 <b>KISC</b> KAUAI INVASIVE SPECIES COMMITTEE	<i>Kauai Status</i>	<i>KISC Status</i>	<i>HPWRA</i>	<i>Invasive Impacts Score</i>	<i>Feasibility Score</i>	<i>Combined Score</i>
<b><i>Flemingia macrophylla</i></b> (large leaf flemingia)	PRESENT	EARLY DETECTION	EVALUATE (5)	6	7	13

Initial PFC report completed: October 2017

PFC report updated as of: N/A

Current Recommendation for KISC: Consider eradication pending scoring rank and committee review

**Knowledge Gaps and Contingencies:**

- 1) Delimiting surveys surrounding known locations are critical to the Feasibility Score, and are necessary to determine the extent and density of the population.
- 2) Data regarding potential impacts is sparse. Populations should be monitored during future early detection surveys to accumulate additional information, which may influence the Invasive Impacts Score.

## Background

*Flemingia macrophylla* (Fabaceae), or “large leaf flemingia”, is a small tree or shrub that is cultivated throughout the tropics, usually as a cover crop to improve soil fertility (Blair et al. 2005). Although *F. macrophylla* was detected and investigated by KISC during 2013, it was not taken on as a KISC Target for eradication. Thus, the purpose of this prioritization assessment report is to evaluate whether KISC should attempt eradication (i.e. accept “Target” status) or joint control with partnering agencies (i.e. accept as “Partnership” species status), while providing a record of decision making. This will be informed by scoring and comparing *F. macrophylla* to other “Early Detection” species known to Kauai (See Table 5 in KISC Plant Early Detection Report for status terminology).

## Detection and Distribution

*F. macrophylla* was first vouchered on Kauai during a survey conducted by the KISC crew in 2013 (KISC s.n., PTBG) in Wailua Homsteads. According to the most recent account of naturalized plants statewide, it is currently considered naturalized on Hawaii Island (Imada 2012). However, 2015-2017 KISC early detection surveys reveal that it should now be considered naturalized on Kauai as well (K. Brock, 747, PTBG). On Kauai, there are three recorded sites of *F. macrophylla*, all of them within a 2 km radius of the Kauai Agricultural Research Station, where it was apparently once cultivated for research purposes. Together, these sites are distributed across 2 districts (Lihue, Kawaihau) and 1 watershed (Wailua) (Figure C20- 1). One site is located at the research station, where it is no longer cultivated but can be seen occasionally in unmaintained areas. A second site (detected in 2013) is located 1.5 km east of the research station in a patch of alien forest in Wailua Homsteads and a third site is located 2km to the south, naturalized along the edge of an alien forest. It’s unclear how many mature plants are present at the Wailua Homsteads site, but approximately 30 (20 mature) plants were seen at the site south of the research station. Additionally, immature plants can occasionally be seen in the immediate vicinity of the research station during 2015-2017 surveys, although they are frequently removed during routine maintenance. However, these sites likely do not represent all sites within the immediate area as KISC staff recalls seeing it sprout up along the ditch of Kuamoo road between roadside mowings.

Distributions of known sites imply 3 possible scenarios:

- 1) Assuming that the research station is the only site of introduction for this plant, seeds must be dispersed by birds because the site south of the research station is on the other side of the Wailua River (but, bird-dispersal of *F. macrophylla* has never been recorded (HPWRA. 2003)), or
- 2) *F. macrophylla* was planted in multiple places in the Wailua Homsteads area, including on agroforestry lands south of the Wailua River, or
- 3) Plants radiate from an introduction site at the research station and are continuously distributed throughout the entire area (reflecting short-distance dispersal patterns) but detection of the plant is biased by surveys conducted in easily accessed areas only.

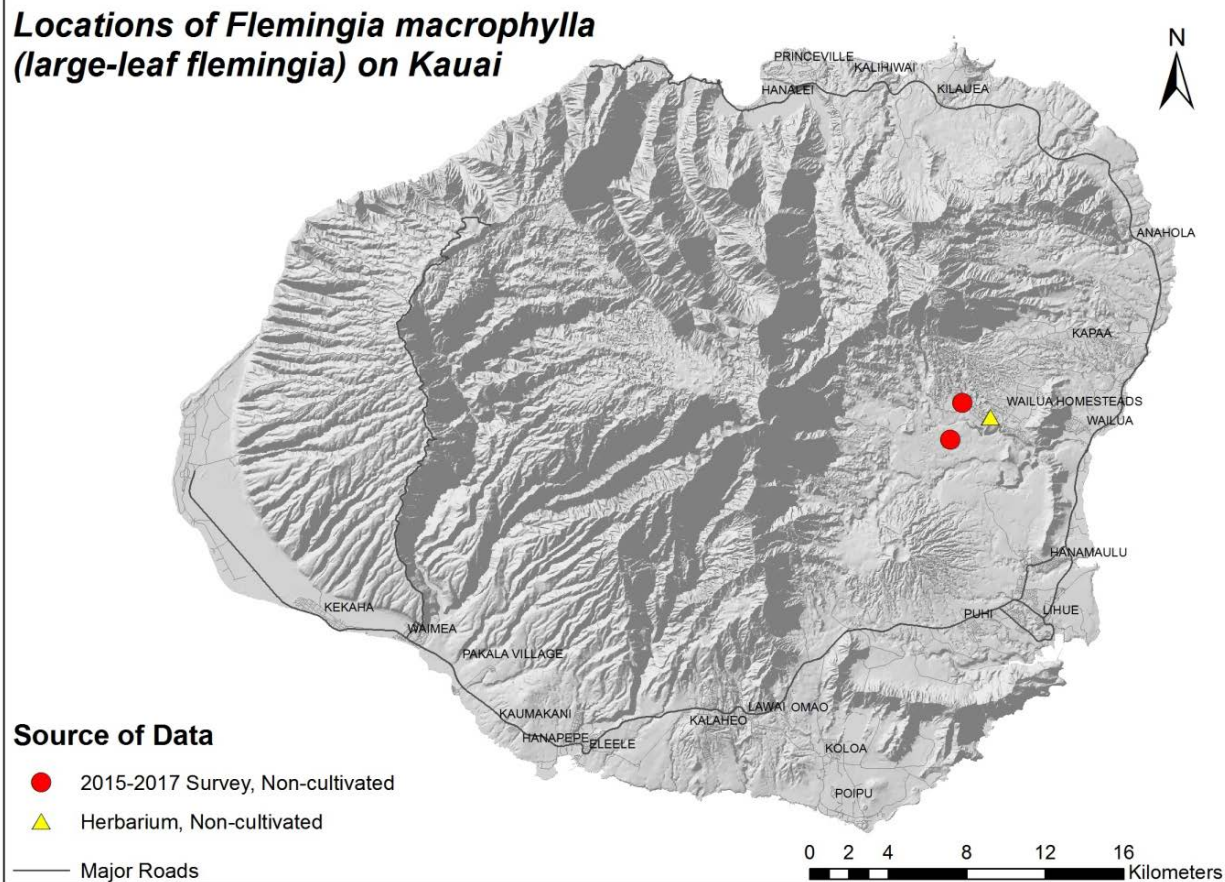


Figure C20- 1. Locations of *F. macrophylla* on Kauai. Locations where presence of the plant was confirmed during 2015-2017 surveys are denoted by red circles.

### Hawaii Pacific Weed Risk Assessment (HPWRA) Score

*F. macrophylla* is designated as “Evaluate”, receiving a score of 5 (HPWRA. 2003, Daehler et al. 2004). Traits contributing to this status are listed below according to whether they pertain to the likelihood a plant will invade vs. the consequences of the invasion, according to Daehler and Virtue (2010). Categorization of traits in this manner more accurately informs invasive impact potential scoring and prioritization of species that are already established on Kauai.

<i>Likelihood of Invasion</i>	<i>Consequences of Invasion</i>
<ul style="list-style-type: none"> <li>• Well suited to climates in Hawaii</li> <li>• Repeatedly introduced and naturalized in areas with comparable climates</li> <li>• Shade tolerant</li> <li>• Tolerates a wide range of soil conditions</li> <li>• Produces viable seed</li> <li>• Self-compatible</li> <li>• Matures in less than 1 year</li> <li>• Propagules dispersed intentionally</li> <li>• Benefits from disturbance</li> </ul>	<ul style="list-style-type: none"> <li>• Nitrogen fixer</li> </ul>

Refer to the full Weed Risk Assessment for *F. macrophylla* at <https://sites.google.com/site/weedriskassessment/assessments/Download-Assessments>.

## Invasive Impacts Score

### 1. Impact on natural community structure and/or composition

**Score: 2** = Minor impacts

*F. macrophylla* was assigned a score of 2 in this category, although very little data is available to inform this scoring. In Tonga, it was listed in a report identifying invasive species of environmental concern, but this species was specifically mentioned to communicate that it is starting to naturalize where planted. Although the authors suggest that it should not be cultivated in new areas, it doesn't document invasive impacts to native communities (Space and Flynn 2001). Given that it has been cultivated throughout the tropics for many decades (Hess et al. 2008, Oiticica et al. 2015), one would expect some publication regarding its impacts if it has become a serious environmental weed elsewhere. However, minor or moderate weeds are often unstudied. The sparse data collected in Kauai suggests that *F. macrophylla* grows rapidly and colonizes disturbed soil. The population of 30 individuals south of the research station on Kauai occupies alien forest edges where soil is eroding into a ditch. This indicates that it may invade disturbed habitats, but it may be less likely to colonize stable native climax communities. As a small tree or shrub, it is likely to persist in the mid-low canopy of remnant alien/native ecosystems in moist, lowland environments. No data suggests that it will displace native plants in more intact ecosystems.

However, *F. macrophylla* appears to be able to germinate and establish in shaded areas on Kauai, and global data indicates that it can be cultivated in very wet soil and at high elevations up to 2000m (Orwa et al. 2009). Furthermore, many disturbances including invasive animals, human impacts and climate change occur in Kauai's native habitats. Thus, regardless of whether this plant is accepted as a KISC target, continuous monitoring should be completed to assess the ability of this plant to affect high value native habitats at high elevations.

### 2. Impacts to Agriculture, Culture and other Human Systems

**Score: 2** = Moderate Impacts

*F. macrophylla* received a score of 2 because it has been deemed invasive on several Pacific islands according to the Pacific Island Ecosystems at Risk project (PIER 2013), although no specific impacts have been recorded. Additionally, it is regarded as invasive in Reunion (Tassin et al. 2006) and has been recommended for control on certain islands in Samoa, Cook Islands and Tonga (Space and Flynn 2001, 2002a, b). This plant grows rapidly and colonizes disturbed areas and data from Kauai suggests that long distance dispersal is possible, indicating that this plant may spread throughout the island quickly. Thus, it will likely become at least a moderate pest of human-controlled systems including residential areas, gardens/landscapes, forestry plantations and agricultural crops that have multi-year turnovers.



Figure C20- 2. *F. macrophylla* naturalizing under *Falcataria* (albezia) canopy along the edge of an alien forest 2km south of the potential site of introduction on Kauai.

### 3. Impacts to biotic and abiotic processes

**Score: 2** = Moderate Impacts

*F. macrophylla* was assigned a score of 2 because this plant is likely to influence soil nutrient cycling via nitrogen fixation. Additionally, the leaf litter of this species is known to persist for a long time, shading seedlings germinating immediately below the plant and altering carbon stores (Dzowela et al. 1995, Blair et al. 2005, Hess et al. 2008, Oiticica et al. 2015). Although *F. macrophylla* is often planted because these traits improve soil for agricultural purpose, it is possible that nitrogen and carbon accumulation in Kauai soils will facilitate invasions by other quick-growing alien species that can take advantage of high soil nutrients. *F. macrophylla* was not assigned a score of 3 because it has not been recorded as forming pure stands, and thus, it's unclear how much soil nutrient cycling will be altered if individuals are distributed sporadically.

**TOTAL INVASIVE IMPACTS SCORE: 6**

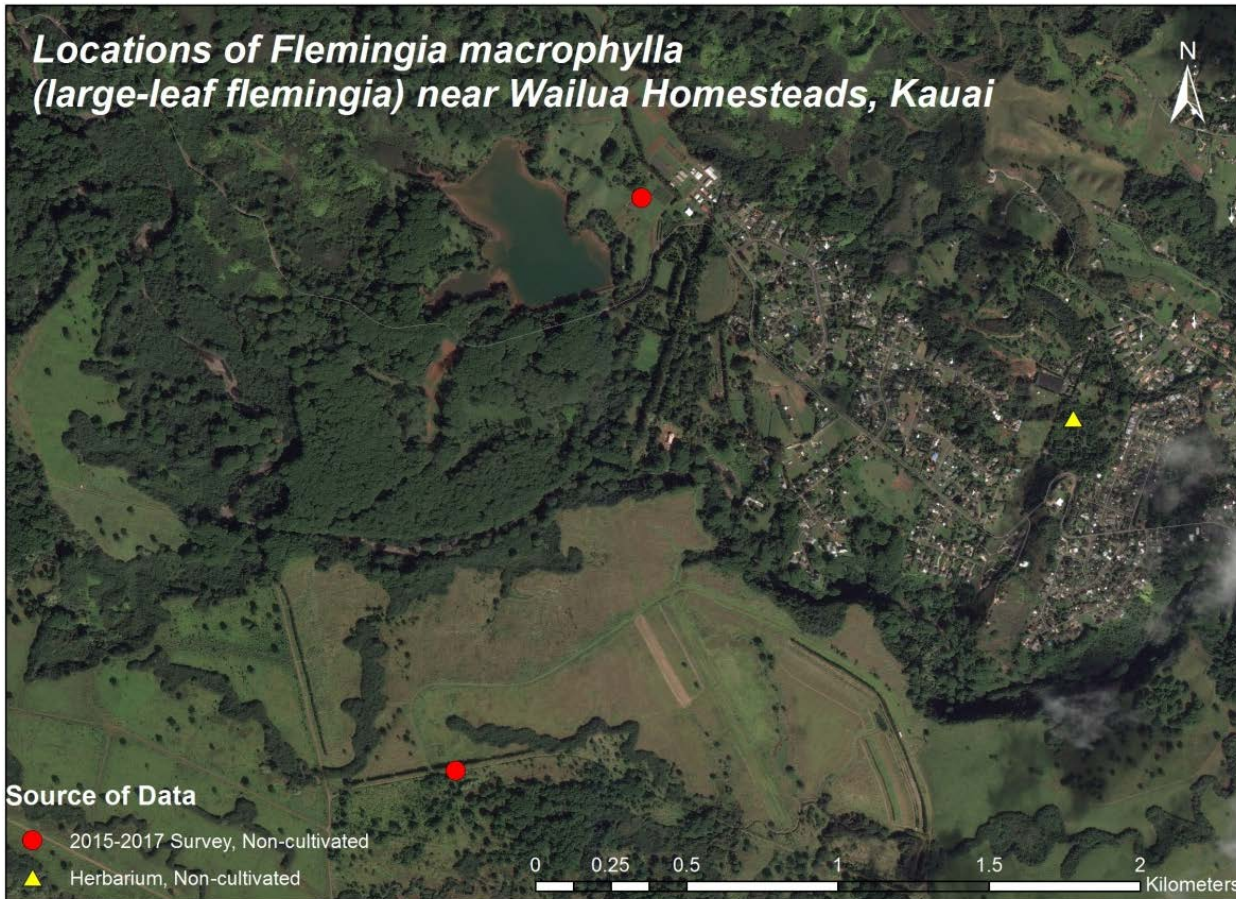
### Feasibility of Control Score

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

### Delimiting Survey:

**Score: 2** = Moderate Effort

Feasibility of a delimiting survey for *F. macrophylla* was given a score of 2 because although there are only 3 known sites, the dispersal vector and number of plants between these sites is unclear (See Detection and Distribution Section above). The area between known sites needs to be searched since it is possible that plants are spreading from a single introduction point at Kauai Agricultural Research Station. Terrain in this area is difficult, especially along the Wailua river valley, which will make surveying slow or perhaps impossible in very steep areas. However, some of this area overlaps with the miconia search buffer zone, so reconnaissance surveys in this area could search for both species. This score may be downgraded to a 1 or 0 if substantially more individuals are found or if they are much further distributed than indicated by current data.



**Figure C20- 3. Map of *F. macrophylla* locations on Kauai with red circles denoting locations where presence of the plant was confirmed in 2015-17 surveys. Observations by KISC staff in the past indicate that it has also been observed growing along Kuamoo road (not indicated on map) southeast of the research station (northern-most red dot).**

**Initial control:**

**Score: 2 = Moderate Effort**

Feasibility of initial control for *F. macrophylla* was given a score of 2 because although survey data has enumerated only 50 plants, uncertainties in how this plant is dispersed and verbal reports of this plant occurring periodically along Kuamoo road suggest that more plants are present. If it is determined that the plant is spreading from the Kauai Agricultural Research Station by short-distance dispersal (See Detection and Distribution Section above), then this indicates that the population is quite dense, requiring many individuals to be controlled. Thus, this score may be downgraded to a 1 or 0 if substantially more individuals are found during delimiting surveys.

## Monitoring:

Score: 3 = Minimal Effort

Feasibility of monitoring for *F. macrophylla* was given a score of 3, but it assumes that the delimiting survey will not reveal significantly more sites. Although *F. macrophylla* is known to form a seed bank (Luo and Wang 2006), it is hypothesized that it is short lived since seeds stored in ideal conditions spoil quickly due to high fat content (HPWRA. 2003). Because the plant matures rapidly (matures and produces seed within 6-7 months), return intervals must be short to make progress towards eradication. Since germination begins to decline after 6 months (HPWRA. 2003), KISC crew can move to an infrequent monitoring schedule 2-3 years after regeneration ceases.

FEASIBILITY OF CONTROL SCORE: 7

COMBINED SCORE = 6 + 7 = 13

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