KISC KAUAI INVASIVE SPECIES COMMITTEE	Kauai Status	KISC Status	HPWRA	Invasive Impacts Score	Feasibility Score	Combined Score
Morella cerifera (wax myrtle)	**Present**	**EARLY DETECTION**	**HIGH RISK (21)**	**9**	**6.5**	**15.5**

Initial PFC report completed: December 2017
PFC report updated as of: N/A
Current Recommendation for KISC: Pending Ranking and Committee approval (Remove known patch; return to survey list to document distribution?).
Knowledge Gaps and Contingencies:

1) Surveys around known locations are required to gain knowledge of whether viable seed has been produced
2) Landowner cooperation is necessary to remove cultivated trees
3) Outreach effort is necessary to increase chances that individuals at private residences are reported.

Background

Morella cerifera (Myricaceae), or "wax myrtle", is a large shrub or small tree that has been occasionally cultivated as an ornamental and forestry species in Hawaii (Starr et al. 2003, HPWRA 2012). *M. cerifera* has been controlled by KISC in the past and has been considered an "Early Detection" species since it was detected during 2010 Early Detection Surveys. Additionally, this plant is listed on KISC's Pono Endorsement "Black List" to minimize its spread through the nursery trade. Although all plants found during 2010 surveys were removed, additional plants have been detected since. This prioritization assessment report was written to evaluate whether KISC should eradicate (i.e. accept "Target" status) this plant from Kauai. This will be informed by scoring this plant relative to other "Early Detection" species known to Kauai (See Table 5 in KISC Plant Early Detection Report for status terminology).

Detection and Distribution

M. cerifera was first detected on Kauai in 2010 when it was deemed "adventive" according to the Hawaii Vascular Plant Checklist (Frohlich and Lau 2012, Imada 2012). Statewide, *M. cerifera* is considered naturalized on Maui and Hawaii islands (Imada 2012) and is currently targeted for eradication by the Big Island Invasive Species Committee (BIISC 2017). Records of forestry species planted on forest reserves in Hawaii between 1910-1960 indicate that *M. cerifera* was not planted on Kauai as a part of government-lead programs, although 50 individuals were planted on Oahu (Skolmen 1980). Two *M. cerifera* sites were detected on Kauai in 2010 and removed shortly thereafter. One site in Haena was spreading by root suckering and a second site in Kapaa was found growing out of a hedge with the field remarks "cultivation status unknown" for both sites (Figure C34- 1). However, 2015-2017 survey and partner agency reports detected another site in Nawiliwili consisting of two cultivated and heavily pruned shrubs (K. Brock 724, PTBG). The sex and reproductive status of these trees remain unclear because no flowers or fruit were seen during surveys. Most *M. cerifera* individuals are dioecious, requiring both male and female plants to be present to produce viable seed (Brown and Cooprider 2011). This reproductive trait may explain why clearly naturalized individuals have not been detected in Kauai, although apparently monoecious (both female and male flowers on one plant) individuals can sometimes be found in its native range (Brown and Cooprider 2011). Combined, these data indicate that this plant has been planted in the Lihue, Kawaihau and Hanalei judiciary districts although plants were removed from all but the Lihue district where one cultivated site persists on the border of the Hulei and Puali watersheds.

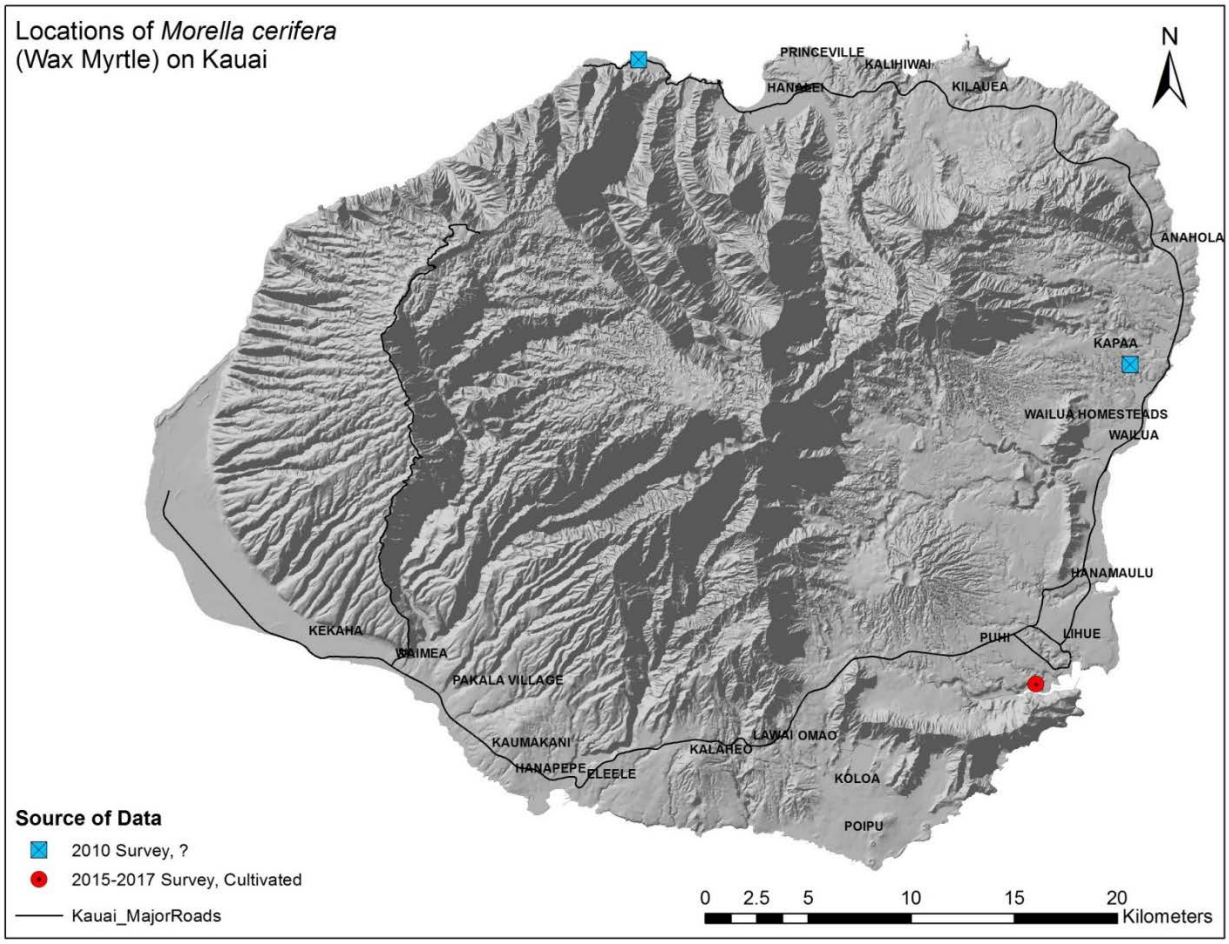

Figure C34- 1. Locations of *M. cerifera* on Kauai. Blue squares denote sites that were detected during 2010 where known plants have likely been eradicated. Red circles denote sites that were detected during 2015-2017 surveys.

Hawaii Pacific Weed Risk Assessment (HPWRA) Score

M. cerifera is designated as "High Risk", receiving a score of 21 (HPWRA 2020). 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.

Likelihood of Invasion	*Consequences of Invasion*
• Well suited to climates in Hawaii • Naturalized outside of its native range in tropical/subtropical climates • Shade tolerant during some phase of its lifecycle • Tolerates a wide range of soil conditions • Produces viable seed • Hybridizes naturally • Reproduces by vegetative fragmentation • Propagules dispersed intentionally by people • Propagules dispersed by birds • Propagules survive passage through the gut • Benefits from disturbance	• A weed of agriculture, forestry, or horticulture • An environmental weed • A congeneric weed, sharing a genus with other known weeds (i.e. implies inheritance of tendencies to inflict invasive impacts) • Allelopathic • Creates a fire hazard in natural ecosystems • Forms dense thickets • Fixes nitrogen

Refer to the full Weed Risk Assessment for *M. cerifera* at https://sites.google.com/site/weedriskassessment/assessments/Download-Assessments.

Invasive Impacts Score

1. Impact on natural community structure and/or composition

Score: 3 = Major impacts

M. cerifera was assigned a score of 3 because its ability to invade native habitat has been observed in Hawaii from 100m to over 1000m in elevation (Kurten et al. 2008, Frohlich and Lau 2012). Kurten et al. (2008), who investigated the invasive potential of a young invading stand in Hilo, predict that *M. cerifera* poses a threat to lowland Hawaiian ecosystem similar to what is observed in montane areas with *M. faya*, which is a transformative invader in Hawaii (Vitousek et al. 1987). Notably, *M. cerifera* is a common, thicket forming shrub in its native range (southeast North America – Central America) exhibiting strong tolerance to saline soils in coastal environments (Shiflett et al. 2017). Its ability to form thickets in its native range has made it the subject of research projects attempting to understand traits contributing to plant ecosystem dominance (Brantley and Young 2010, Shiflett et al. 2017). In Florida, it is considered to be a native plant that can become invasive under certain circumstances, and has become more common as human-caused disturbances increase (HPWRA 2012). Although *M. cerifera* is known to prefer disturbed sites, rapid colonization of bare soil ahead of other species is not required to displace native species as saplings can establish in shaded understories (Kurten et al. 2008, Shiflett et al. 2017). These studies indicate that this species could potentially impact a broad range of natural ecosystems of Kauai by rapidly colonizing and outcompeting native vegetation, especially on slopes and where soil is disturbed. Once established, dispersal of seeds by birds is likely to facilitate rapid spread. Additionally, the existing site is located in a POPREF polygon (Huleia –HUL) containing PEP plants. Differences in soil between Kauai and the younger Maui and Hawaii islands may affect the invasive potential of this nitrogen-fixing shrub (Cordell et al. 2001), but this scoring has conservatively assumed that potential impacts are comparable to those predicted from neighboring islands.

2. Impacts to Agriculture, Culture and other Human Systems

Score: 3 = Major impacts

M. cerifera received a score of 3 because its ability to rapidly colonize disturbed sites in a broad range of climates may allow it to colonize human-controlled systems including residential areas, gardens/landscapes, forestry plantations and agricultural areas on Kauai. It is considered one of the worst weeds of pastures in Florida and has colonized approximately 800,000 hectares of agricultural land, resulting in a reduction of grazing yield (Kalmbacher et al. 1993). Its known ability to invade lowland habitats on neighboring islands indicates that it is climatically well-suited to agricultural lands on Kauai, most of which are found below 200m elevation. Additionally, it is known to densely colonize the understory of forestry plantations (HPWRA 2012).

3. Impacts to biotic and abiotic processes

Score: 3 = Major Impacts

M. cerifera received a score of 3 in this section because of its ability to fix nitrogen and contribute to wildfire (Haywood et al. 2000, Kurten et al. 2008). Studies of an invaded forest in Hilo, Hawaii showed that *M. cerifera* was able to alter nitrogen uptake in adjacent native vegetation (*Metrosideros*) in a nitrogen-poor lava flow, which was dominated by early successional native species that are tolerant of low nitrogen soils (Kurten et al. 2008). Nitrogen fixation may facilitate invasions of other alien species that are able to out-compete native species for soil resources (Simberloff et al. 2013). Additionally, the leaves and fruits of *M. cerifera* are coated in a highly flammable wax, increasing the likelihood and magnitude of fire in invaded ecosystems (Haywood et al. 2000).

TOTAL INVASIVE IMPACTS SCORE: 9

Figure C34- 2. *M. cerifera* invasion at Polipoli, Maui (Photo Credit: F. & K. Starr)

Figure C34- 3. *M. cerifera* invasion at Waiale Gulch, Maui (Photo Credit: F. & K. Starr)

Feasibility of Control Score

Feasibility of Control Scoring and rationale for *Morella cerifera* 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 *M. cerifera* was given a score of 2 because additional surveys should be conducted surrounding sites detected in 2010 as surveyors indicated that the cultivation status of the plants was unclear, which may indicate that mature plants are nearby. Additionally, areas surrounding the current site at Nawiliwili have not been searched for saplings. As all plants have been found in private residences, outreach efforts to the public are necessary to increase detection of other plants occurring on private land.

Initial control:

Score: 2 = Moderate Effort

Feasibility of initial control for *M. cerifera* was given a score of 2 because the trees in Nawiliwili are located at the entrance to a gated community, making it difficult to identify someone in charge of landscaping. No one has responded to KISC's efforts to communicate, although information packages have been left multiple times for the landowner at the site.

Monitoring:

Score: 2.5 = Moderate-Minimal effort

No information is available to predict the ability of *M. cerifera* seeds to persist in the soil, although some reports hint that germination can be delayed if the waxy coating on the fruit is delayed (HPWRA 2012). Adding to this uncertainty is that it is unknown whether any plants have produced seed on Kauai, as no fruits or flowers have been observed, and the sex of the plants have not been determined. This indicates that at least some follow-up visits are necessary, although the duration may be short if no seedlings are detected.

FEASIBILTY OF CONTROL SCORE: 6.5

COMBINED SCORE: 9 + 6.5 = 15.5

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