	<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>Alstonia macrophylla</i></b> (deviltree)	PRESENT	EARLY DETECTION	HIGH RISK (9)	5.5	6	11.5

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 required to confirm that new plants haven't established.
- 2) Further communication is needed to gain permission from a landowner who has previously denied removal of one tree.
- 3) An assessment of how costly/necessary it is to hire a certified arborist and equipment to haul away debris.
- 4) An invasive plant prevention plan designed to encourage collaboration between Botanical Gardens and local conservation agencies should be considered.

## Background

*Alstonia macrophylla* (Apocynaceae), or “deviltee”, is a large tree that is cultivated in some tropical regions as an agroforestry species and as a medicinal plant known to people of Thailand, Malaysia and the Philippines (Khyade et al. 2014). It is occasionally cultivated as an ornamental. *A. macrophylla* gained a KISC status of “Early Detection” in 2010, when early detection surveys detected one tree in Kapaa and recommended it for eradication. Control arrangements were investigated shortly afterwards, but the tree was purposefully planted and the owner expressed a strong desire to keep it. Thus, the purpose of this prioritization assessment report is to reevaluate whether KISC should reattempt eradication (i.e. accept “Target” status) by scoring and comparing *A. macrophylla* to other “Early Detection” species known to Kauai. This will determine how much effort and resources should be spent convincing known land owners and assessing new sites, which may affect KISC’s reputation and be a time consuming venture.

## Detection and Distribution

Statewide, *A. macrophylla* is considered naturalized on Hawaii Island and Oahu (Imada 2012). Herbarium vouchers of *A. macrophylla* at National Tropical Botanical Garden (NTBG) in Lawai indicate that it has been present, but not naturalized, on Kauai as early as 1989 (T. Flynn 3320, PTBG). Despite being used as a forestry tree elsewhere in the world, it is not listed as being planted on Kauai Forest Reserves between 1910-1960 by the US Forest Service (Skolmen 1980), although this list is not an exhaustive account of trees used for forestry purposes across Kauai. 2015-2017 early detection surveys confirmed the presence of a single cultivated tree in Kapaa that was detected in 2010 (Figure C3- 1). Although this tree was observed producing a large amount of seed, no seedlings were observed beneath the tree or in the adjacent disturbed, residential habitat in either 2010 or 2017. Additionally, at least one tree is cultivated as part of NTBG’s living collection in Lawai valley (Figure C3- 1). Combined, these data indicate that this plant is cultivated in the Kawaihau and Lihue districts, occupying 2 watersheds.

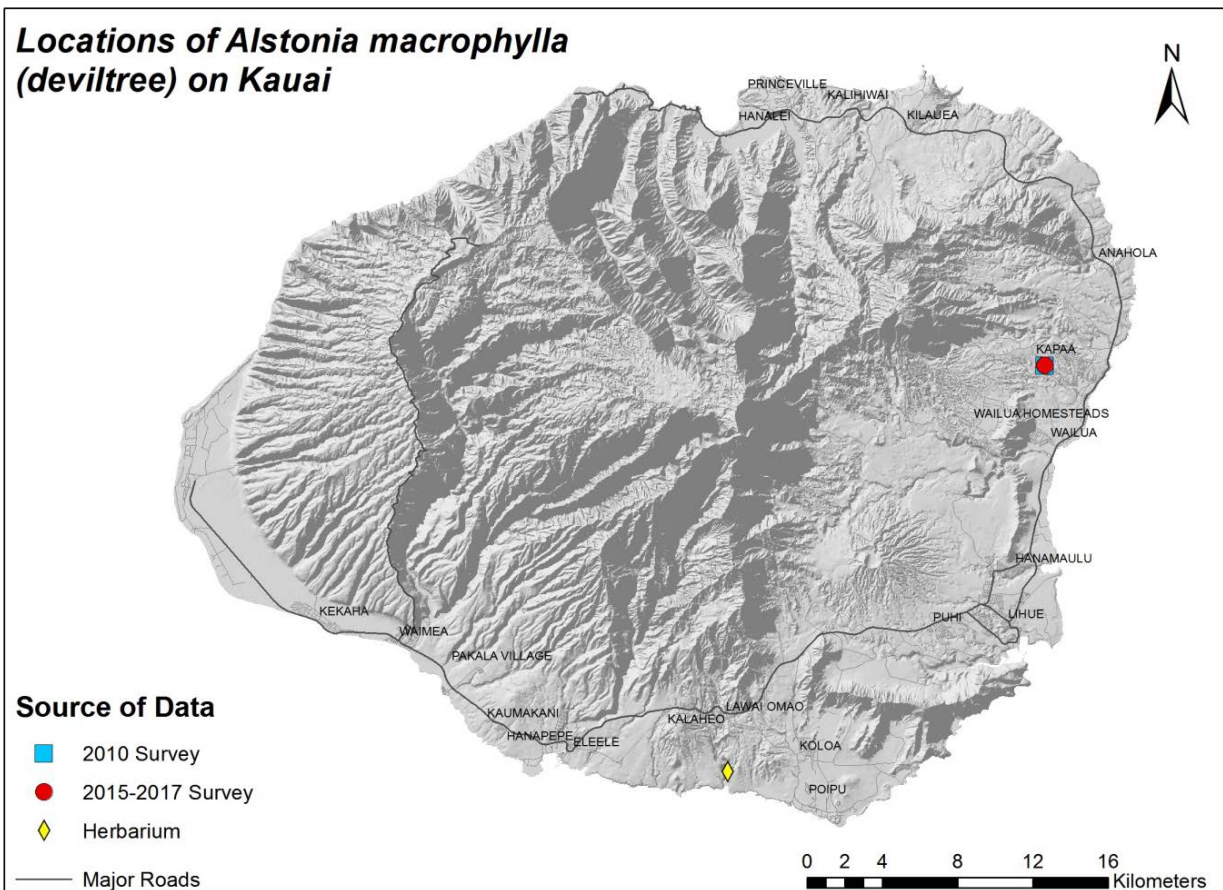


Figure C3- 1. Locations of *A. macrophylla* on Kauai. Locations where presence of the plant was confirmed during 2015-2017 surveys are denoted by red circles (in Kapaa).

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

*A. macrophylla* is designated as “High Risk”, receiving a score of 9 (Daehler et al. 2004, HPWRA 2008). 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>• Propagules dispersed intentionally by people</li> <li>• Propagules wind dispersed</li> <li>• Prolific seed production (&gt;1000/m<sup>2</sup>)</li> <li>• Benefits from disturbance</li> </ul>	<ul style="list-style-type: none"> <li>• A weed of gardens/amenities/disturbed areas</li> <li>• Toxic to animals</li> </ul>

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

## Invasive Impacts Score

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

**Score: 2.5** = Moderate impacts

*A. macrophylla* was assigned a score of 2.5 mainly because of records detailing its invasive impacts in Sri Lanka and the Seychelles. Today, it is known as one of the top 10 most problematic invasive plants of wet, mid-altitude – montane forests in Seychelles alongside other invasive plants well known to Kauai including *Falcataria moluccana* and *Psidium cattleianum* (Kueffer et al. 2008) (Figure C3- 2). Although it is naturalized from sea level - 1500m on Sri Lanka, its impacts to native habitats are most noted in forests that have experienced recent disturbance (Dilrukshi and Ranwala 2016, MMDE 2016). This indicates that similar behavior may be possible on Kauai if it were to become established in high-elevation, native-dominated habitats, since many of them are subject to disturbance from invasive animals and climate change. The range of invasion in Sri Lanka at higher elevations may also hint that currently known trees on Kauai may not be showing obvious signs of invasiveness because they are planted at low elevations, which are less ideal for seed germination or seedling survival (MMDE 2016). The cultivated tree in Kapaa has been seen producing fruits and seeds prolifically but no seedlings have been observed, suggesting seed germination or seedling survival may be low. However, no specific mapping of *A. macrophylla* or any attempts to quantify its impacts across elevation gradients has been done to support this possibility. *A. macrophylla* has started to naturalize on Hawaii Island and Oahu, although no reports of invasive impacts have been noted. However, because of its large size and ability to overtop other vegetation (Figure C3- 3), even sparse densities of this plant are likely to have some impacts on adjacent vegetation. Furthermore, long-distance dispersal of the light, fluffy seeds may facilitate a rapid spread after it becomes established. It received a score of 2.5 instead of 3 because although some reports indicate invaded stands can be dense, it does not form monotypic stands and therefore, some native vegetation can remain in the lower canopy. On Kauai, locations of *A. macrophylla* are present in one POPREF polygon containing PEP plants (Kapaa -KAP).



**Figure C3- 2. Photo of *A. macrophylla* invasion (tall, thin trunks, forming upper-most canopy with lighter green leaves) in Sri Lanka (MMDE 2016).**



Figure C3- 3. *A. macrophylla*, naturalizing near Hilo on Hawaii Island (J.B Friday photo)

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

### Score 1 = Minor impacts

*A. macrophylla* received a score of 1 because of its known propensity to colonize disturbed sites and produce numerous seeds. In suitable climates, these traits will likely cause some impacts to gardens/cultivated sites and forestry plantings, requiring time and resources to control saplings. However, most references to its invasiveness are with regards to natural habitats at higher elevations than most human settlements on Kauai (MMDE 2016). Continuing early detection surveys are required to monitor existing populations for seedling germination to determine Kauai-specific invasive potential.

## 3. Impacts to biotic and abiotic processes

### Score 2 = Moderate Impacts

*A. macrophylla* was assigned a score of 2 because of studies showing the toxicity of plants in the genus *Alstonia*. Bark and leaf extracts from *A. scholaris* can be applied as a lethal herbicide on herbs (Javaid et al. 2010), implying that leaf and bark accumulation of *A. macrophylla* in the soil may injure and suppress adjacent plants sharing the same rooting

zone. The soil beneath the known *A. macrophylla* is somewhat barren of vegetation (observed in 2017), but is also heavily shaded by the canopy, so it's hard to say whether soil toxicity is influencing this observation. Additionally, large doses of *A. scholaris* extract given to mice and rats orally are lethal, causing multi-system organ failure (Baliga et al. 2004). However, it is unknown whether this effect would be as strong in *A. macrophylla* and if there'd ever be circumstances where the dosage would be high enough to have an effect on humans or wildlife on Kauai.

**TOTAL INVASIVE IMPACTS SCORE: 5.5**

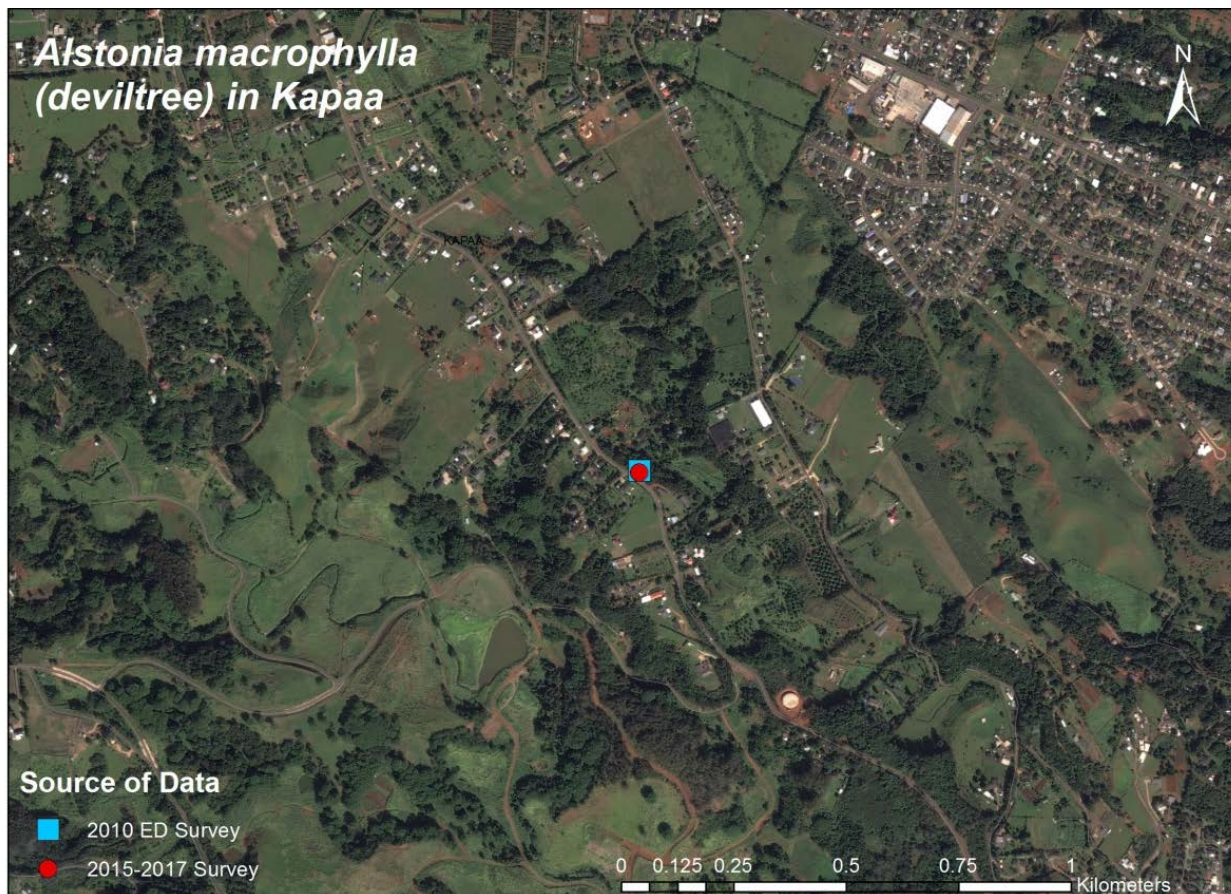
### Feasibility of Control Score

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

#### Delimiting Survey:

**Score 3 = Minimal Effort**

Feasibility of a delimiting survey for *A. macrophylla* was given a score of 3 because only 2 trees are known to exist on Kauai presently, and although it is occasionally sought out for cultivation, it has not been noted in the nursery trade on Kauai. Delimiting surveys can be completed by focusing downwind of known plants, as seeds are wind dispersed (HPWRA 2008, Dilrukshi and Ranwala 2016) (Figure C3- 4). However, KISC may choose to downgrade this score to a 2 or lower depending on saplings distribution. The seeds are known to be wind dispersed, but the single *A. macrophylla* tree in Kapaa did not show any signs of seedling production.



**Figure C3- 4. Map of *A. macrophylla* locations in Kapaa. Locations where presence of the plant was confirmed during 2015-2017 surveys are denoted by red circles.**

## Initial control:

**Score 1** = Major Effort

Feasibility of initial control for *A. macrophylla* was given a score of 1 because, despite there being only 2 trees existing on Kauai, there are known issues with the gaining landowner permission for the Kapaa site. Additionally, a second tree is present within the living collection at NTBG in Lawai and removal or management of certain plants may require significant effort. Since the tree in Kapaa is 10-12 meters tall, additional resources may be required to fell the tree safely (including a certified arborist) and equipment to haul away wood and debris.

## Monitoring:

**Score 2** = Moderate Effort

Seed viability studies have shown that 95% of the thin-coated seeds of *A. macrophylla* germinate within 20 days of sowing, and that long term dry storage viability starts to taper off after 6 months (Dayan et al. 2006). This indicates that the ability for this plant to form a seed bank that is greater than 2-3 years is low, although it's important to note that these results are derived from a laboratory study and factors that are variable in nature, like moisture, temperature and light, were not investigated. However, assuming that *A. macrophylla* specimens are not removed from the living collection at NTBG, continuous collaboration and monitoring for seedling survival is necessary to ensure a population does not establish and spread from this site.

**FEASIBILITY OF CONTROL SCORE: 6**

**COMBINED SCORE: 5.5 + 6 = 11.5**

## Literature Cited

- Baliga, M. S., G. C. Jagetia, J. N. Ulloor, M. P. Baliga, P. Venkatesh, R. Reddy, K. Rao, B. S. Baliga, S. Devi, S. K. Raju, V. Veeresh, T. K. Reddy, and K. L. Bairy. 2004. The evaluation of the acute toxicity and long term safety of hydroalcoholic extract of *Sapthaparna* (*Alstonia scholaris*) in mice and rats. *Toxicology Letters* **151**:317-326.
- Daehler, C. C., J. S. Denslow, S. Ansari, and H. C. Kuo. 2004. A risk-assessment system for screening out invasive pest plants from Hawaii and other Pacific Islands. *Conservation Biology* **18**:360-368.
- Daehler, C. C., and J. G. Virtue. 2010. Likelihood and consequences: reframing the Australian weed risk assessment to reflect a standard model of risk. *Plant Protection Quarterly* **25**:52-55.
- Dayan, M., R. S. Reaviles, and D. B. Bandian. 2006. Indigenous Forest Tree Species in Laguna Province. Ecosystems Research and Development Bureau Department of Environment and Natural Resources, Laguna, Philippines.
- Dilrukshi, I., and S. M. W. Ranwala. 2016. Kirigala forest fragments and the identity as a dipterocarp plantation or Hora Kele of Ingiriya. *Journal of the National Science Foundation of Sri Lanka* **44**:313-327.
- HPWRA. 2008. *Alstonia macrophylla*. Hawaii Pacific Weed Risk Assessment.
- Imada, C. T. 2012. Hawaiian native and naturalized vascular plant checklist (December 2012 update). , . Bishop Museum Technical Report 60/ Hawaii Biological Survey Contrib. 2012-021: 29 pp. + 27 appendices.
- Javaid, A., S. Shafique, and R. Bajwa. 2010. PARTHENIUM MANAGEMENT THROUGH AQUEOUS EXTRACTS OF ALSTONIA SCHOLARIS. *Pakistan Journal of Botany* **42**:3651-3657.
- Khyade, M. S., D. M. Kasote, and N. P. Vaikos. 2014. *Alstonia scholaris* (L) R. Br. and *Alstonia macrophylla* Wall. ex G. Don: A comparative review on traditional uses, phytochemistry and pharmacology. *Journal of Ethnopharmacology* **153**:1-18.
- Kueffer, C., G. Klingler, K. Zirfass, E. Schumacher, P. J. Edwards, and S. Gusewell. 2008. Invasive trees show only weak potential to impact nutrient dynamics in phosphorus-poor tropical forests in the Seychelles. *Functional Ecology* **22**:359-366.
- MMDE. 2016. Invasive Plants of Sri Lanka. Ministry of Mahaweli Development and Environment, Biodiversity Secretariat, Battaramulla, Sri Lanka.
- Skolmen, R. G. 1980. Plantings on the forest reserves of Hawaii 1910-1960. *in* U. S. Institute of Pacific Islands Forestry and F. Service., editors., Honolulu, USA.