

	Kauai Status	KISC Status	HPWRA	Invasive Impacts Score	Feasibility Score	Combined Score
<p><i>Angiopteris evecta</i> (mule's foot fern)</p>	Naturalized	RETIRED	HIGH RISK (8)	6	2	8

Initial Prioritization Assessment Report completed: January 2017

Report updated as of: N/A

Current Recommendation for KISC: Voted to RETIRE or PARTNERSHIP SPECIES Status at 2/16/2018 KISC Committee Meeting

Knowledge Gaps and Contingencies:

- 1) Will organizations doing high elevation and native ecosystem weed control partner with us to make eradication more feasible?

Background

Angiopteris evecta (Marattiaceae) is a large fern native to Australia, the Malay Peninsula and adjacent islands. It has a minimum maturity time of approximately 3-4 years and is well regarded as an invasive species in Hawaii, Jamaica and Costa Rica (Christenhusz and Toivonen 2008). It is spread by spores that disperse long distances by wind, though no dispersal studies have been conducted to predict maximum potential dispersal distances. Although little is known about the length of time that propagules persist in the seed bank, viable but dormant spores have been recorded in New South Wales, Australia, where recovery strategies are being investigated to halt the population decline of this endangered species. *A. evecta* was first introduced to Hawaii via the Lyon Arboretum on Oahu in 1927 and has been occasionally cultivated as an ornamental since then (Staples and Herbst 2005).

Detection and Distribution

A. evecta was first vouchered in Kauai as a cultivated specimen at the National Tropical Botanical Garden in 1990 (J. T. Beck 1218, NY). The first naturalized individual (Wood 2006) was collected in the back of Wainiha valley below Hinalele falls (K.R. Wood 10933, PTBG;). It is unclear whether these vouchers correspond closely to the dates of introduction and naturalization respectively, but given the current distribution of individuals on Kauai and its occurrence in longstanding nurseries, it is likely that it arrived prior to 1990. It has been speculated that spores from mature plants on Oahu may arrive on Kauai during strong wind events.

A. evecta was adopted as a KISC target in 2010 (Table 1 of main report). There are 18 known locations of *A. evecta* in Kauai (Figure C4- 1), with sites apparently restricted to mesic – moist habitats (Price et al. 2012). The distribution of this plant is widespread, with locations found in all five of Kauai's judiciary districts. Location information is derived from early detection survey data, invasive species reports to KISC as well as from multiple agencies including National Tropical Botanical Garden digitized herbarium data, DLNR's Division of Forestry and Wildlife and The Nature Conservancy.

Invasive Impacts Score

1. Impact on natural community structure and/or composition

Score: 3 = Major impacts

A. evecta was assigned a score of 3 in the “Impacts to Natural Communities” category due to its ability to spread rapidly over long distances and impact native habitat and watershed health. *A. evecta* is thought to be capable of transforming streams and drainages due to its known capacity to form thickets on Oahu. Additionally, locations of this plant were present in seven pop ref polygons also containing PEP (Plant extinction and Prevention Program) species (Map not shown).



Figure C4- 2. Photo of *Angiopteris evecta* on Manoa Falls trail on Oahu (adjacent to introduction site at Lyon Arboretum) displaying size and ability to overtop adjacent vegetation.

2. Impacts to Agriculture, Culture and other Human Systems

Score: 0 = No perceivable impact

No impacts to agriculture are known.

3. Impacts to Biotic and Abiotic Processes

Score: 3 = Major Impacts

A. evecta was assigned a score of 3 in the “Impacts to Biotic and Abiotic Processes” section due to potential impacts on soil nutrient cycling and its propensity to colonize streams, thereby altering hydrological processes (Staples and Herbst 2005). Results from a recent and soon to be published study on the island of Moorea in French Polynesia indicate that presence of *A. evecta* rhizomes may facilitate *Miconia calvescens* germination by increasing potassium and phosphorous in the germination substrate (Lee 2016).

TOTAL INVASIVE IMPACTS SCORE: 6

Feasibility of Control Score

Feasibility of Control Scoring and rationale for *A. evecta* is presented below. Refer to Appendix A for details regarding the Invasive Impact Score.

Delimiting Survey:

Score: 0 = Impossible

Feasibility of a delimiting survey for *A. evecta* was given a score of 0 because the infestation is currently widespread on Kauai with several sightings in remote areas. Multiple helicopter surveys are necessary to gain better knowledge of *A. evecta*'s distribution, which is not financially feasible under KISC's as-is budget and operations. Additionally, due to its ability to tolerate shade and colonize low-lying sites, it is likely that helicopter surveys will be unable to detect all individuals in ecosystems with dense/tall canopy. A few locations are found in cultivation, where it is the centerpiece for landscaping, and thus the landowners are reluctant to allow removal. Of the 18 known locations, KISC has treated 6 sites.

Initial control:

Score: 1 = Substantial Effort

Feasibility of initial control for *A. evecta* was given a score of 1 because several small populations likely exist on difficult terrain requiring helicopter access. Considering the number of locations in remote areas, it is likely that many more populations exist than are currently detected. KISC has found control methods that are effective, but vegetative regrowth allows the plant to persist for multiple visits.

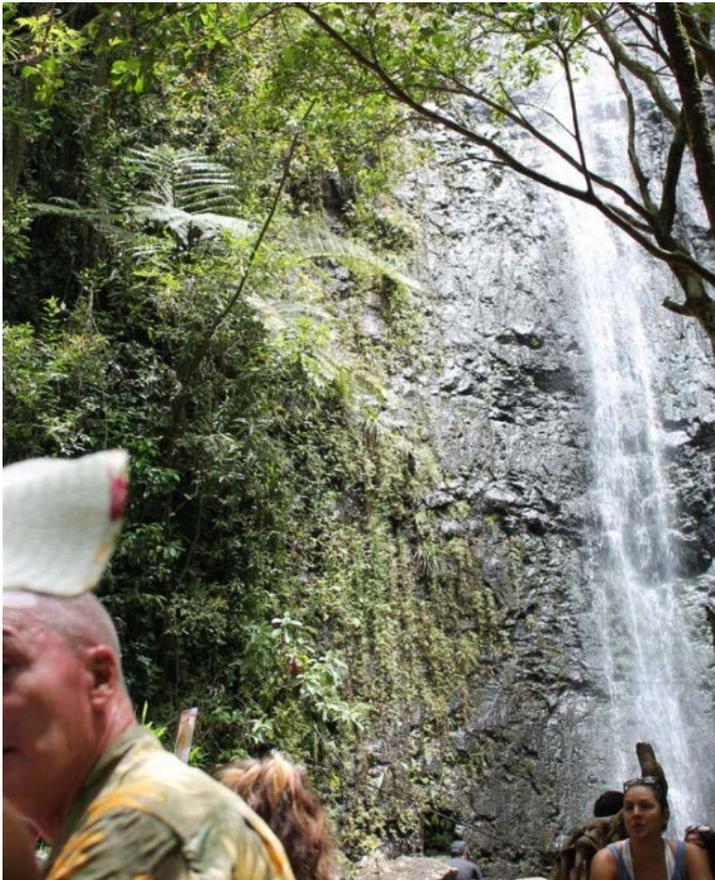


Figure C4- 3. Photo of *Angiopteris evecta* next to Manoa Falls on Oahu (adjacent to introduction site at Lyon Arboretum) showing ability to colonize difficult terrain.

Monitoring:

Score: 1 = Substantial Effort

Feasibility of monitoring for *A. evecta* was tentatively given a score of 1, although this score is directly dependent on the results of the delimiting survey. Planning resource requirements for effective monitoring is hindered by lack of data regarding how long spores can persist in the soil and remain viable. The 3-4 year maturity time for this plant potentially allows for infrequent (but regular) monitoring visits relative to other KISC targets. However, KISC control trials have observed that it's common for vegetative budding to occur after initial control, which may necessitate more frequent follow-up visits.

FEASIBILITY OF CONTROL SCORE: 2

COMBINED SCORE: 6 + 2 = 8

Literature Cited

- Christenhusz, M. J. M., and T. K. Toivonen. 2008. Giants invading the tropics: the oriental vessel fern, *Angiopteris evecta* (Marattiaceae). *Biological Invasions* 10:1215-1228.
- HPWRA. 2012. *Angiopteris evecta*. Hawaii Pacific Weed Risk Assessment
- Lee, J. 2016. Biological facilitation of the giant tree fern *Angiopteris evecta* in the germination of the invasive velvet tree *Miconia calvescens*. Biological facilitation of the giant tree fern *Angiopteris evecta* in the germination of the invasive velvet tree *Miconia calvescens*. *PeerJ Preprints* 4:e2643v2641
- Price, J. P., J. D. Jacobi, S. M. Gon, III, D. Matsuwaki, L. Mehrhoff, W. Wagner, M. Lucas, and B. Rowe. 2012. Mapping plant species ranges in the Hawaiian Islands—Developing a methodology and associated GIS layers. Page 34. s: U.S. Geological Survey Open-File Report
- Staples, G., and D. Herbst. 2005. *A tropical garden flora: plants cultivated in the Hawaiian Islands and other tropical places*. Bishop Museum Press., Honolulu, HI.
- Wood, K. R. 2006. New Plant Records and Rediscoveries within the Hawaiian Islands. *Bishop Museum Occasional Papers* 88:18-19.