Integration and Synthesis Summary for Plants, Non-lower 48

Monocot and dicot flowering plants that require outcrossing with biotic pollination vectors

Assessment Groups 5 & 9

This Integration and Synthesis Summary includes our jeopardy analysis for any species that we or EPA determined will "likely be adversely affected" by the proposed action. Our jeopardy analysis of the proposed action's impacts to listed species is split into three major factors: vulnerability, exposure, and toxicity. The tables below contain summaries of our rankings (high, medium, low) for vulnerability, exposure, and toxicity. Data and information used to determine individual species' rankings and a template worksheet to show how rankings were assessed and combined are in Appendix E. All plants in this Appendix (plant assessment groups 5 & 9) require outcrossing (i.e., pollen transfer between individuals) facilitated by biotic vectors, such as bees or birds, in order to reproduce successfully and maintain their populations over time. All species in this assessment group are found outside the conterminous United States, including the State of Hawai'i and Pacific and Caribbean Island U.S. Territories.

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 summarize the vulnerability of that species to additional stressors. This effort allows us to consider whether a species' current condition is moving toward recovery or further decline. In general, we expect the species' vulnerability to additional stressors to be higher if they are moving toward further decline than if they their condition is improving. We also identify which species are most (and least) susceptible to additional stressors in general based on information that could be surmised from species listing and recovery documents, or other sources as cited and considered in the *Status* section of this biological opinion.

Our assessment of vulnerability focuses on seven factors: (1) the species listing status and recent 5-year status review recommendation (if available), (2) distribution, (3) number of populations, (4) species population trends, (5) if pesticides have been noted as a threat, (6) if pollinator loss has been noted as a threat, and (7) 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, 5-year species status reviews, species recovery plans, species status assessments, and other sources containing the best available scientific information for the species.

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

Exposure

We anticipate plants and their pollinators will primarily be exposed to methomyl through direct contact, either as the result of exposure to pesticide applications on-field or through spray drift off-field. Methomyl degrades quickly in the environment (i.e., within a few days) and as such is not likely to persist on surfaces or in the air for prolonged periods of time.

We characterize the expected level of exposure using overlap data, past methomyl usage data, and any species-specific considerations such as life history information (e.g., habitat preferences, pollinator preferences) and existing protections or conservation actions. Species with greater than 10% overlap between their range and methomyl use sites are assigned a high overlap score, species with 5-10% overlap are assigned a medium overlap score, and species with less than 5% total overlap are assigned a low overlap score.

We determine the overall exposure ranking by qualitatively combining total overlap with any additional exposure considerations that might modify the level of exposure likely to occur. In the absence of any relevant exposure modifiers, the overall exposure ranking is the same as the overlap score (e.g., high overlap score with no exposure modifiers results in a high overall exposure ranking). In situations where we are aware of additional factors that influence the level of exposure likely to occur, we adjust the overall exposure ranking as appropriate (e.g., a species that only occurs in remote areas away from use sites can have a medium or low exposure ranking despite having a high overlap score or a species known to grow near agricultural areas can have a high exposure ranking despite having a low overlap score). Past methomyl usage data on Pacific or Caribbean islands is unavailable. However, prior reporting data indicate that annual treatment with insecticides occurs on 8-45% of agricultural crops per island on Hawai'i and 20-70% of crops per municipality in Puerto Rico. We use these data broadly as confirmation that insecticide usage occurs on these islands, with methomyl presumably among these insecticides. Where appropriate (e.g., species with more spatially refined range maps), we use these data as an additional exposure modifier to estimate the extent that a species' range is likely to be treated with insecticides, which we consider an upper bound for methomyl usage.

Toxicity

We characterize the expected toxic effect to species based on the anticipated level of direct and indirect[1] adverse effects to individuals. Our analysis of toxicity assumes individuals are exposed to methomyl at levels estimated by EPA's environmental exposure modeling and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Direct effects are based on the anticipated level of mortality and sublethal effects (e.g., reduced growth) likely to occur in exposed individuals. Indirect effects are based on the impact a listed species is likely to experience when the organisms they rely on, such as those that act as pollinators or seeds dispersers, are exposed to methomyl and experience adverse effects.

Available toxicity data indicate that plants will not experience any direct adverse effects to survival, growth, or reproduction with exposure to methomyl. In contrast, available toxicity data indicate that insects, including those that act as pollinators and seed dispersers for listed plants, are sensitive to methomyl at estimated environmental concentrations and are likely to die from exposure on both application sites and adjacent areas exposed via drift. However, we expect insect species to exhibit a range of sensitivities to methomyl and do not anticipate the entire insect pollinator community will die. Plants that rely on a select few species of pollinators or seed dispersers (i.e., specialists) are likely to experience high levels of indirect effect as high mortality in a few insect pollinator species can significantly reduce pollination and seed dispersal. In contrast, generalist plants that can use a wide range of insect species are likely able to recover more quickly from temporary losses of some insect species, resulting in lower levels of indirect effects from the proposed action.

Bird and mammal pollinators/seed dispersers are generally less sensitive to methomyl exposure than insects. While methomyl exposure in birds and mammals can cause mortality under specific circumstances (e.g., by consuming exclusively contaminated food items on or adjacent to methomyl use sites) we do not expect methomyl use is likely to appreciably diminish the availability of bird or mammal pollinators or seed dispersers. For species where the relationship with pollinators and seed dispersers is unknown, we make the conservative assumption that the species has a specialist-type relationship exclusively with insect pollinators and seed dispersers.

We evaluate indirect effects by assessing (1) how critical biotic outcrossing is to the species, (2) the type of pollination vector required, (3) the type of seed dispersal vector required, and (4) how strict the pollinator and seed disperser requirement is for the species (e.g., can the species use a wide range of insect species or is the species a pollinator obligate or specialist?). Species that

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

score the same on all toxicity factors are given the same overall toxicity ranking (e.g., species scores high on all factors has a high overall toxicity ranking). Species that only have medium or low scores are given a low overall toxicity ranking. Species that have a mix of high and low scores are given a medium overall toxicity ranking, and species with a mix of high and medium scores are given a high overall toxicity ranking.

Summary of Conclusions for Plants in Assessment Groups 5&9, NL48

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of methomyl, and the cumulative effects, it is the Service's biological opinion that the registration of methomyl, as proposed, is not likely to jeopardize the continued existence of the 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 groups and incorporated into the rationales as appropriate. Species-specific information (e.g., environmental baseline, cumulative effects, status of the species, exposure, and toxicity) was considered for all species, including those species in the grouped analyses, and are presented in full in Appendices B and E. Species with rationales that did not fit in a group, or warranted a separate rationale because of their life history, conservation status, or other information indicated that effects could be different, have an individual discussion to provide additional explanation. This approach allowed us to streamline our discussion in this Opinion by avoiding repeating our findings when species in the respective groupings would be expected to be affected similarly. The use of these groupings, therefore, does not mean that our evaluation failed to evaluate each individual species. On the contrary, our process and analysis for each species remained the same, regardless of the format of the discussion presented below.

Species with low exposure (informed by low overlap with agriculture), medium vulnerability, and medium toxicity

We group species together that have low or medium vulnerability, and low overlap with agricultural sites where methomyl is registered for use. For NL48 plant assessment groups 5&9, only the beautiful goetzea meets the criteria for this group (Table 1). While we present some specific information about the species in Table 1 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 1. Plant species in groups 5 and 9 (i.e., outcrossers with biotic pollination vectors) with medium vulnerability, medium toxicity, and low concern of adverse effects due to low exposure as informed by low overlap between the species' range and agricultural land uses where methomyl is registered for use.

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	Total Action Area Overlap (%)	Determination
Goetzea elegans	Beautiful goetzea	Medium	Low	Medium	2.08	No Jeopardy

Conclusion:

The beautiful goetzea is a small evergreen tree in the nightshade family endemic to the island of Puerto Rico. The species was determined to have a medium vulnerability ranking because while its distribution is limited to the north coastal plain of Puerto Rico, none of the known populations have been lost since listing in 1985, and additional populations have been discovered in four municipalities (USFWS 2019).

Overlap of methomyl use areas with the species' range indicates a low extent of exposure, as there is 2.1% overlap between the action area and its range. Toxicity is expected to be medium, primarily due to the species' ability to use both insects and birds (mainly bananaquits, *Coereba flaveola*) for outcrossing and successful reproduction. In addition, the beautiful goetzea likely uses birds and mammals as seed dispersers, thus reducing the effects of methomyl exposure on seed dispersal for this species.

While toxicity is medium for the beautiful goetzea, given that exposure is anticipated to be low, the risk of indirect adverse reproductive effects to the species from loss of pollinators is low. Furthermore, because the species has a medium vulnerability, it is more likely to be able to withstand additional stressors in the environment, including temporary declines in the pollinator community in a very small portion of its range from methomyl exposure.

As a result, while we anticipate minimal adverse effects to the beautiful goetzea due to the loss of insect pollinators and resultant loss of reproductive success from methomyl exposure, we do not expect that these adverse effects will cause species-level effects due to low. This is due to the expected exposure of pollinators to methomyl, the plant species' ability to withstand temporary declines in pollinators in a very small portion of its range, and the species' reliance on a variety of pollinator species for successful reproduction, including birds which are less likely than insects to experience adverse effects from exposure. 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 beautiful goetza.

References:

U.S. Fish and Wildlife Service. 2019. *Goetzea elegans* (Matabuey or beautiful goetzea) 5-Year Review: Summary and Evaluation. Boquerón, Puerto Rico. 34 pp.

Species with low exposure (informed by low overlap with agriculture), high vulnerability, and medium or high toxicity

The species in Table 2, below are grouped together as they all have high vulnerability, medium or high toxicity, and low exposure informed by low overlap with agricultural sites where methomyl is registered for use. While we present some specific information about the species in Table 2 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 2. Plant species in groups 5 and 9 (i.e., outcrossers with biotic pollination vectors) with high vulnerability, medium or high toxicity, and low concern of adverse effects due to low exposure as informed by low overlap between the species' range and agricultural land uses where methomyl is registered for use.

Scientific Name	Common Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	Total Action Area Overlap (%)	Determination
Agave eggersiana	No common name	High	Low	Medium	0	No Jeopardy
Chamaecrista glandulosa var. *mirabilis*	No common name	High	Low	Medium	0	No Jeopardy
Crescentia portoricensis	Higuero de sierra	High	Low	Medium	2.2	No Jeopardy
Euphorbia haeleeleana	`Akoko	High	Low	High	0.25	No Jeopardy
Gesneria pauciflora	No common name	High	Low	Medium	2.2	No Jeopardy
Kadua haupuensis	No common name	High	Low	Medium	0.02	No Jeopardy
Kokia cookei	Cooke's kokio	High	Low	Medium	2.42	No Jeopardy
Lyonia truncata var. *proctorii*	No common name	High	Low	Medium	0	No Jeopardy
Nervilia jacksoniae	No common name	High	Low	Medium	2.56	No Jeopardy
Ochrosia haleakalae	Holei	High	Low	Medium	4.23	No Jeopardy

C-B5. NL48 Flowering Plants: Outcrossers with Biotic Pollinations vectors (Groups 5&9)

In our review of the current status of the species, and the environmental baseline and cumulative effects for the action area, the Service determined that the vulnerability rankings of the species in Table 2 are high. Our evaluation of the effects of the proposed action on these species indicates a low extent of exposure due to the low overlap of the action area with the range of these species. Toxicity is expected to be medium or high for the plant species in this group, mainly due to their reliance on insect pollinators for outcrossing and successful reproduction. However, many of the plants in Table 2 use abiotic vectors for some or all seed dispersal and most can use a variety of insect species for pollination and seed dispersal (i.e., pollinator generalists). As such, they are likely to recover more quickly from temporary losses of pollinators in a small portion of their range. Several species in this group, such as *Gesneria pauciflora* and *Agave eggersiana* use birds for pollination, thus decreasing the likelihood of adverse effects to their reproduction as birds are less sensitive than insects to methomyl exposure as explained in the Effects of the Action section above.

While all species listed in Table 2 have high vulnerability rankings and toxicity is high or medium, given that exposure is anticipated to be low (as demonstrated by the low percent overlap between the action area and species' ranges), the risk of indirect adverse reproductive effects to the listed plants from loss of pollinators and/or seed dispersers is low. Furthermore, the total overlap metric we use is a conservative estimate of exposure as it does not fully account for redundancy between use site layers, assumes exposure is occurring in all possible overlapping areas, and does not consider information on past methomyl usage. Thus, while these species' vulnerability and toxicity rankings may be high, we have high confidence that the pollinators and seed dispersers of these plant species will have minimal exposure to methomyl.

As a result, while we anticipate minimal adverse effects due to the loss of insect pollinators and seed dispersers and resultant loss of reproductive success from methomyl exposure, we do not expect that these adverse effects will cause species-level effects due to low expected exposure to methomyl, reliance on a variety of pollinator species for successful reproduction, and use of abiotic vectors for some or all seed dispersal. After adding the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, we have determined the proposed action is not expected to appreciably reduce survival and recovery of these species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the species in Table 2.

Species with Individual Integration and Synthesis summaries

For the species in Table 3, our preliminary vulnerability, exposure, and toxicity rankings indicated that the proposed action may result in moderate to high adverse effects. As such, we discuss each species in more detail in individual Rationales for Conclusion below. In some cases, we modified initial exposure and toxicity rankings due to additional information regarding exposure and effects for individual species, as described below.

Table 3. Plant species in groups 5 and 9 (i.e., outcrossers with biotic pollination vectors) with moderate to high adverse effects anticipated from the proposed action. We addressed each species in individual Integration and Synthesis summaries.

Scientific Name	Common Name	Determination
Brighamia insignis	Olulu	No Jeopardy
Chamaesyce skottsbergii var. *skottsbergii*	Ewa Plains `akoko	No Jeopardy
Flueggea neowawraea	Mehamehame	No Jeopardy
Gardenia brighamii	Hawaiian gardenia	No Jeopardy
Nothocestrum latifolium	`Aiea	No Jeopardy

Rationale for Species Conclusion: Olulu

Scientific Name:	Common Name:	Entity ID:
Brighamia insignis	Olulu	649

Conclusion:

The olulu is a short-lived perennial shrub endemic to the island of Kaua‘i and possibly Niihau. As of the 2022 5-year Review, there were no known wild individuals, though surveys are ongoing in suitable habitat. Seed collections represent at least three founders from the Ho’olulu area and reintroduction of 16 individuals occurred in 2018 in the Limahuli area of the National Tropical Botanic Garden on Kaua‘i.

All the plant species in this appendix, including the olulu, require outcrossing to reproduce successfully. A recent study indicates that the olulu likely depends on native moths (possibly Sphingidae) for successful pollination, but only non-native insects were observed visiting the species and are not likely to be effective pollinators. The native moths responsible for pollination of this species may now be extinct or in extremely low numbers. Thus, the olulu likely has a pre-existing pollinator deficit, and it will be difficult for it to recover in the wild without sufficient outcrossing via native pollinators (USFWS 2008, USFWS 2022).

Seed dispersal is likely by gravity given the seeds are ovoid to ellipsoid, smooth, and lacking any sort of wing or outgrowth (USFWS 1995). As such, adverse effects to reproduction from loss of seed dispersers are not anticipated.

The species is a narrow endemic whose reproductive success is dependent upon the presence of specific moth pollinators for reproduction. These moths may already be extinct in the wild or in very low numbers. The exposure ranking indicates a substantial loss of pollinators within the species' range is likely to occur. However, as of 2022, there were no extant individual plants found in the wild and recently reintroduced individuals in the National Tropical Botanic Gardens are hand-pollinated by staff and any remaining native pollinators are unlikely to experience methomyl exposure due to protection at the Gardens. Thus, a reduction in pollinator abundance in this species' range is not likely to have adverse effects to the species at this time. While there are thousands of seeds in storage, and a number of propagated plants and plans for reintroduction into remaining suitable habitat when that becomes feasible, the 2022 5-year review indicates the first priority for recovering this species is to prevent its extinction. Goals for preventing the olulu's extinction are continuing to survey for populations in areas of suitable habitat (taking climate change into account); controlling and monitoring for feral ungulates, the main threat to the species; and to continue captive propagation for genetic storage and eventual reintroduction.

We determined that the olulu has 10.2% overlap between the action area and its range. However, it is unlikely that the olulu will be reintroduced into locations in its historic range where methomyl applications are likely to occur, and it is unclear whether additional reintroduction of individuals will occur within the duration of this consultation (15 years) as the initial goals for extinction prevention must be met first (ungulate control, identification and protection of suitable habitat more resistant to climate change, continued captive propagation). Furthermore, prior reporting data indicate that annual treatment with all insecticides on the island of Kauaʻi occurs on up to 7.7% of crops. As this percentage reflects usage of all insecticides, and not just methomyl, we consider it an upper bound for methomyl usage. Using the 7.7% figure, we determine that 0.78% of the range is likely to be treated with methomyl. As such, we anticipate that exposure to methomyl from the proposed action will be low.

For these reasons, we do not anticipate adverse, species-level effects to the olulu from the loss of reproductive success from pollinator mortality due to methomyl exposure that will be expected to occur over the duration of the action. 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 olulu.

References:

U.S. Fish and Wildlife Service. 2022. *Brighamia insignis* (olulu) 5-Year Review: Short Form Summary. Honolulu, Hawaiʻi. 8 pp.

U.S. Fish and Wildlife Service. 2008. *Brighamia insignis* (olulu) 5-Year Review: Summary and Evaluation. Honolulu, Hawai'i. 13 pp.

U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Kaua'i Plant Cluster. Honolulu, Hawai'i. 287 pp.

Rationale for Species Conclusion: Ewa Plains `akoko

Scientific Name:	Common Name:	Entity ID:
Chamaesyce skottsbergii var. skottsbergii	Ewa Plains `akoko	665

Conclusion:

The Ewa plains `akoko is a perennial shrub endemic to the Ewa plains area on the island of O'ahu, a broad plain of low relief consisting largely of a reef formed during the Pleistocene when sea level was higher than at present. Numerous historic populations have been extirpated. Currently, wild plants remain at the U.S. Navy Base Realignment and Closure area at Barbers Point and the Department of Hawaiian Homelands land proposed for development of a solar power project. In total there are fewer than 200 wild individuals remaining, but the Service is working to create a stable reintroduced population within the Pear Harbor National Wildlife Refuge, and almost 1,000 individuals have been outplanted at this site since 2016, with 233 currently surviving. In addition, the Service is working with the Navy to protect the existing plants on its property and augment and maintain the population (USFWS 2019). Furthermore, prior reporting data indicate that annual treatment with all insecticides on the island of O'ahu occurs on up to 45% of crops. As this percentage reflects usage of all insecticides, and not just methomyl, we consider it an upper bound for methomyl usage. Using the 45% figure, we determine that 5.3% of the range is likely to be treated with methomyl. As such, we anticipate methomyl exposure for this species will be low despite the 11.7% overlap between the action area and its range.

All the plant species in this appendix, including the Ewa plains `akoko, require outcrossing to reproduce successfully. While the species requires insect pollinators for successful reproduction, the insect pollinators are non-native 'generalists' and are widespread and non-host specific. This decreases our concern that the level of methomyl exposure expected within the range of the species will result in appreciable adverse effects to the species since the insect species it relies on for successful reproduction are varied and abundant (USFWS 1993). Seeds of the species are dispersed by explosive discharge from their capsules; thus, we do not expect adverse effects to reproduction from loss of seed dispersers.

Because of the species' ability to rely on a variety of abundant pollinators and abiotic methods for seed dispersal, and that most individuals occur in protected areas where methomyl exposure is unlikely (on the NWR or on BRAC where protections are underway) we do not anticipate adverse, species-level effects from the loss of reproductive success from pollinator mortality due to methomyl exposure that will be expected to occur over the duration of the action. 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 Ewa plains akoko.

References:

U.S. Fish and Wildlife Service. 1993. Draft Recovery Plan for *Chamaesyce skottsbergii var. skottsbergii* and *Achyranthes spendens var. rotundata*. Portland, Oregon. 87 pp.

U.S. Fish and Wildlife Service. 2019. *Euphorbia skottsbergii var. skottsbergii* (ʻakolo) 5-Year Review: Short Form Summary. Honolulu, Hawaiʻi. 11 pp.

Rationale for Species Conclusion: Mehamehame

Scientific Name:	Common Name:	Entity ID:
Flueggea neowawraea	Mehamehame	1117

Preliminary Conclusion:

This long-lived, large perennial tree occurs on the islands of Kauaʻi, Oʻahu, Maui, and Hawaiʻi. Overall, the number of wild individuals has increased from approximately 76 in the last 5-Year Review in 2013 to 91 currently remaining, due to additional surveys that discovered new individuals on Kauaʻi and Hawaiʻi. In addition, there are currently 152 outplanted individuals. Threats to the species include non-native ungulates and invasive non-native plants, black twig borer infestation, seed predation by rats, and climate change. Some plants are provided protection from ungulates by fencing and there is some rodent and non-native plant control. Seed collections, propagation, and outplanting are ongoing (USFWS 2021).

This species is diecious, meaning it has separate male and female trees, and thus needs a vector to transport pollen from male to female trees in order to reproduce. Both male and female flowers lack petals, which suggests wind pollination, though no studies have been completed and biotic vectors, including insects, cannot be ruled out. Few trees have been observed in flower or fruit; individual trees are usually isolated and far from trees of the opposite gender, and most are unhealthy due to black twig borer damage.

The need for cross-pollination constrains this species' recovery, given its low numbers, isolation of mature trees, and separation of male and female trees. Reductions in population size and reproduction could result in expression of inbreeding depression among any progeny that result, including reduced reproductive vigor (USFWS 2009).

All the plant species in this appendix, including the mehamehame, require outcrossing to reproduce successfully. The pollination vectors for this species are unknown but could include insects (USFWS 2021). Given this is the best available information, we assume the species depends on insects for successful pollination. Seed dispersal vectors are also unknown, though given the seeds' fleshy nature, birds and/or mammals may consume them and help in dispersal. Thus, we don't anticipate substantial effects to seed dispersers based on low potential effects to these disperser taxa as discussed in the Effects of the Action section above.

While the overlap of the species' range with methomyl use sites is high at 13.4%, prior reporting data indicate that annual treatment with all insecticides across the main islands in the State of Hawai'i occurs on up to 45% of crops. As this percentage reflects usage of all insecticides, and not just methomyl, we consider it an upper bound for methomyl usage. Using the 45% figure, we determine that 6.0% of the range is likely to be treated with methomyl, leading us to conclude there will be a moderate extent of exposure to the pollinators of this species. Furthermore, it is likely that pollinators of this species may be attracted on field while certain methomyl crops are blooming. Given the high vulnerability of this species, and its pre-existing reproductive deficits, pollinator loss from on field exposure is likely to meaningfully add to the overall exposure for the pollinators of the species. Even a moderate decrease in the insect pollinator community in the range of this species is likely to exacerbate its pre-existing reproductive decline (low population numbers, isolation of mature trees, separation of male and female trees, and potential inbreeding depression).

Because the species likely relies on insects for successful reproduction, and has a pre-existing reproductive decline within small, isolated populations that further decrease the reproductive abilities of the species, we anticipate adverse, species-level effects from the loss of reproductive success from pollinator mortality due to methomyl exposure in a moderate portion of the range that will be expected to occur over the duration of the action.

Final Conclusion (with Species-Specific Conservation Measures):

Because of the effects described in our preliminary conclusion above (Preliminary Conclusion), EPA and the applicant agreed to incorporate the following measures as part of the action. Within the Pesticide Use Limitation Area (PULA) for the mehamehame:

1. *Methomyl must be applied using the following buffers: 320 feet for aerial applications, 105 feet for ground applications, and 160 feet for airblast applications. Based on AgDRIFT modeling, the buffers will reduce spray drift from entering habitat for the mehamehame and its pollinators by >95% for terrestrial habitat. These buffer distances may be reduced using other measures identified as equivalent mitigations (i.e., reducing spray drift by similar magnitude) as specified in EPA's Draft Insecticide Strategy and as described in Appendix A-1 of this Opinion.*
2. *Methomyl will not be applied from two hours after sunrise until two hours before sunset on cucurbits, eggplants, and citrus. This measure will minimize on-field exposure to pollinators of the species during their most active foraging period. In addition, methomyl will not be applied within three days prior to bloom, during bloom, and until petal fall is complete on lima and dry beans in order to minimize exposure to pollinators attracted on field during bloom of these crops.*

The PULA for the mehamehame will be developed as described in the Description of the Proposed Action section of the main Opinion and Appendix A-1. EPA is currently considering public comments received on the Draft Insecticide Strategy. If additional mitigation options become available during finalization of the Insecticide Strategy or in the future, this might warrant re-initiation to incorporate those measures into the action (i.e., additional options and mitigations for end users). In that case, EPA will provide documentation that these measures provide equivalent conservation for listed species, including reduction in off-site transport. Upon confirmation by the Service, those options will be added to the acceptable mitigations listed for end users of methomyl.

After incorporation of the specific conservation measures above, we expect exposure for the pollinators of the mehamehame to be low. Upon review of the current status of the listed species, environmental baseline for the action area, effects of the proposed action, cumulative effects, and species-specific conservation measures, it is our biological opinion that the registration of methomyl, as proposed, is not likely to jeopardize the continued existence of the mehamehame.

References:

U.S. Fish and Wildlife Service. 2021. *Flueggea neowawraea* (mehamehame) 5-Year Review: Short Form Summary. Honolulu, Hawaiʻi. 10 pp.

U.S. Fish and Wildlife Service. 2009. *Flueggea neowawraea* (mehamehame) 5-Year Review: Short Form Summary. Honolulu, Hawaiʻi. 8 pp.

Rationale for Species Conclusion: Hawaiian gardenia

Scientific Name:	Common Name:	Entity ID:
Gardenia brighamii	Hawaiian gardenia	715

Conclusion:

Gardenia brighamii is a small, long-lived perennial tree in the coffee family (Rubiaceae), historically endemic to the islands of Oʻahu, Molokaʻi, Lānaʻi, and Hawaiʻi. Currently, wild individuals are only extant on Oʻahu (one individual) and Lānaʻi (nine individuals), and total numbers continue to decrease.

Seeds and propagules are in storage representing three founders from Oʻahu, more than eight founders from Lānaʻi, and one founder from Molokaʻi. Propagation is ongoing and more than 200 individuals were outplanted on Oʻahu, one outplanted on Molokaʻi, three outplanted on east Maui, and 244 outplanted on Lānaʻi (155 persist). Living collections have been established, however, no recruitment has been reported. Three subpopulations are within exclosures on Lānaʻi to protect trees from damage from feral animals and rats (USFWS 2021).

The original pollen vector is not known, but flower type suggests an insect. A serphid fly was collected on open flowers in 1991 by Heidi Bornhorst of The Nature Conservancy and identified as *Allograpta exotica*, a common species, by Neil Evenhuis of Bishop Museum. *Gardenia brighamii* is apparently self-compatible and seedlings resulting from self-pollination have shown high survivability. The original dispersal agent is not known but was most likely a bird (USFWS 1993).

While the overlap of the species' range with methomyl use sites is medium at 6.4%, prior reporting data indicate that annual treatment with all insecticides across the main islands in the State of Hawaiʻi occurs on up to 45% of crops. As this percentage reflects usage of all insecticides, and not just methomyl, we consider it an upper bound for methomyl usage. Using the 45% figure, we determine that 2.8% of the range is likely to be treated with methomyl, leading us to conclude there will be a low extent of exposure to the pollinators of this species. Hawaiian gardenia appears to require insects for successful reproduction but has also shown to produce viable seedlings by self-pollination, thus reducing its reliance on insects for reproduction and further decreasing our concern that the low level of methomyl exposure expected within the range of the species will result in appreciable adverse effects to the species. Seeds of the species are likely dispersed by birds; thus, we expect minimal adverse effects to reproduction from loss of seed dispersers as discussed in the Effects of the Action section above.

Because of the low exposure to methomyl and the species' ability to rely on self-pollination in addition to a common insect for pollination and birds for seed dispersal, we do not anticipate adverse, species-level effects to the Hawaiian gardenia from the loss of reproductive success from pollinator mortality due to methomyl exposure that will be expected to occur over the duration of the action. 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 Hawaiian gardenia.

References:

U.S. Fish and Wildlife Service. 2021. *Gardenia brighamii* (Hawaiian gardenia) 5-Year Review: Short Form Summary. Honolulu, Hawaiʻi. 11 pp.

U.S. Fish and Wildlife Service. 1993. Recovery Plan for the Hawaiian gardenia, *Gardenia brighamii.* Portland, Oregon. 76 pp.

Rationale for Species Conclusion: `Aiea

Scientific Name:	Common Name:	Entity ID:
Nothocestrum latifolium	`Aiea	1760

Conclusion:

Nothocestrum latifolium is a long-lived perennial tree, and a member of the nightshade family (Solanaceae). The species occurs in mesic and dry forests, mesic and dry shrublands and grasslands, and in developed areas where habitat conversion has occurred. There are approximately 132-133 wild individuals of *Nothocestrum latifolium* on the island of Maui and 6 on Molokaʻi in 7 populations across both islands. Historically, the species also occurred on Kauaʻi, Oʻahu, and Lānaʻi. Propagation and translocation efforts are ongoing. Approximately 1,500 individuals have been outplanted in protected locations and of those, 1,050 survived.

Nothocestrum latifolium has greenish-yellow, perfect flowers, which mean plants contain bisexual flowers that produce both male and female reproductive organs. The flowers of the species are believed to be insect and/or bird pollinated. Flower morphology and pollinator types for the family Solanaceae and the genus *Nothocestrum* suggest moths and birds as potential pollinators based on pollination syndrome (characteristics of the flower that are likely preferred by a certain pollinator taxon). Based on the identified pollination information, it is not known if the native and endangered Blackburn's sphinx moth (*Manduca blackburni*) serves a pollinator afor *N. latifolium*. However, *N. latifolium* and other species of *Nothocestrum* are host plants for Blackburn's sphinx moth (USFWS 2021).

Pollinator and disperser deficiency is a threat to *Nothocestrum latifolium*. The loss of native insect pollinators (moth or butterfly) through habitat loss or predation by non-native insects has likely resulted in decreased pollination for *N. latifolium*. Because only small populations exist, the loss of pollinators and dispersers reduces this species' reproductive vigor, fruit and seed production, and establishment success. With the disappearance of insect, bird, or other pollinators, this species likely has reduced potential for outcrossing and possibly increased potential for inbreeding depression (USFWS 2022).

Fruits of *N. latifolium* are fleshy, yellow-orange berries that are attractive to birds, and are likely dispersed by them. In 2012, possible seed dispersal via birds was documented in the Auwahi Forest Restoration Project site. As such, we anticipate minimal adverse effects to reproduction of this species from loss of bird seed dispersers, as discussed in the Effects of the Action Section, above (USFWS 2021).

We determined that *N. latifolium* has 5.5% overlap between the action area and its range. However, prior reporting data indicate that annual treatment with all insecticides across the islands of the State of Hawaiʻi occurs on up to 45% of crops, depending on the island. This data also indicates that annual treatments for the island of Maui, where most individuals of this species exist, occurs on up to 15% of crops. As these percentages reflect usage of all insecticides, and not just methomyl, we consider them an upper bound for methomyl usage. Given that most individuals currently occur on Maui, but in order for the species to recover, establishment of populations must occur on other islands (including Oʻahu), we assume the actual percent treatment where the species occurs or will occur is somewhere between 15-45%. Thus, we will use 30% as an upper bound to determine that 1.65% of the range is likely to be treated with methomyl, leading us to conclude there will be a low extent of exposure to the pollinators and seed dispersers of this species.

Even though this species has a pre-existing reproductive deficit, we do not anticipate adverse, species-level effects to *N. latifolium* from the loss of reproductive success from pollinator mortality as methomyl exposure is expected to occur in only a very small portion of the range over the duration of the action. 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 *Nothocestrum latifolium*.

References:

U.S. Fish and Wildlife Service. 2022. Recovery Plan for 50 Hawaiian Archipelago Species. Portland, Oregon. 207 pp.

U.S. Fish and Wildlife Service. 2021. *Nothocestrum latifolium* (ʻaiea) 5-Year Review: Summary and Evaluation. Honolulu, Hawaiʻi. 26 pp.