of Agriculture (CoA) and low likelihood of non-agricultural exposure.

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	% Range Treated (CoA)	Determination
Blodgett's silverbush	*Argythamnia blodgettii*	High	Low	High	4.75	No Jeopardy
Cape Sable Thoroughwort	*Chromolaena frustrata*	High	Low	High	4.75	No Jeopardy
Everglades bully	*Sideroxylon reclinatum* ssp. *austrofloridense*	Low	Low	High	4.75	No Jeopardy
Sand flax	*Linum arenicola*	High	Low	High	4.75	No Jeopardy

The species in Table 1 have low or high vulnerabilities. Pesticides are a noted threat to the Blodgett's silverbush, particularly for their effects to pollinators. Most Blodgett's silverbush and Everglades bully individuals are on protected lands. These species are not known to occur on agricultural atrazine use sites but may be exposed via spray drift or runoff in small portions of their ranges.

The species in Table 1 have high toxicity because herbicides like atrazine are designed to control plants. Therefore, we assume all listed plant species are sensitive to atrazine exposure and no significant difference in the toxicity of atrazine among major plant taxa (e.g., dicots, monocots, non-flowering plants) is expected. In general, we anticipate individuals exposed to atrazine, from agricultural or non-agricultural use sites, are likely to experience direct adverse effects in the form of reduced biomass and growth, which, in severe cases, would result in death. We do not expect reductions in pollinators and seed dispersers of listed plant species from atrazine exposure, and therefore, indirect adverse effects are not likely to occur for these species.

We anticipate a small number of individuals of each species are likely to experience exposure to agricultural uses of atrazine because the CoA indicates very little herbicide usage (potentially including atrazine) occurred on the agricultural crops in the counties where these species' ranges occur. Given that this reporting broadly includes all herbicide usage, we consider the CoA data a conservative estimate of atrazine usage. In addition, these data are presented at a relatively high spatial resolution. Therefore, we have high confidence that only a small percentage of the species' ranges are likely to be exposed to atrazine.

In addition to agricultural exposure, one of the four species in Table 1 may be exposed to atrazine from non-agricultural (i.e., turf) uses. One population of Blodgett's silverbush occurred on a golf course, and the status of that population is uncertain (USFWS 2023). For the other species in this table, these non-agricultural use sites do not provide the species' necessary habitat (e.g., pine rockland, coastal berm). Given our understanding of atrazine usage on use sites such as golf courses and residential lawns (see *Exposure to Non-Agricultural Uses*, above), we expect atrazine usage within the ranges of these species to be limited. In addition, if applied, we anticipate off-site transport of atrazine will be minimal as characteristics of the non-agricultural use sites (i.e., continuous cover, no till) are expected to result in little runoff. Furthermore, commercial and residential applicators typically apply herbicides with hand-held equipment that release course droplets, limiting the potential for spray drift from these specific uses. Therefore, we expect atrazine exposure from non-agricultural uses to be low for these species.

In summary, we expect a small number of individuals of the species in Table 1 will experience exposure to atrazine over the project duration. Exposure will be limited to small portions of the species' ranges that overlap with agricultural herbicide usage according to CoA or non-agricultural usage on turf, where applicable. Therefore, we expect the proposed action will result in direct adverse effects (e.g., reduced biomass, growth, or survival) of, at most, a very small number of individuals of these species. We do not expect indirect adverse effects through reductions in pollinators or seed dispersers from atrazine exposure. We determine the overall risk of adverse effects to these species is low. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including general label conservation measures), we have determined the proposed action is not likely to appreciably reduce the survival and recovery of these species in the wild. Thus, it is our biological opinion that the registration of atrazine, as proposed, is not likely to jeopardize the continued existence of the species in Table 1.

References:

U.S. Fish and Wildlife Service. 2023. Blodgett's Silverbush (*Argythamnia blodgettii*) 5-Year Review: Summary and Evaluation. Vero Beach, Florida. 30 pp.

Species with low exposure achieved through conservation measures and low likelihood of non-agricultural exposure

For the species in Table 2, we expect they will have low exposure after incorporating general label measures (e.g., measures already on the label, three runoff points and ground and aerial buffers determined through implementation of the Herbicide Strategy, and rate reductions and other restrictions to particular registered uses) and six-point PULAs for sugarcane, guava, and macadamia nuts accessed through EPA's Bulletins Live! Two. Therefore, we expect adverse effects to be low. While we present some specific information about the species below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 2. Plant species with low agricultural exposure achieved through conservation measures and low likelihood of non-agricultural exposure.

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	Conservation Measures	Determination
Aboriginal prickly-apple	*Harrisia (=Cereus) aboriginum (=gracilis)*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Ashy dogweed	*Thymophylla tephroleuca*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Britton's beargrass	*Nolina brittoniana*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Carter's small-flowered flax	*Linum carteri carteri*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Deltoid spurge	*Chamaesyce deltoidea ssp. deltoidea*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Florida bonamia	*Bonamia grandiflora*	Medium	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Florida brickell-bush	*Brickellia mosieri*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Florida perforate cladonia	*Cladonia perforata*	High	Low	High	General label measures + PULA	No Jeopardy

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	Conservation Measures	Determination
					sugarcane, guava, macadamia nut	
Florida prairie-clover	*Dalea carthagenensis floridana*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Fragrant prickly-apple	*Cereus eriophorus var. fragrans*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Garber's spurge	*Chamaesyce garberi*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Longspurred mint	*Dicerandra cornutissima*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Papery whitlow-wort	*Paronychia chartacea*	Low	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Pigeon wings	*Clitoria fragrans*	Medium	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Pineland sandmat	*Chamaesyce deltoidea pinetorum*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Prostrate milkweed	*Asclepias prostrata*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Scrub buckwheat	*Eriogonum longifolium var. gnaphalifolium*	Medium	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Scrub lupine	*Lupinus aridorum*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Small's milkpea	*Galactia smallii*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy
Tiny polygala	*Polygala smallii*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy

C-B4. Plants in Terrestrial Habitats: Integration and Synthesis Summaries

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	Conservation Measures	Determination
Wide-leaf warea	*Warea amplexifolia*	High	Low	High	General label measures + PULA sugarcane, guava, macadamia nut	No Jeopardy

The species in Table 2 have low to high vulnerabilities. Specifically, pesticides are a noted threat to the ashy dogweed and prostrate milkweed. Many Britton's beargrass, Florida prairie-clover, and tiny polygala are on protected lands.

The species in Table 2 have high toxicity because herbicides like atrazine are designed to control plants. Therefore, we assume all listed plant species are sensitive to atrazine exposure and no significant difference in the toxicity of atrazine among major plant taxa (e.g., dicots, monocots, non-flowering plants) is expected. In general, we anticipate individuals exposed to atrazine, from agricultural or non-agricultural use sites, are likely to experience direct adverse effects in the form of reduced biomass and growth, which, in severe cases, would result in death. We do not expect reductions in pollinators and seed dispersers of listed plant species from atrazine exposure, and therefore, indirect adverse effects are not likely to occur for these species.

These species are not known to occur on agricultural atrazine use sites but may be exposed via spray drift or runoff. We expect the general label measures for agricultural uses described above (e.g., reduced application rates, 15-foot spray drift buffer for ground application, 170-foot spray drift buffer for aerial applications, and three runoff mitigation points) will reduce off-field exposures by an order of magnitude (i.e., a 90% reduction). In addition, the species in Table 2 are included in an additional three-point PULA (six points total) for all sugarcane, guava, and macadamia uses. The PULA will reduce off-field atrazine residues by two orders of magnitude (i.e., a 99% reduction), which will ensure no more than low levels of direct and indirect adverse effects to individuals of this species will occur.

In addition to agricultural exposure, three of the 21 species in Table 2 may be exposed to atrazine from non-agricultural (i.e., turf) uses. Deltoid spurge, Florida brickell-bush, and Florida perforate cladonia may occur near developed areas, but lawns do not provide their necessary habitat (i.e., pine rocklands, pine scrub). We expect any non-agricultural exposure would be from off-site transport. Given our understanding of atrazine usage on use sites such as golf courses and residential lawns (see *Exposure to Non-Agricultural Uses*, above), we expect atrazine usage within the ranges of these species to be limited. In addition, if applied, we anticipate off-site transport of atrazine will be minimal as characteristics of the use sites (i.e., continuous cover, no till) are expected to result in little runoff. Furthermore, commercial and residential applicators typically apply herbicides with hand-held equipment that release course droplets, limiting the potential for spray drift from these specific uses. Therefore, we expect atrazine exposure from non-agricultural uses to be low for these species.

In summary, with implementation of conservation measures on product labels and a six-point PULA for sugarcane, guava, and macadamia nut uses, we expect that few individuals will be exposed to atrazine via off-site transport from agricultural or non-agricultural areas. Therefore, we expect the proposed action will result in direct adverse effects (e.g., reduced biomass, growth, or survival) of, at most, a very small number of individuals of these species. We do not expect indirect adverse effects through reductions in pollinators or seed dispersers from atrazine exposure. We determine the overall risk of adverse effects to these species is low. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including general label and specific conservation measures), we have determined the proposed action is not likely to appreciably reduce the survival and recovery of these species in the wild. Thus, it is our biological opinion that the registration of atrazine, as proposed, is not likely to jeopardize the continued existence of the species in Table 2.

Species with Individual Integration and Synthesis Summaries

The species in Table 3 have individual Integration and Synthesis summaries. We expect Herbicide Strategy conservation measures to reduce pesticide loading into aquatic habitats by up to 90% (i.e., one order of magnitude) compared to unmitigated runoff and reduce spray drift from entering species' terrestrial habitats by >95%. We anticipate that this reduction will minimize off-site transport of atrazine and reduce the likelihood, magnitude, and frequency of exposure to a level where no more than low levels of adverse effects are likely to occur to plants through this exposure route. While the conservation measures on the label are expected to reduce the extent of off-field exposure and reduce exposure concentrations, we anticipate atrazine residues on use sites could remain at levels high enough to cause greater than low levels of adverse direct and/or indirect effects to these plant species. They may occur on atrazine use sites, either agricultural or non-agricultural. For each species, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 3. Species with Individual Integration and Synthesis Summaries

Common Name	Scientific Name	Determination
South Texas ambrosia	*Ambrosia cheiranthifolia*	No Jeopardy
Walker's manioc	*Manihot walkerae*	No Jeopardy

Integration and Synthesis Summary: South Texas ambrosia

Scientific Name:	Common Name:	Entity ID:
Ambrosia cheiranthifolia	South Texas ambrosia	624

Conclusion: No Jeopardy

Species Range

Based on range map dated: 01-27-2018; Wherever found; *States within the range:* TX

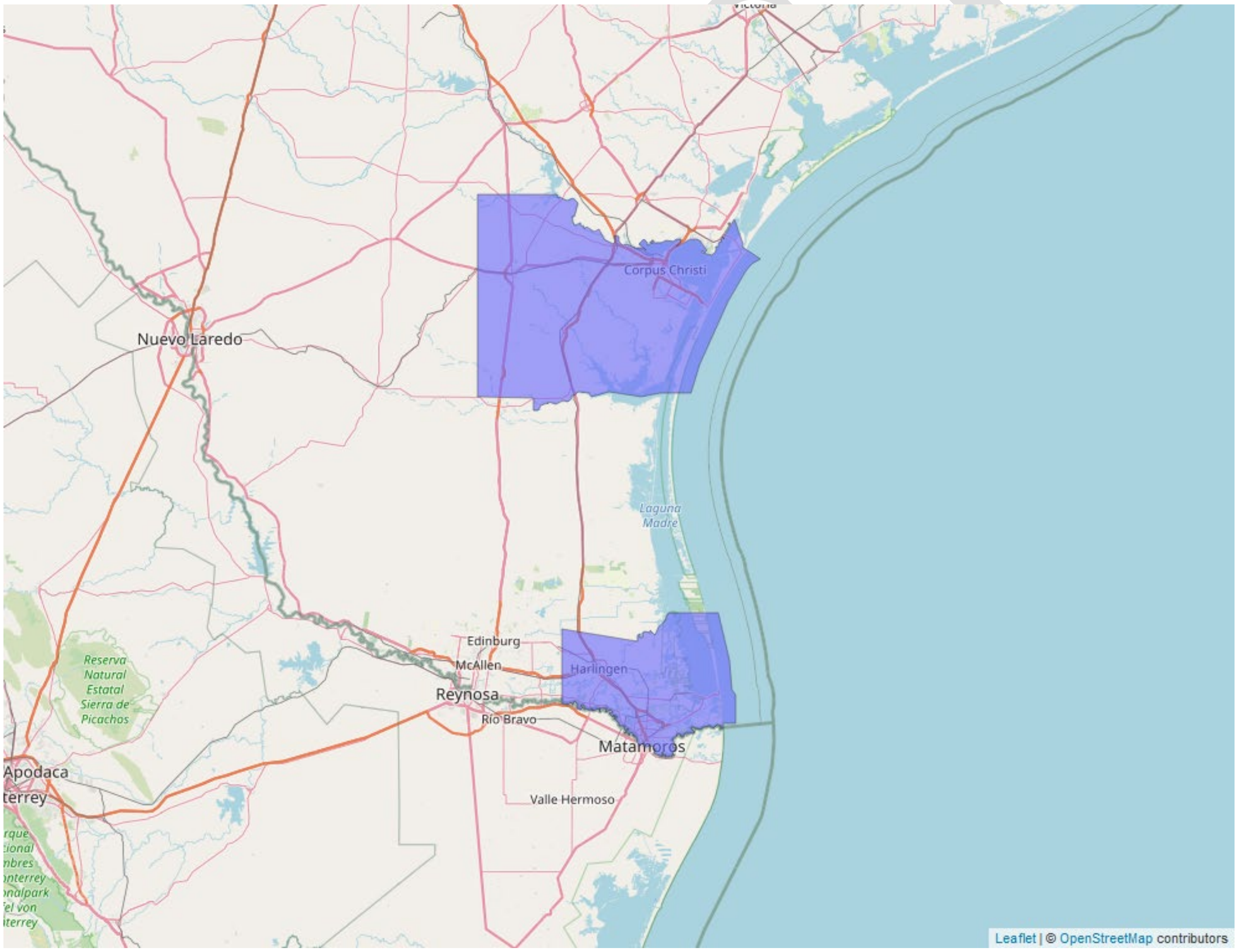

Figure 2. Range map of South Texas ambrosia (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/3331.

Vulnerability

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

Summary of Status

Listing status: Endangered

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

Most recently completed 5-Year Review: 8/4/2022

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

Number of populations: Multiple populations (few)

Species trends: Unknown species trends

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

South Texas ambrosia is a perennial, herbaceous plant in the Asteraceae (sunflower) family. Female and male flowers are separate but found on the same plant and bloom in late summer and fall. The inflorescence and floral structure of the Asteraceae family are suited for wind pollination, and ants may serve as pollinators and/or seed dispersers also. However, the species' pollination mechanisms are unknown, and it may rely on insects for pollination. The species relies on rhizomatous growth (i.e., producing underground stems), and single plant may be represented by hundreds of clonal stems. South Texas ambrosia grows at low elevations, typically on well-drained, heavy soils associated with subtropical woodland communities in openings of coastal prairies and savannas. Historically, the species occurred in Cameron, Jim Wells, Kleberg, and Nueces counties in South Texas, and the state of Tamaulipas in Mexico. As of 2021, there were six verifiable extant sites found in scattered, fragmented areas of remaining habitat located in Nueces and Kleberg counties in the Coastal Bend region of Texas; the species' status in Mexico is unknown. South Texas ambrosia occurs in 14 populations, several with subpopulations, in a patchy and scattered distribution across its range, but only six between Nueces and Kleberg counties are believed to be extant. They occur on lands managed by Department of Defense (Naval Air Station Kingsville), a Texas Department of Transportation right of way, city and county parkland, and private lands. Propagation efforts are underway by the San Antonio Botanical Garden (USFWS 2010). Overall species abundance declined between 2018 and the last review in 2022 (USFWS 2022).

Much of the species' habitat has undergone land use change for urban development, agricultural fields, and improved pastures, all of which support non-native grasses that can outcompete native vegetation like South Texas ambrosia. Mowing at certain heights and under regimes that allowed the plant to flower (i.e., monthly intervals) benefitted South Texas ambrosia by reducing competitive pressures from invading non-native grasses. Plowing, paving, and other construction can eliminate this species. Loss of genetic diversity and effects of climate change may also affect the species. Pesticide drift, both herbicides and insecticides, are a known threat to the species from nearby agricultural and urban development. Because pollination mechanism is unknown for the species, insect pollinator loss is noted as an adverse effect of insecticide exposure (USFWS 2010, 2022).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap with Agricultural Use Sites

Data indicate that 37.9% of the species' range overlaps with agricultural use sites and up to 100% of the species' range[8] overlaps with areas adjacent to use sites that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is up to 100% overlap[8] between the species' range and the agricultural footprint of atrazine use sites (Table 4).

Table 4. Agricultural use overlap and annual usage data (% Range Treated) for the South Texas ambrosia.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Corn	8.4	50.1	58.4	8.4	50.1	58.4
Vegetables and Ground Fruit (Sweet Corn)	0.3	9.6	9.9	0.3	9.6	9.9

[8] Total overlap is capped at 100%.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Other Grains (Sorghum & Sugarcane)	28.2	45.2	73.4	28.2	45.2	73.4
Other Orchards (Guava & Macadamia Nut)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other Crops (Wheat-Corn-Fallow)	0	0	0	0	0	0
Other Crops (Wheat-Sorghum-Fallow)	0.9	40.6	41.5	0.9	40.6	41.5
Other Crops (Wheat-Fallow-Wheat)	0	0	0	0	0	0
Other Crops (Sod)	0.1	7.3	7.4	0.1	7.3	7.4
Total	**37.9**	**100[8]**	**100[8]**	**37.9**	**100[8]**	**100[8]**

Usage

Past usage data indicate that up to 100% of the species' range[8] has been treated with or exposed to atrazine annually from agricultural uses with 37.9% occurring on agricultural fields and up to 90.3% resulting from off-field transport.

Additional Exposure Considerations

Cropland serves as unsuitable habitat and barriers to gene flow, but herbicide exposure from adjacent row crop lands is a known threat to South Texas ambrosia.

Exposure from Non-Agricultural Uses

Herbicide use is a potential threat from a golf course and city and county parks. The species occurs on unplowed, but mowed, railroad and highway rights of way, cemeteries, mowed park fields, and erosional areas along creeks. Urban areas serve as unsuitable habitat and barriers to gene flow. Where lawns/turf areas are planted with manicured grasses, we do not expect this species to occur. If the property occurs in Kleberg or Nueces county and the lawn or grass is simply mowed native grass or a mixture of native and introduced grass, South Texas ambrosia may be present on the mowed site (Austin Field Office, 2025, pers. comm.). As such, non-agricultural use of atrazine could be a source of exposure for this species. However, given our knowledge of atrazine application to turf areas (see *Exposure to Non-Agricultural Uses*, above), we expect atrazine usage within the range of the South Texas ambrosia to be limited. In addition, we expect off-site transport from spray drift and runoff from these uses to be minimal.

Conservation Measures

There are several conservation measures on the atrazine label that apply to all agricultural uses and are intended to reduce spray drift to off-site areas, including a 15-foot spray drift buffer for ground applications and a 170-foot spray drift buffer for aerial applications. Additionally, product labels require three runoff mitigation points for all agricultural uses, which will reduce atrazine concentrations in runoff. We expect these measures will reduce the concentration of atrazine entering species' habitats by up to an order of magnitude (i.e., up to a 90% reduction in atrazine residues in spray drift and runoff).

In addition to label measures, South Texas ambrosia is in a Pesticide Use Limitation Area (PULA) that requires an additional three runoff mitigation points (i.e., six points total) for all uses of sugarcane, guava, and macadamia nuts. Because the species occurs near very little guava or macadamia nuts (overlap <0.1%), of particular importance is sugarcane. We anticipate these additional runoff points will further reduce atrazine residues in runoff by another order of magnitude (i.e., up to 99% reduction in atrazine runoff residues in total).

Effects of the Action: Toxicity

Direct Effects

Based on toxicity data available for atrazine in plant species, we expect that exposure to atrazine (either on use sites or in off-site areas) will result in large impacts to growth, which, if severe enough, can result in mortality. While we anticipate atrazine use can impact the growth and survival of plant species off-field (exposure through spray drift or runoff), we expect implementation of conservation measures on agricultural product labels and existing pesticide practices in non-agricultural atrazine use sites to reduce the likelihood, magnitude, and frequency of exposure to a level such that we anticipate no more than low level effects to few individuals in these areas.

Indirect Effects

We do not expect that atrazine use will result in any indirect adverse effects to individual plants as we do not anticipate atrazine is likely to reduce the abundance and availability of seed dispersers or to disrupt pollination functions necessary to support reproduction.

Effects of the Action Summary

There is a large extent of overlap between the species' range and the action area, and pesticide usage reporting indicates that a large percentage of the species' range will be treated with atrazine on agricultural fields annually. While we do not expect South Texas ambrosia to occur on agricultural fields, herbicide exposure from adjacent row crop lands is a known threat to the species. With implementation of conservation measures on product labels and the six-point PULA for sugarcane, we expect that few individuals will be exposed to atrazine via off-site transport and will experience no more than low level of adverse effects to growth and survival.

South Texas ambrosia could occur in lawn and turf areas, but only in certain areas of the range, and if the area is limited to native grasses or a mixture of native and introduced grass. We do not expect the South Texas ambrosia to occur where turf areas are planted with manicured grasses. When individuals are exposed on treated turf, we expect large impacts to growth, which, if severe enough, can result in mortality. However, we do not expect atrazine to be a commonly used herbicide on turf, and as such, we expect atrazine usage on lawns within the range of the South Texas ambrosia, if any, will be limited. We expect off-site transport from turf use to be minimal, and as such, do not expect concentrations of atrazine to result in adverse effects to individuals exposed off-site.

Given the limited conditions in which we expect the South Texas ambrosia to occur on turf, and the limited usage of atrazine for this use, we expected few individuals, if any, are expected to be exposed on atrazine use sites. Given this low exposure and the implementation of the conservation measures on product labels, we conclude the overall risk of adverse effects to the species is low.

Species Conclusion

South Texas ambrosia is a perennial herb found across six sites in coastal Texas. It grows at low elevations, typically on well-drained, heavy soils associated with subtropical woodland communities in openings of savannas and coastal prairies. It can be found on residential lawns if native vegetation has not been replaced by planted sod. Abundance has continued to decline across the range. It is threatened by non-native plant species, urban and agricultural development, and pesticide drift.

We expect some plants exposed to off-site transport may die or experience reduced growth. Though South Texas ambrosia may occur on non-agricultural use sites, particularly lawns in Kleberg and Nueces counties that have not been planted with introduced grasses, we expect atrazine use on turf is limited. The species occurs near agricultural areas and may be exposed through off-site transport, but we expect adverse effects to a small number of individuals after incorporating conservation measures on the label and six-point PULA that will greatly limit off-site transport into this species habitat from sugarcane uses (45.2% overlap with the species' range). We do not expect reduction in function to pollination or seed dispersal from atrazine exposure, and therefore, indirect adverse effects are not likely to occur for this species.

After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the South Texas ambrosia.

References

U.S. Fish and Wildlife Service. 2022. South Texas Ambrosia (*Ambrosia cheiranthifolia*) 5-Year Review: Summary and Evaluation. Corpus Christi, Texas. 7 pp.

U.S. Fish and Wildlife Service. 2010. South Texas Ambrosia (*Ambrosia cheiranthifolia*) 5-Year Review: Summary and Evaluation. Corpus Christi, Texas. 34 pp.

Integration and Synthesis Summary: Walker's manioc

Scientific Name:	Common Name:	Entity ID:
Manihot walkerae	Walker's manioc	763

Conclusion: No Jeopardy

Species Range

Based on range map dated: 01-27-2018; Wherever found; *States within the range:* TX

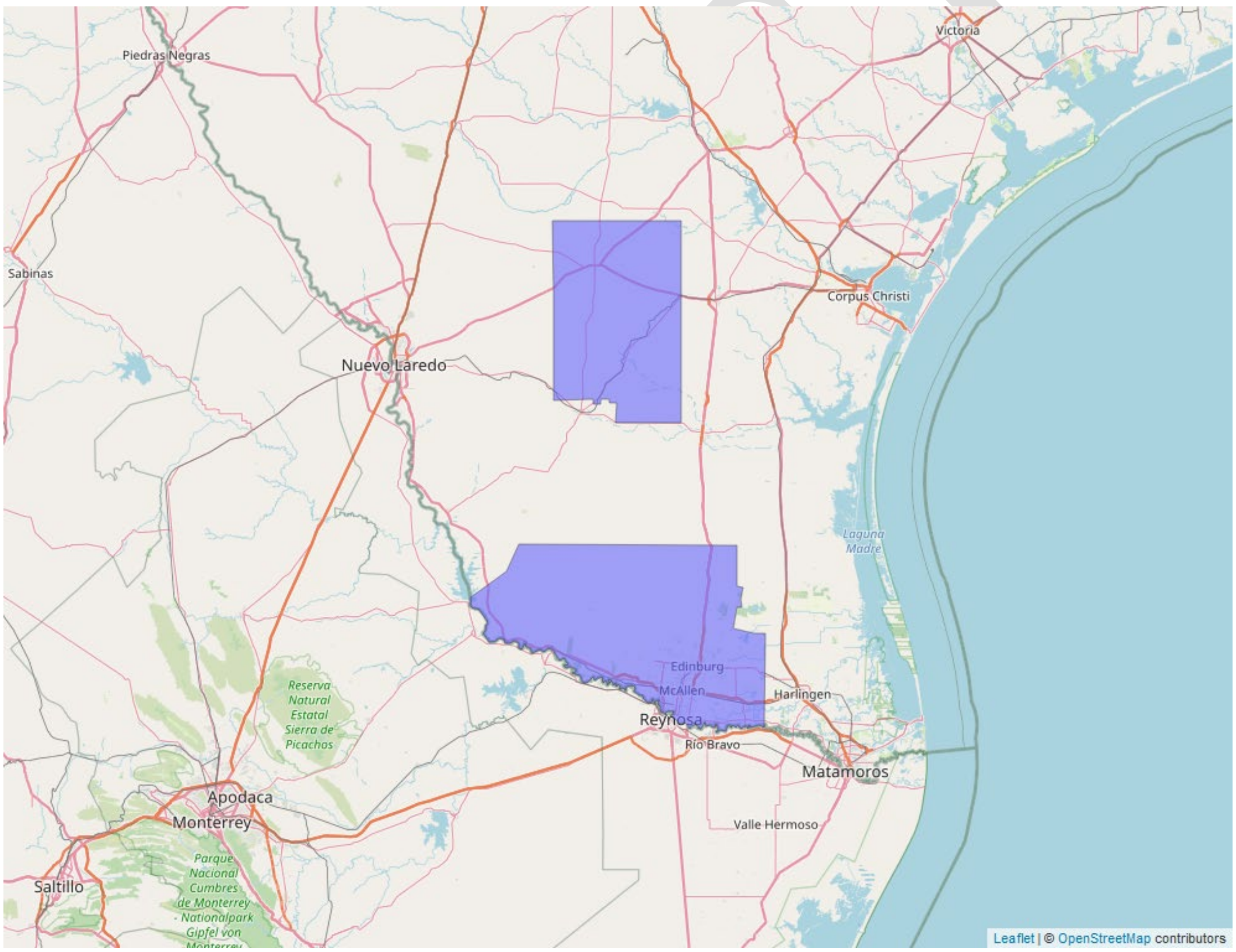

Figure 3. Range map of Walker's manioc (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/1892.

Vulnerability

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

Summary of Status

Listing status: Endangered

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

Most recently completed 5-Year Review: 6/4/2009

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

Number of populations: Multiple populations (few)

Species trends: Unknown species trends

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

Environmental Baseline/Cumulative Effects (EB/CE) Summary

Walker's manioc is a narrow endemic found in native brush and grassland habitats on shallow calcareous soils over caliche in two counties in the Lower Rio Grande Valley of Texas. There are 11 potentially extant sites in Texas, 24 potentially extant sites in Mexico, and all 35 are believed to operate as a metapopulation. Many areas between surveyed sites have appropriate habitat but have not been surveyed. Each Texas site has between one to approximately 90 individuals and many occur on private lands. Three of the largest sites are on protected areas of Lower Rio Grande Valley National Wildlife Refuge and three private landowners in Mexico have active voluntary conservation agreements (USFWS 2019). Some Walker's manioc plants have been found along roadsides and in rights of way (USFWS 2009). While Walker's manioc can self-fertilize and use tubers for vegetative reproduction, the species relies on insect pollinators to maintain genetic diversity through pollen transport between individual plants. However, the species does not appear to require a rare or specialized pollinator (USFWS 2009, 2019).

Threats include destruction and fragmentation of habitat, non-native grasses, conversion to agriculture, pesticide runoff and drift, caliche surface mining, javelina and feral hog uprooting, and development (e.g., residential, urban, and energy). Walker's manioc reemerged following herbicide application that killed the above-ground portion of the plant (USFWS 2019).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap with Agricultural Use Sites

Data indicate that 24% of the species' range overlaps with agricultural use sites and 100% of the species' range[9] overlaps with areas adjacent to use sites that are likely exposed through off-site transport (e.g., through spray drift or runoff). In total, there is up to 100% overlap[9] between the species' range and the agricultural footprint of atrazine use sites (Table 5).

Table 5. Agricultural use overlap and annual usage data (% Range Treated) for the Walker's manioc.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Corn	5.6	36.8	42.4	5.6	36.8	42.4
Vegetables and Ground Fruit (Sweet Corn)	2.6	21.9	24.5	0.3	2.4	2.7
Other Grains (Sorghum & Sugarcane)	12.1	42.4	54.4	12.1	42.4	54.4
Other Orchards (Guava & Macadamia Nut)	0.0	0.0	0.0	0.0	0.0	0.0
Other Crops (Wheat-Corn-Fallow)	0.0	0.0	0.0	0.0	0.0	0.0
Other Crops (Wheat-Sorghum-Fallow)	2.0	29.7	31.8	1.5	22.1	23.6
Other Crops (Wheat-Fallow-Wheat)	0.0	0.0	0.0	0.0	0.0	0.0

[9] Total overlap is capped at 100%.

Use Layer	Use Site Overlap (% range)	Off-Site Overlap (% range)	Total Overlap (% range)	% Range Treated On-Site	% Range Treated Off-Site	% Total Range Treated
Other Crops (Sod)	1.7	19.7	21.4	1.7	19.7	21.4
Total	**24.0**	**100[9]**	**100[9]**	**21.1**	**100[9]**	**100[9]**

Usage

Past usage data indicate that up to 100% of the species' range[9] has been treated with or exposed to atrazine annually from agricultural uses with 21.1% occurring on agricultural fields and up to 100% resulting from off-field transport[9].

Additional Exposure Considerations

Walker's manioc was found in a maize field in the Loreto Sand Plain in Tamaulipas, Mexico, in 1994 (Austin Field Office, 2016, pers. comm.). The land cover at this site was originally shrub savanna. It was plowed in the late 1980s, but no herbicides were ever used. The manioc plants were emerging from chopped up pieces of tubers. Based on this scenario, it is possible that manioc could be present in some farmland in southern Texas, however, there are no records of populations growing in cropland in Texas.

Exposure from Non-Agricultural Uses

Walker's manioc is not known to occur on non-agricultural atrazine use sites, and we expect off-site transport resulting from spray drift and runoff from these uses to be minimal.

Conservation Measures

There are several conservation measures on the atrazine label that apply to all agricultural uses and are intended to reduce spray drift to off-site areas, including a 15-foot spray drift buffer for ground applications and a 170-foot spray drift buffer for aerial applications. Additionally, product labels require three runoff mitigation points for all agricultural uses, which will reduce atrazine concentrations in runoff. We expect these measures will reduce the concentration of atrazine entering species' habitats by up to an order of magnitude (i.e., up to a 90% reduction in atrazine residues in spray drift and runoff).

In addition to label measures, Walker's manioc is in a Pesticide Use Limitation Area (PULA) that requires an additional three runoff mitigation points (i.e., six points total) for all uses of sugarcane, guava, and macadamia nuts. Because the species does not occur near guava or macadamia nuts (overlap 0%), of particular importance is sugarcane. We anticipate these additional runoff points will further reduce atrazine residues in runoff by another order of magnitude (i.e., up to 99% reduction in atrazine runoff residues in total).

Effects of the Action: Toxicity

Direct Effects

Based on toxicity data available for atrazine in plant species, we expect that exposure to atrazine (either on use sites or in off-site areas) will result in large impacts to growth, which, if severe enough, can result in mortality. While we anticipate atrazine use can impact the growth and survival of plant species off-field (exposure through spray drift or runoff), we expect implementation of conservation measures on agricultural product labels and existing pesticide practices in non-agricultural atrazine use sites to reduce the likelihood, magnitude, and frequency of exposure to a level such that we anticipate no more than low level effects to few individuals in these areas.

Indirect Effects

We do not expect that atrazine use will result in any indirect adverse effects to individual plants as we do not anticipate atrazine is likely to reduce the abundance and availability of insect pollinator necessary to support reproduction.

Effects of the Action Summary

There is a large extent of overlap between the species' range and the action area, and pesticide usage reporting indicates that a large percentage of the species' range will be treated with atrazine on agricultural fields annually. We expect atrazine concentrations to result in high levels of adverse effects to plants on pesticide use sites. While 100% of the range overlaps with agricultural use sites of atrazine, we expect atrazine applications to occur on-field in just 24% of the species' range. This overlap and usage is largely attributable to corn, for which there is at least one known occurrence of Walker's manioc growing on-field. When exposed on atrazine use sites, we expect atrazine to result in large impacts to growth, which can lead to mortality. However, given that there are no records of populations growing in cropland in Texas, we expect that few individuals, if any, will experience adverse effects from on-field exposure.

With implementation of conservation measures on product labels and a six-point PULA for sugarcane uses, we expect that few individuals of Walker's manioc will be exposed to atrazine via off-site transport and will experience no more than low level of adverse effects to growth and survival.

As such, we conclude the overall risk of adverse effects to the species is low.

Species Conclusion

Walker's manioc is a narrow endemic found in native brush and grassland habitats on shallow calcareous soils over caliche in coastal Texas. A few of the largest populations occur on a National Wildlife Refuge. While most Walker's manioc individuals occur in native shrublands, one individual was found on an agricultural site in Mexico in 1994. There are no known records of Walker's manioc occurring on agricultural lands in Texas or since 1994 in Mexico. Threats to the species include habitat loss, non-native grasses, pesticide runoff and drift, surface mining, and swine uprooting.

We expect Walker's manioc occurrence on agricultural fields is uncommon because the species has never been documented on a crop field in Texas and the observation in Mexico was a plant growing from cut up tubers on the field. We do not expect the species to occur on non-agricultural use sites. In addition, the largest populations of Walker's manioc are on a National Wildlife Refuge where atrazine has not been used in the past 10+ years. Therefore, our primary concern for atrazine exposure is through off-site transport from agricultural fields. Even though we expect some plants exposed to off-site transport may die or experience reduced growth, we expect adverse effects to a small number of individuals after incorporating conservation measures on the label and six-point PULA that will greatly limit off-site transport into this species habitat from sugarcane uses (42.4% overlap with the species' range). We do not expect reductions in insect pollinators and seed dispersers of the Walker's, and therefore, indirect adverse effects are not likely to occur for these species.

After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Walker's manioc.

References

U.S. Fish and Wildlife Service. 2019. Recovery Plan Amendments for Nine Southwest Species. Albuquerque, New Mexico. 14 pp.

U.S. Fish and Wildlife Service. 2009. Walker's Manioc (*Manihot walkerae*) 5-Year Review: Summary and Evaluation. Corpus Christi, Texas. 30 pp.