Integration and Synthesis Summary for Plants, Pacific Islands
Flowering Plants Assessment Group 7 – Monocots using biotic pollination vectors, other aspects of reproductive system unknown

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; other aspects of their reproductive mechanism are unknown. 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; CNMI=Commonwealth of Northern Marianas Islands

Scientific Name	Common Name	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
Joinvillea ascendens ssp. ascendens	`Ohe	Endangered	Not Available	Not Available	56 (USFWS, 2016)	Found on the Hawaiian Islands of Kauai, Oahu, Molokai, Maui, and Hawaii.	~200 individuals (USFWS, 2016)	No Mention	No Mention	High
Platanthera holochila	No common name	Endangered	Not Available	Increasing (USFWS, 2015)	~5 (USFWS, 1999)	Currently occurs on the islands of Kauai, Maui, and Molokai (USFWS 1999); extirpated on Oahu (USFWS, 2014).	~35 (USFWS, 2014)	No Mention	No Mention	High
Pleomele hawaiiensis	Hala pepe	Endangered	Not Available	Declining (USFWS, 2012)	6 - 9 (USFWS, 2012)	It is known from Naulu Forest Areas I and II and Poliokeawe Pali (Abbott and Pratt 1996) and reported from the lowland dry forest at Puuwaawaa (Giffin 2009) (Hawaii). When critical habitat was designated, P. hawaiiensis was known from Kiholo, Manuka Natural Area Reserve System, and Hawaii Volcanoes National Park (USFWS 2003) (USFWS, 2012).	300 - 400 wild, 479 outplanted (USWS, 2012)	No Mention	No Mention	High
Pritchardia aylmer-robinsonii	Wahane	Endangered	Not Available	Unknown (USFWS, 2011)	1 (inferred from USFWS, 2011)	Currently found on Kaali Cliff and in Mokouia and Haao Valleys at elevations between 70 and 270 m (230 and 885 ft.) on privately owned land (USFWS, 2003).	1 - 2 wild, 6 propagated (USFWS, 2011)	No Mention	No Mention	High
Pritchardia bakeri	Loulu	Endangered	Declining (USFWS, 2015; 2016)	Not Available	Not Available	This palm occurs on the northern end (Pupukea) and southern end (Kuliouou) of the Koolau Mountain range, on the island of Oahu (Bacon et al. 2012, pp. 1–17; Hodel 2012, pp. 71– 73) (USFWS, 2015).	< 100 (USFWS, 2016)	No Mention	No Mention	High
Pritchardia kaalae	Lo`ulu	Endangered	Decreasing (USFWS, 2016)	Not Available	5 (USFWS, 2016)	Current range: Waianae Mountains of Oahu; historically no additional range.	~911 individuals (USFWS, 2016)	No Mention	No Mention	High
Pritchardia lanigera	Lo`ulu	Endangered	Not Available	Not Available	8 (USFWS, 2013)	It currently occurs along the windward side of the Kohala Mountains, Kau FR, and TNC Kau Preserve (Hawaii) (USFWS, 2013).	< 230 (USFWS, 2013)	No Mention	No Mention	High

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

Scientific Name	Common Name	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
Pritchardia maideniana	Lo`ulu	Endangered	Not Available	Decline in number of populations (USFWS,2012)	4 (USFWS, 2012)	Currently known from the western coast of the Big Island (NatureServe, 2015). It is found in Puna, Kona, and Kau on the island of Hawaii (USFWS, 2012).	> 50 wild; ~76 outplants (USFWS, 2012)	No Mention	No Mention	High
Pritchardia munroi	Lo`ulu	Endangered	Not Available	Stable (USFWS, 2014)	1 (USFWS, 2014)	Historically and currently, *Pritchardia munroi* is found in leeward East Molokai, above Kamalo, near Kapuaokoolau Gulch. The only known wild individual is found on privately owned land (HINHP Database 2000, Read and Hodel 1999) (USFWS, 2003).	1 (USFWS, 2014)	No Mention	No Mention	High
Pritchardia napaliensis	Lo`ulu	Endangered	Not Available	Increasing (USFWS, 2010)	3 - 5 (USFWS, 2010; 2003)	It is known from State-owned land in Pohakuao, Alealau, Waiahuakua, and Hoolulu Valley within the Hono o Na Pali NAR and Na Pali Coast State Park (GDSI 2000; HINHP Database 2000; K. Wood, in litt. 1999) (USFWS, 2003).	157 wild, 73 outplanted (USFWS, 2010)	No Mention	No Mention	High
Pritchardia remota	Lo`ulu	Endangered	Not Available	Increasing to stable (USFWS, 2009; 2003)	4 (USFWS, 2003)	Populations are concentrated in two valleys (West Palm Valley and East Palm Valley) located on opposite sides of the island [Nihoa], approximately 0.6 km (0.4 mi) apart. The largest population is in West Palm Valley, with three smaller subpopulations in East Palm Valley, and scattered trees on steep outer walls of both valleys at the foot of basalt cliffs (Evenhuis and Eldredge 2004) (USFWS, 2009).	~1,100 wild, 61 outplants (USFWS, 2009)	No Mention	No Mention	High
Pritchardia schattaueri	Lo`ulu	Endangered	Not Available	Wild: stable, reintroduced: increasing (USFWS, 2015)	1 wild (USFWS, 2015)	Current range is South Kona, Island of Hawaii (USFWS, 1998).	12 wild, 518 reintroduced (USFWS, 2015)	No Mention	No Mention	High
Pritchardia viscosa	Lo`ulu	Endangered	Not Available	Decline after Hurricane Iniki (USFWS, 2008)	1 (USFWS, 2008)	Currently, there is one occurrence on State-owned land within the Halelea Forest Reserve (GDSI 2000; HINHP Database 2000; 61 FR 53070) (USFWS, 2003).	4 (USFWS, 2008)	No Mention	No Mention	High
Tuberolabium guamense	No common name	Threatened	Decreasing (USFWS, 2015)	Not Available	7 (USFWS, 2015)	*Tuberolabium guamense* (NCN) (*Trachoma guamense* is a synonym) is known only from the Mariana Islands. (USFWS, 2015)	500 - 1500 (NatureServe (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; CNMI=Commonwealth of Northern Marianas Islands

Risk to Individuals and Pollinators if exposed: 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
Joinvillea ascendens ssp. ascendens	`Ohe	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	9.27	Low
Platanthera holochila	No common name	HI	No	High	Biotic - Unknown	Abiotic	Unknown	Insect	6.79	Medium
Pleomele hawaiiensis	Hala pepe	HI	No	High	Biotic - Unknown	Abiotic, Biotic	Unknown	Insect	7.89	Medium
Pritchardia aylmer-robinsonii	Wahane	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	No	Abiotic, Insect	0.00	Low
Pritchardia bakeri	Lo'ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	16.02	Low
Pritchardia kaalae	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	30.64	Low
Pritchardia lanigera	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Biotic	Unknown	Abiotic, Insect	4.85	Low
Pritchardia maideniana	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	7.12	Low
Pritchardia munroi	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	12.23	Low
Pritchardia napaliensis	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	0.05	Low
Pritchardia remota	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect		Low
Pritchardia schattaueri	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	0.00	Low
Pritchardia viscosa	Lo`ulu	HI	No	Medium	Biotic - Unknown	Abiotic, Bird, Mammal	Unknown	Abiotic, Insect	0.00	Low
Tuberolabium guamense	No common name	GU, CNMI	No	High	Biotic - Unknown	Abiotic, Biotic	Unknown	Insect	0.00	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.

Additional Conservation Measures:

Additional information on these new conservation measures can be found in the *Description of the Action* section and Appendix A-2 of this biological opinion, and further information on the anticipated impacts of each measure in the *Effects of the Action* section.

General Conservation Measures

Several additional conservation measures have been recently provided by EPA and will be implemented as part of the Action. 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). 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 reproduction and sub-lethal impacts to the plant itself.

Table 3: Summary of Conclusions

Scientific Name	Common Name	Location	Vulnerability Ranking	Risk Ranking	Potential Exposure Ranking	Species Conclusion (J, NJ)*
Platanthera holochila	No common name	HI	High	Medium	Medium	NJ
Joinvillea ascendens ssp. ascendens	`Ohe	HI	High	Low	Low	NJ
Pritchardia kaalae	Lo`ulu	HI	High	Low	Low	NJ
Pritchardia lanigera	Lo`ulu	HI	High	Low	Low	NJ
Pritchardia napaliensis	Lo`ulu	HI	High	Low	Low	NJ
Pritchardia schattaueri	Lo`ulu	HI	High	Low	Low	NJ
Pritchardia viscosa	Lo`ulu	HI	High	Low	Low	NJ
Pleomele hawaiiensis	Hala pepe	HI	High	Medium	Low	NJ
Pritchardia aylmer-robinsonii	Wahane	HI	High	Low	Medium	NJ
Pritchardia bakeri	Loulu	HI	High	Low	Medium	NJ
Pritchardia maideniana	Lo`ulu	HI	High	Low	High	NJ
Pritchardia munroi	Lo`ulu	HI	High	Low	Medium	NJ
Pritchardia remota	Lo`ulu	HI	High	Low	Medium	NJ
Tuberolabium guamense	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.

For these species, we anticipate their high vulnerabilities and variable levels of risk to individuals or species is offset by low levels of usage of malathion, as described below. As discussed in the Approach to the Analysis of the Pacific and Caribbean Island Species, there is a high degree of uncertainty for quantitative usage data for the Pacific and Caribbean Islands. For species with a portion of their range on Federal lands, we did not quantitatively evaluate use or usage on in these areas, but we assume only low levels of usage, per the rationale described in the Biological Opinion. For the non-Federal lands portion of the species ranges, we have limited information on past malathion usage in the Pacific Islands, and thus our estimation of usage and exposure on non-Federal lands contains a large degree of uncertainty. Briefly, we anticipate that usage in non-agricultural areas will be low (up to 5% of overlap in any given area). We anticipate that the available agricultural usage data, which is from a single year and does not distinguish between use categories, likely provides an upper bound of malathion usage for our analysis, particularly as it includes all insecticides. This usage is also anticipated to be low (~5% of agricultural lands treated across the islands as an upper bound for malathion for the Pacific Islands), though we cannot predict the degree of usage in proximity to particular species' ranges. However, given that 95% of agricultural fields are not anticipated to be treated with insecticides, we assume a low probability that any individual plant will be in proximity to agricultural usage of malathion.

The species in this assessment group all have high vulnerabilities based on their status, distribution, and trends, as shown above. Of the fourteen species in this assessment group, ten are palm species in the genus *Pritchardia*. The *Pritchardia* species in this assessment group range from a single population up to eight total populations, with total numbers of individuals ranging from a single plant to about 1,100. The remaining species in this assessment group are *Platanthera holochila* (no common name), *Joinvillea ascendens ssp. ascendens* (`Ohe), *Pleomele hawaiiensis* (Hala pepe) and *Tuberolabium guamense*. *Platanthera holochila* occurs in 56 populations on five islands and consists of approximately 200 individuals total. *Joinvillea ascendens* occurs in about five populations on three islands and consists of approximately 35 individuals. *Pleomele hawaiiensis* occurs in 5 – 6 populations on the island of Hawaii and consists of approximately 300-400 individuals in the wild and 479 outplanted individuals. The last species in this group, *Tuberolabium guamense*, is known only from the Mariana Islands, where seven populations consist of 500-1,500 individuals.

The species in this assessment group have medium or low risk. As monocots, the species in this group are not expected to experience effects to their growth and survival from direct exposure to malathion, and combined with their ability to use both abiotic vectors and insects for pollination, they were assigned a low risk. Those species solely using insects for pollination were assigned a medium risk. Insect pollinators are expected to experience mortality across the non-Federal portions of the species' ranges from exposure to malathion. These species have a wide variety of seed dispersal vectors, including abiotic vectors, birds, and mammals. Abiotic and mammalian seed dispersers are not anticipated to experience effects from malathion exposure. Same avian 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. Thus, we anticipate adverse effects to individuals of the species in this assessment group related mainly to the loss of a portion of their insect pollinators and avian seed dispersers, where applicable, both of which would result in reduced reproductive success of the affected individual plants.

Due to the lack of usage data for the Pacific Islands, we further refine our analysis by considering the habitats the species are known or assumed to occupy. We anticipate a low level of anticipated exposure within the non-Federal portion of the species ranges, based on habitat types, for *Joinvillea ascendens ssp. ascendens, Pritchardia kaalae, P. Lanigera, P. mapaliensis, P. schattaueri, P. viscosa, Pleomele hawaiiensis,* and *Tuberolabium guamense*. These species occur in forests, on cliffs or sand dunes and in bogs, and were assumed to have low potential for malathion exposure as malathion is not registered for use in forests and the vegetative structure of forests has the potential to block spray drift. Cliffs, sand dunes and bogs on the islands tend to be isolated physically from other land use areas, thus we assumed there would be less potential for malathion exposure from direct use and spray drift.

We anticipate a medium exposure based on habitat types for *Plantanthera holochila, Pritchardia aylmer-robinsonii, P. munroi, P. remota,* and *P. bakeri.* These species are found in shrublands, grasslands and other areas of open vegetation. As such, we assumed they had a somewhat greater potential for exposure than those in the 'low' level of exposure group given the vegetative structure is less able to block spray drift in these habitats and they are somewhat more likely to be in close proximity to a malathion use area.

We anticipate high exposure based on habitat type for *Pritchardia maideniana* due to its presence primarily in areas of human disturbance and development.

However, as stated above, 95% of agricultural fields are not anticipated to be treated with insecticides in the Pacific islands, so we assume a low probability that any individual plant will be in proximity to agricultural usage of malathion. In addition there is low anticipated usage for non-agricultural uses and mosquito adulticide. Furthermore, we anticipate the conservation measures described above will appreciably 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 important for these plants.

Thus, while we anticipate that the proposed action will result in adverse effects to small numbers of individuals, we do not anticipate species-level reproductive effects due to the low likelihood of malathion exposure within their ranges, and the conservation measures that will be implemented will further reduce the likelihood of exposure and effects these species and their pollinators and seed dispersers. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of these species in the wild.