

Integration and Synthesis Summary for Plants, CONUS  
Ferns and Allies: Assessment Group 2

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<sup>1</sup> 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 4), and also factor into the rationales for our conclusions for each species, as described below.

All species in this group are ferns or lycophytes (fern “allies”). They do not have flowers or seeds, but reproduce sexually via spores that are dispersed by wind. Ferns and their allies can also reproduce asexually, through vegetative reproduction in the form of bulbets or rhizomes. During sexual reproduction, ferns produce two free-living generations, a diploid sporophyte (i.e. a fern plant) and a haploid gametophyte. The gametophytes are typically very small (around ½ inch), fragile, and have very specific requirements for growth, such as damp soil conditions and high humidity.

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

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
<i>Asplenium scolopendrium</i> var. <i>americanum</i>	American hart's-tongue fern	Threatened	Decline of <50% to relatively stable (NatureServe, 2015)	Decline of <30% to relatively stable (NatureServe, 2015)	Approximately 106 extant occurrences rangewide (28 in the United States; 78 in Canada) (NatureServe, 2015)	Known from New York, Michigan, Alabama (two counties in each) and Tennessee (one county); and in the province of Ontario, Canada (USFWS, 1993).	Approximately 5,500-6,500 individuals in the United states; at least 30,000 individuals in Canada (NatureServe, 2015)	No Mention	NA	Medium
<i>Isoetes louisianensis</i>	Louisiana quillwort	Endangered	Decline of 30-70% (NatureServe, 2015)	Stable (USFWS, 2012)	20 (USFWS, 2012)	Occurs in ten counties in southern Mississippi, as well as St. Tammany and Washington Parishes in adjacent eastern Louisiana and Monroe and Conecuh Counties in nearby southern Alabama (Moore and Leonard 1996, Sorrie and Leonard 1999). Range extent is approximately 22,000 square km. (NatureServe, 2015)	10,000 - 70,000 (NatureServe, 2015)	No Mention	NA	Medium
<i>Isoetes melanospora</i>	Black spored quillwort	Endangered	Not Available	Declining (USFWS, 2008)	12 (NatureServe, 2015)	Piedmont physiographic region in Georgia. (NatureServe, 2015)	> 10,000 (NatureServe, 2015)	No Mention	NA	High
<i>Isoetes tegetiformans</i>	Mat-forming quillwort	Endangered	Not Available	Declining (USFWS, 2008)	7 (NatureServe, 2015)	Only Greene and Columbia Counties, Georgia. Reports from North Carolina are in error (i.e. Federal Register list). Fairly intensive work in western Georgia, South Carolina and North Carolina has not revealed this species.	1,000 – 2,500 individuals (NatureServe, 2015)	No Mention	NA	High

<sup>1</sup> 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
<i>Polystichum aleuticum</i>	Aleutian shield fern	Endangered	Not Available	Not Available	1-5 (NatureServe, 2015)	Very narrow endemic, now known from only 3 rock outcrops on Mt. Reed, Adak I. Historically also known from Atka I. Nearest location of a closely related taxon is Honshu, Japan.	>131 individuals (USFWS, 2019)	No Mention	NA	High
<i>Thelypteris pilosa</i> var. <i>alabamensis</i>	Alabama streak-sorus fern	Threatened	Unknown (NatureServe, 2015)	Stable (USFWS, 2014)	2 (NatureServe, 2015)	Restricted to a 4-mile stretch of Sipsey Fork, a tributary of the Black Warrior River in Alabama. (NatureServe, 2015)	2,500 - 10,000 individuals (NatureServe, 2015)	No Mention	NA	High
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	Florida bristle fern	Endangered	Declining	Declining (NatureServe 2010, pp.1-2)	Miami-Dade County: 4 sites (colonies); Sumter County: 1 colony	There are currently five, and possibly six, extant occurrences of Florida bristle fern (Gann et al. 2002, pp. 552-554), four in Miami-Dade County and two in Sumter County (Table 1). In Miami-Dade County, Florida bristle fern is known from Meissner Hammock in two solution holes (K. Bradley, pers. comm. 2009), from Fuchs Hammock Preserve in three solution holes, and from Castellow Hammock Park in two large solution holes and several smaller holes and rocky outcroppings (J. Possley, pers. comm. 2008). In Sumter County, it is known from one colony in the Withlacoochee State Forest's Jumper Creek Tract, north of Wahoo. Another occurrence consisting of two colonies on private land just south of the State Forest may be extirpated.	<1,000 plants	No Mention	NA	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); R Plot Appendices; NA = Not Applicable

**Risk to Individuals and Pollinators if exposed:** The individual plants in this assessment group are estimated to experience up to a 12% decrease in dry weight if exposed to malathion on the following use sites, based on labeled application rates: orchards and vineyards, developed, nurseries, open space developed and Christmas trees. No effects are expected on other use sites. Ferns and their allies do not rely on animal species for pollination or seed dispersal, thus no effects are expected to these plants from loss in seed dispersers from malathion exposure across use sites within their ranges.

Scientific Name	Common Name	Effects to Mortality or Growth Expected (yes or no; reduction in dry weight when exposed in use areas that may have effects)	Effects to Pollinators (% Pollinator mortality)	Method of Reproduction (risk modifier)	Seed Dispersal Vector (risk modifier)	Obligate or Specific Pollinator (risk modifier)	Pollination Vector*	Risk Ranking
<i>Asplenium scolopendrium</i> var. <i>americanum</i>	American hart's-tongue fern	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low
<i>Isoetes louisianensis</i>	Louisiana quillwort	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low
<i>Isoetes melanospora</i>	Black spored quillwort	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low
<i>Isoetes tegetiformans</i>	Mat-forming quillwort	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low
<i>Polystichum aleuticum</i>	Aleutian shield fern	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low**
<i>Thelypteris pilosa</i> var. <i>alabamensis</i>	Alabama streak-sorus fern	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	Florida bristle fern	Yes (12%)	NA	Non-flowering	Abiotic	NA	NA	Low

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

**Volatilization:** We do not expect transport from volatilization to be an appreciable source of exposure for most or all species in this assessment group. For species that occur at high elevations, we expect additional exposure to malathion that may vaporize from application sites. However, the magnitude of increased exposure is uncertain due to the unpredictability of weather events, along with variability of the geographical features across the landscapes that influence transport and deposition, though the information available does not allow us to conclude that concentrations from this route alone will rise to the level where effects are expected.

Table 3: Summarizing Data and Information for Usage Ranking

Data Sources: R Plots Appendices for individual plant species; Federal lands overlap analysis; California data analysis; NA = Not Applicable

Scientific Name	Common Name*	Acres in Species Range*	% Range Overlap with Federal Lands*	% Range in CA*	Comments for % Range in CA *	Total Overlap % (all agricultural and residential uses) *	Total Overlap % (mosquito adulticide*	Anticipated Usage within Range (agricultural data based on SUUM): total % of range for all uses	Anticipated Usage within Range (agricultural data based on CalPUR): total % of range for all uses	Ranking: Confidence Level	Usage Ranking
<i>Asplenium scolopendrium</i> var. <i>americanum</i>	American hart's-tongue fern	4,421,626	11.48	0	NA	8.01	12.31	0.97	NA	Standard	Low
<i>Isoetes louisianensis</i>	Louisiana quillwort	3,646,315	22.83	0	NA	6.94	37.66	0.58	NA	Standard	Low
<i>Isoetes melanospora</i>	Black spored quillwort	2,131,457	0.01	0	NA	18.98	48.86	1.14	NA	Standard	Low
<i>Isoetes tegetiformans</i>	Mat-forming quillwort	186,562	0.00	0	NA	6.77	4.83	0.95	NA	Standard	Low
<i>Polystichum aleuticum</i>	Aleutian shield fern	**	**	0	NA	**	**	**	NA	Standard	**
<i>Thelypteris pilosa</i> var. <i>alabamensis</i>	Alabama streak-sorus fern	370,168	49.16	0	NA	4.51	24.8	0.42	NA	Standard	Low
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	Florida bristle fern	1,552,660	46.08	0	NA	19.39	47.38	1.76	NA	Standard	Low

\* Information in this column was used to inform the ranking metrics or the draft determination when relevant.  
\*\*Overlap and usage data is not available for Alaskan species

**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 recently been provided by EPA and will be implemented as part of the Action. These measures will apply to both species in this assessment group. We summarize the new measures and our related assumptions below.

*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 these plant species, thus decreasing the risk of direct sub-lethal 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 substantially 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 these plant species, thus decreasing the risk of sub-lethal impacts to the plant itself.

**Table 4: Summary of Conclusions**

Scientific Name	Common Name	Vulnerability Ranking	Risk Ranking	Usage Ranking	Species Conclusion (J, NJ)*
<i>Asplenium scolopendrium</i> var. <i>americanum</i>	American hart's-tongue fern	Medium	Low	Low	NJ
<i>Isoetes louisianensis</i>	Louisiana quillwort	Medium	Low	Low	NJ
<i>Isoetes melanospora</i>	Black spored quillwort	High	Low	Low	NJ
<i>Isoetes tegetiformans</i>	Mat-forming quillwort	High	Low	Low	NJ
<i>Polystichum aleuticum</i>	Aleutian shield fern	High	Low	**	NJ**
<i>Thelypteris pilosa</i> var. <i>alabamensis</i>	Alabama streak-sorus fern	High	Low	Low	NJ
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	Florida bristle fern	High	Low	Low	NJ

\* NJ = No Jeopardy; J = Jeopardy  
\*\*Overlap and usage data is not available for Alaskan species. However, based on the similarities of the Aleutian shield fern to the other species in this assessment group, most importantly, the fact that they do not rely on animal pollinators or seed dispersers, the magnitude of overlap and usage is not anticipated to change the response of this species to malathion exposure. Thus, we have determined this species will not be jeopardized by the Action, as explained in the rationale.

**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.

While the species in this assessment group have either high or medium vulnerabilities based on their status, distribution, and trends as described above, the risk to all species in this group posed by labeled uses across the range is anticipated to be low. In addition, the estimated usage within the range is for all species in this group is anticipated to be low, based on our analysis above. Furthermore, pollinating and seed dispersing animals do not play a role in the life cycle of ferns and their allies. As a result, we expect there will be no effects to the reproduction and survival of these species due to loss of pollinating and seed dispersing species from malathion exposure in the plants' range. While we expect some individual plants will experience reduced growth due to direct exposure to malathion, we do not anticipate this reduction in growth will result in species-level effects. We anticipate the additional conservation measures above will further decrease the likelihood of exposure and resultant sub-lethal effects of these species from malathion. 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.

We do not anticipate that the use of this pesticide will result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of these species in the wild.