Integration and Synthesis Summary for Plants, Pacific Islands
Flowering Plants Assessment Group 5 – Monocots reliant upon outcrossing with biotic pollination vector

The tables below contain summaries of the information and data we used to determine the ranking (high, medium, low) for vulnerability, risk and usage indicators. Information in most of the columns was used directly in the ranking determination (green fill). Where indicated, information in other columns was not used directly in the ranking calculation, but provided additional information about the species that fed into one of the ranking metrics or was used to make the draft determination when relevant. The summary for this assessment group also includes new conservation measures[1] that have been incorporated into the Action since the draft biological opinion was released. The measures and our related assumptions are incorporated into our analysis (immediately above Table 3), and also factor into the rationales for our conclusions for each species, as described below.

All species in this assessment groups are monocots, a class of angiosperm flowering plant defined by having only one cotyledon (embryonic seed leaves). There are a large variety of monocot species, though typical monocot plants include grasses, lilies and palms. The monocots in this assessment group utilize biotic vectors to accomplish pollination, such as insects, birds and mammals. All plants in this group need to achieve outcrossing (pollen transfer between individuals), in order to reproduce successfully and maintain their populations over time. Seed dispersal for the species in this group is achieved by biotic (dispersal by animals) and/or abiotic (dispersal by wind, water or gravity) means.

Table 1: Summarizing Data and Information for Vulnerability Ranking

Data Sources: Status of the Species (SOS) accounts updated as of November 2019 (Appendix C); NA=Not Applicable; HI=Hawaii; GU=Guam; CMNI=Commonwealth of the Northern Marianas Islands

Scientific Name	Common Name	Location	Status	Population Level Trends	Species Level Trends	Number of Populations	Distribution	Number of Individuals	Pesticides Listed as a Threat	Pollinator loss Listed as a Threat	Vulnerability Ranking
Pleomele fernaldii	Hala pepe	HI	Endangered	50% decline since 1999 (USFWS, 2016)	Declining (NatureServe, 2015)	3 (NatureServe, 2015)	It is found only on the island of Lanai (Wagner et al. 1999i, p. 1,352; Wagner and Herbst 2003, p. 67) and occurs from Hulopaa and Kanoa gulches southeast to Waiakeakua and Puhielelu (St. John 1947, pp. 39–42 cited in St. John 1985, pp. 171, 177–179; HBMP 2006; PEPP 2008, p. 75; HBMP 2010; Oppenheimer 2010d, in litt.) (USFWS, 2016).	Several hundred - 1,000 (USFWS, 2016)	No Mention	No Mention	High
Pleomele forbesii	Hala pepe	HI	Endangered	Unknown (NatureServe, 2015)	Decline of 10-30% (NatureServe, 2015)	20 (USFWS, 2012)	On the island of Oahu in the state of Hawaii, in the Waianae Mountains and the Koolau Mountains (USFWS, 2012).	290 - 307 individuals (USFWS, 2012)	No Mention	No Mention	High
Nervilia jacksoniae	No common name	GU, CNMI	Threatened	Not Available	Decreasing (USFWS, 2015)	15 (USFWS, 2015)	It currently occurs on Guam and Rota (Mariana Islands) (USFWS, 2015).	520 (USFWS, 2015)	No Mention	No Mention	High

*Information in this column was used to inform the ranking metrics or the draft determination when relevant.

Table 2: Summarizing Data and Information for Risk Ranking

Data Sources: SOS accounts (Appendix C); NA=Not Applicable; HI=Hawaii; GU=Guam; CMNI=Commonwealth of the Northern Marianas Islands

Risk to Individuals and Pollinators if exposed:

[1] Additional information on these new conservation measures can be found in the Description of the Action section of this biological opinion.

The individual plants in this assessment group are not expected to experience effects to growth or survival from exposure to malathion.

Mortality is expected for insect pollinators and seed dispersers exposed to malathion on use sites, via spray drift, and from mosquito control applications. Because terrestrial invertebrates exhibit a range of sensitivities to malathion, insect abundance is expected to be reduced where exposure occurs, but not completely eliminated. However, some species are likely to incur greater levels of mortality than others based on their sensitivity. As plants often have unknown or specific pollinators and seed dispersers for which toxicity data is unavailable, we assume insects that pollinate or disperse the seeds of listed plants are sensitive to malathion, and that exposure will cause mortality. In field studies, reductions of common insect species following pesticide exposure are often temporary with recovery over a short period of time. However, since listed plants may be reliant on insect pollinators or seed dispersers that are limited in range or abundance, these insect species may be less likely to recover following pesticide exposure.

Some bird pollinators and seed dispersers exposed to malathion on use sites may experience mortality or sublethal effects, depending on the site of exposure and size of the bird. Smaller birds exposed on use sites with higher allowable use rates (e.g., developed, open space developed, orchards and vineyards) have a greater chance of being affected. Exposure to spray drift is not expected to result in effects to bird seed dispersers. No effects (mortality or sublethal effects) are expected for mammalian pollinators or seed dispersers from malathion exposure either on use sites or from spray drift.

Scientific Name	Common Name	Location	Direct effects expected (yes or no, reduction in dry weight when exposed in use areas that may have effects)	Effects to Pollinators	Method of Reproduction (risk modifier)	Seed Dispersal Vector (risk modifier)	Obligate or Specific Pollinator (risk modifier)	Pollination Vector*	% Range Overlap with Federal Lands	Risk Ranking
Pleomele fernaldii	Hala pepe	HI	No	Medium	Biotic - Outcrosser	Abiotic	No Mention	Insect, Bird	<0.01	Medium
Pleomele forbesii	Hala pepe	HI	No	Medium	Biotic - Outcrosser	Abiotic	No Mention	Insect, Bird	21.88	Medium
Nervilia jacksoniae	No common name	GU, CNMI	No	High	Biotic - Outcrosser	Abiotic, Biotic	No Mention	Insect	<0.01	Medium

*Information in this column was used to inform the ranking metrics or the draft determination when relevant.

Cumulative Effects and Environmental Baseline: Please refer to the Status of the Species accounts (Appendix C) and overarching Environmental Baseline and Cumulative Effects sections of this Opinion.

General Conservation Measures

Several additional conservation measures have recently been provided by EPA and will be implemented as part of the Action (see *Description of the Action* section of the biological opinion and Appendix A-2 for further details on these measures). These measures will apply to all species in this assessment group with corresponding use type overlap and usage (i.e., mosquito adulticide, agricultural and residential uses, see Table 3). All measures are anticipated to limit the exposure of pollinators and seed dispersers to malathion in the described use area where it occurs in or around the range of the species, thus further reducing the risk of reproductive effects to the species. We summarize the new measures and our related assumptions below.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and other crops UDLs will prohibit application of malathion within three days prior to bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to limit the exposure of pollinators/seed dispersers to malathion in this use area where it occurs in or around the range of the species, reducing the risk of impacts to reproduction.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications (previously ranging from 3-13 applications per year, depending on the specific crop) to 2-4 per year, as described in the Description of the Action of this Opinion. This is anticipated to reduce the amount of malathion used and decrease exposure to the species and its pollinators/seed dispersers, thus decreasing the risk of impacts to reproduction and direct impacts to the plant itself.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are anticipated to significantly reduce exposure to species and their pollinators/seed dispersers that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. We anticipate this measure will further reduce exposure to biotic pollinators and seed dispersers, thus decreasing the risk of impacts to the reproduction of these plants.

Table 3: Summary of Conclusions

Scientific Name	Common Name	Location	Vulnerability Ranking	Risk Ranking	Potential Exposure Ranking	Species Conclusion (J, NJ)*
Pleomele fernaldii	Hala pepe	HI	High	Medium	Medium	NJ
Pleomele forbesii	Hala pepe	HI	High	Medium	Medium	NJ
Nervilia jacksoniae	No common name	GU, CNMI	High	Medium	Low	NJ

J = Jeopardy; NJ = No Jeopardy

Rationale for Species Conclusions

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

Individual plants in this assessment group are not expected to experience mortality or growth effects from exposure to malathion, as monocot plants are not anticipated to experience effects from direct exposure to malathion.

Pleomele fernaldii and ***Pleomele forbesii*** have high vulnerabilities based on their endangered status and restricted distributions as shown above. Both species have narrow ranges, *P. forbesii* is found only in the mountains of Oahu and *P. fernaldii* only on the island of Lanai. The risk to these species posed by labeled uses across the range is anticipated to be medium, as shown above. Both rely on unknown species of insect and bird pollinators and are believed to require outcrossing (movement of pollen from one individual to another) in order to reproduce successfully. Mortality is expected for insect pollinators and seed dispersers exposed to malathion on use sites or via spray drift. Some bird pollinators and seed dispersers exposed to malathion on use sites may experience mortality or sublethal effects, depending on the site of exposure and size of the bird. Smaller birds exposed on use sites with higher allowable use rates (e.g., developed, open space developed, orchards and vineyards) have a greater chance of being affected. Exposure to spray drift is not expected to result in effects to bird seed dispersers. We anticipate adverse effects to these species due to the reduction in pollinating insects and birds that would result in reduced reproductive success
Both species of Pleomele use abiotic (likely wind) pollination vectors for seed dispersal, therefore we do not anticipate use of malathion within their ranges will cause adverse effects to seed dispersal or the reproductive capacity of these species. Since these species can use both insects and birds as pollinating vectors, and may rely on one type of pollination vector if the other is temporarily reduced in numbers, we do not anticipate the appreciable adverse reproductive effects to these plants as a result of pollinator mortality.

As described in the Approach to the Analysis for Pacific and Caribbean Island Species, we considered available usage data broadly and determined the relative likelihood of exposure of island species based on their preferred habitat. We anticipate these species will have a medium level of exposure to malathion given they exist in forests and on cliffs but also in shrubland areas where exposure to malathion is more likely given the low stature and inability of most shrubland vegetation to block spray drift. These species also occur in forests and cliffs where we anticipate less exposure to malathion due to the blocking effects of vegetation on spray drift in the forest, and relative isolation from malathion use areas and spray drift on cliffs. As such, we anticipate that a medium level of exposure to malathion is not likely over the entire range of these species, and as a result, we do not expect adverse effects to insect and bird pollinators would cause appreciable reproductive effects to these species. . Moreover, we anticipate the conservation measures described above will reduce the risk of exposure of both types of pollinators in the portion of the range where we anticipate malathion to be applied. For example, residential uses of malathion are now limited to two applications per year (reduced from as many as necessary) and to spot treatments only, reducing the application footprint and likelihood of spray drift within developed and open space developed areas. The reduced application footprint and likelihood of spray drift are a result of the allowable application methods for spot treatment (such as the use of hand-pump sprayers, which are not capable of producing broadcast use) and low amounts of chemical used.

We do not anticipate that the use of this pesticide is likely to have species-level effects due to their reliance on more than one type of pollinator, existence in habitat areas where they do not have a high potential for malathion exposure, their reliance on abiotic seed dispersal vectors, and the conservation measures that will be implemented. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of *P. fernaldii* and *P. forbesii* in the wild.

Nervilia jacksoniae has a high vulnerability based on its limited distribution and restricted range on the islands of Guam and Rota. It is found in the Padanus forest that is difficult to access as it in a very rugged karst area covered in thick vegetation. The risk to this species posed by labeled uses across the range is anticipated to be medium, as shown above. This species relies on unknown species of insects for pollination and is believed to require outcrossing (movement of pollen from one individual to another) in order to reproduce successfully. Mortality is expected for insect pollinators exposed to malathion in use areas or via spray drift. We anticipate adverse effects to this species from reduction in pollinating insects that would result in reduced reproductive capacity. *N. jacksoniae* has unknown seed dispersal vectors, but is assumed to utilize a combination of abiotic and

biotic vectors. Bird and insect seed dispersers are expected to experience mortality from malathion exposure and cause some loss of reproductive output in this species. However, since this species is able to rely on a variety of seed dispersal vectors, and may rely on one type of pollination vector if another is temporarily reduced in numbers, we do not anticipate the adverse reproductive effects to this plant to result in species-level effects. Furthermore, we anticipate the conservation measures described above will further reduce the risk of exposure of both pollinators and seed dispersers in the portion of the range where we anticipate malathion to be applied. For example, new restrictions prohibit application on crops in certain UDLs three days prior to bloom, during bloom, and until petal fall is complete. Given that most pollinating insects are likely to be attracted to crops in bloom and thus more likely to be present in agricultural areas during these times, avoiding application during bloom is anticipated to reduce exposure and resultant mortality of pollinators that are important for this species.

We anticipate this species will have a low level of exposure given it exists in dense, difficult to access forested areas where malathion is not registered for use and that can act as a block to a portion of spray drift from other use areas. As a result, we do not anticipate the use of this pesticide is likely to have species-level effects due to its reliance on more than one type of seed disperser, its existence in areas that we expect will have low exposure, and the conservation measures that will be implemented. Therefore, we do not anticipate the proposed action would appreciably reduce survival and recovery of *N. jacksoniae* in the wild.