 KISC 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>
<i>Bischofia javanica</i> (bishop wood)	PRESENT	EARLY DETECTION	HIGH RISK (7)	7	6	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 required to gain knowledge of whether additional trees have established from cultivated sites.
- 2) Landowner cooperation is necessary to remove cultivated trees
- 3) An assessment of equipment and personnel costs to fell and remove two large, cultivated trees.
- 4) Outreach effort is necessary to increase chances that individuals at private residences are reported.

Background

Bischofia javanica (Phyllanthaceae), or “bishop wood”, is sometimes planted as a fast growing shade tree and is occasionally used as a forestry species (Staples and Herbst 2005). *B. javanica* gained a KISC status of “Early Detection” in 2010, when early detection surveys detected it in Princeville and recommended it for eradication. Control arrangements were investigated shortly afterwards, but obstacles associated with removing two large trees from a golf course stalled progress. 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 *B. javanica* 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 be a time consuming venture (See Table 5 in KISC Plant Early Detection Report for status terminology).

Detection and Distribution

2010 surveys detected three *B. javanica* individuals in Princeville, two of which are ornamentals on a golf course and the other is single tree cultivated at a private residence. No herbarium records of *B. javanica* existed prior to 2015-2017 surveys (K. Brock 901, PTBG). Two additional sites were identified during 2015-2017 surveys: one consisting of a single tree at a nursery in Puhi, and another along the roadside in Princeville. Combined, sites of *B. javanica* occur across two districts (Hanalei, Lihue) and three watersheds (Waialeia, Anini, Huleia; Figure C5- 1). It appeared that the tree cultivated in the nursery had not been sold for a very long time; it was growing in an old storage area and the nursery manager was not familiar with recent sales of the plant. The roadside site in Princeville, consisting of 3 mature trees and a few saplings (or perhaps suckers), appears not to have been purposefully planted (Figure C5- 2). However, it will not be documented as a new naturalization record for Kauai alongside other species observed during 2015-2017 surveys, because there is some chance that these trees could have been cultivated and then abandoned. Statewide, it is currently known as naturalized on Oahu only (Imada 2012). *B. javanica* is dioecious, meaning that male and female flowers are located on different plants, and in this case, are required to cross-pollinate to produce viable fruit. One female and one male tree are present on a golf course in Princeville, with the female observed fruiting prolifically during 2015-2017 Surveys. As these fruits are known to be dispersed by birds and rats (Yamashita et al. 2003, Shiels 2011), it is possible that these trees could be the parents of the roadside site located 1.2 kms to the west. Future surveys are needed to investigate and monitor whether *B. javanica* is truly naturalized in this area.

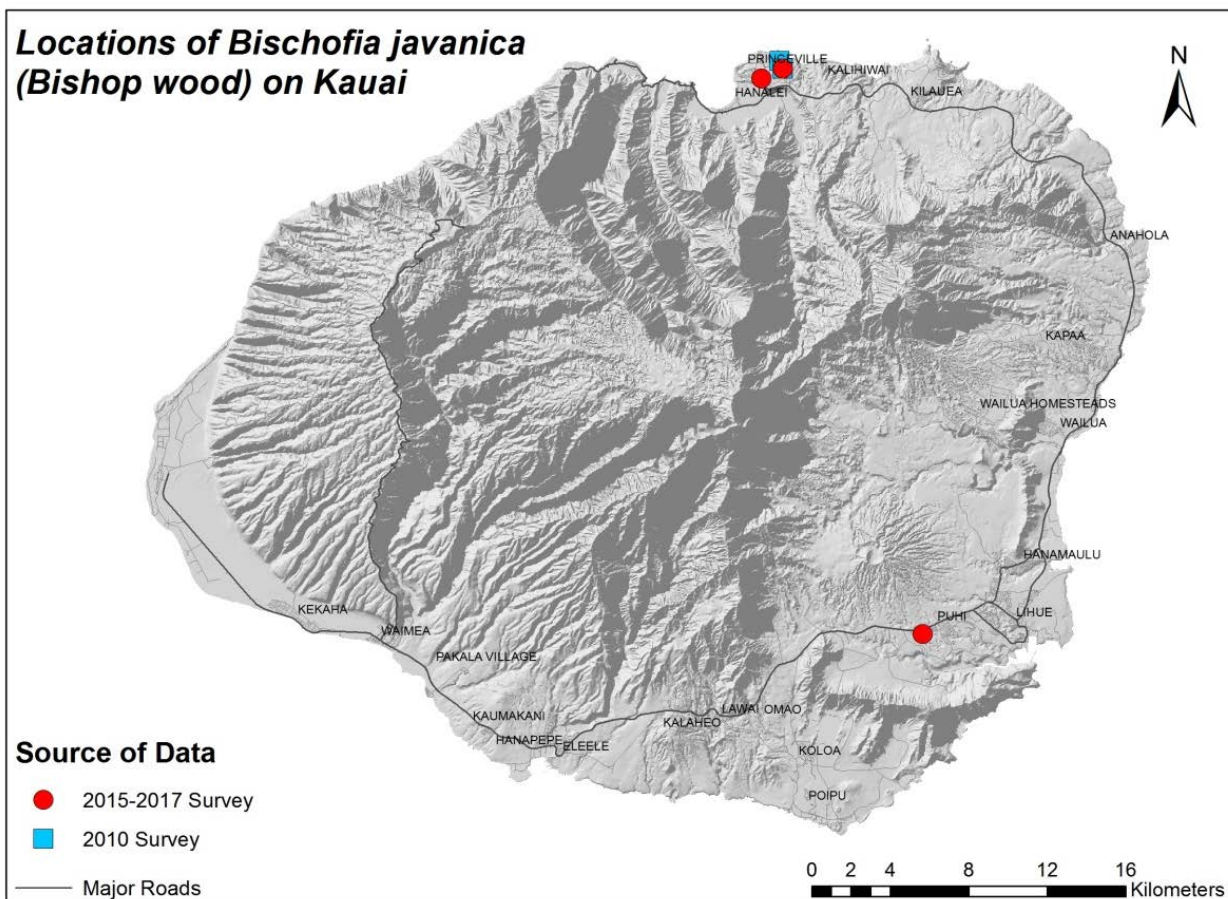


Figure C5- 1. Locations of *B. javanica* on Kauai. Locations where presence of the plant was confirmed during 2015-2017 surveys are denoted by red circles.

Hawaii Pacific Weed Risk Assessment (HPWRA) Score

B. javanica is designated as “High Risk”, receiving a score of 7 (HPWRA 2002, 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"> • Well suited to climates in Hawaii • Repeatedly introduced and naturalized in areas with comparable climates • Shade tolerant • Tolerates a wide range of soil conditions • Produces viable seed • Propagules bird dispersed, surviving passage through the gut • Prolific seed production (>1000/m²) • Benefits from disturbance 	<ul style="list-style-type: none"> • A weed of gardens/amenity/disturbed areas • Environmental weed • Toxic to animals

Refer to the full Weed Risk Assessment for *B. javanica*, including how these traits and characteristics affect HPWRA scoring, 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

B. javanica was assigned a score of 3 because of reports of this tree being the most impactful invader of native forests on the Bonin Islands of Japan, in addition to being regarded as invasive in southern Florida (Yamashita et al. 2003, Hata et al. 2006). On the Bonin Islands, *B. javanica* forms dense stands in native climax communities and is well-regarded as a threat to several endemic species despite not forming dense climax communities in its native range (Sugiura et al. 2009, Yazaki et al. 2015). Because of this, the invasion of *B. javanica* is well studied, with experiments revealing that it competitively replaces native species by responding to light, nutrients and available soil moisture more quickly than other plants (Yamashita et al. 2000, Osone et al. 2014, Yazaki et al. 2015). Particularly, this tree occupies areas of disturbance, with populations expanding after typhoons (Yamashita et al. 2003, Hata et al. 2006). Additionally, the invasive success of *B. javanica* has been attributed to having greater seed longevity, lower seed predation and longer fruiting periods than native trees on the Bonin Islands (Yamashita et al. 2003, Fukasawa et al. 2009, Shiels 2011). Seedlings of *B. javanica* are also exceptionally shade tolerant, allowing it to establish in native-dominated habitats (Yamashita et al. 2003, Hata et al. 2006, Fukasawa et al. 2009). Although most high-value native forests on Kauai are at greater elevations than those on the Bonin Islands (maximum elevation of 326 m above sea level), the more northerly latitude of these islands induces a climate more similar to higher elevations on Kauai (Hata et al. 2006, Giambelluca et al. 2013). Thus, invasive behavior of *B. javanica* in Kauai may become comparable to the Bonin Islands. In particular, *B. javanica* responds to drought conditions more favorably than other plants by utilizing temporary increases of soil moisture more quickly. This trait may increase its ability to invade native forests as drying climate trends in Hawaii proceed (Vorsino et al. 2014, Diaz et al. 2016, Barbosa and Asner 2017). On Oahu, it is naturalizing and spreading at low-mid elevations (250-500m) (Wagner et al. 1999). In a study investigating the dispersal of alien plant seeds by rats, a compilation of the 25 most problematic invasive plants in Hawaii included *B. javanica* based on expert opinion (Shiels 2011). However, it's unclear from this study which invasive impacts lead to this species being listed.

2. Impacts to Agriculture, Culture and other Human Systems

Score: 2 = Moderate Impacts

B. javanica received a score of 2 because populations of this plant are known to increase following disturbance and fruits are spread rapidly via bird dispersal (Yamashita et al. 2003, Hata et al. 2006, Fukasawa et al. 2009, Sugiura et al. 2009, Osone et al. 2014). These traits allow it to colonize human-controlled systems including residential areas, gardens/landscapes, forestry plantations and any agricultural crops that have multi-year turn overs. In Florida, *B. javanica* usually grows to 10-18 meters tall is known to have aggressive roots that lift sidewalks and fruits that stain sidewalks and buildings if not removed immediately (Gilman and Watson 2007). Branches can be brittle, which may be hazardous if growing next to buildings or highways. This score may be upgraded to a 3 if additional invasive impacts, including the formation of monotypic stands in agricultural/forestry settings in Hawaii are noted. It is important to note that because *B. javanica* is dioecious, spread of this plant may not be noticed until populations have reached a density at which plants can easily outcross and produce viable seed. Once this has occurred, eradication will be difficult as seeds can be dispersed by birds (Fukasawa et al. 2009).



Figure C5- 2. Photograph of *B. javanica*, potentially naturalizing, along a roadside in Princeville.

3. Impacts to biotic and abiotic processes

Score: 2 = Moderate Impacts

B. javanica was assigned a score of 2 because the ability of this plant to outcompete adjacent plants for light, nitrogen and soil moisture is likely to influence soil, hydrology and ecosystem structure. Additionally, *B. javanica* is toxic to some animals (HPWRA 2002). However, this score assumes a moderate canopy density and may be upgraded to a 3 if future data indicates a higher or lower ability for this plant to form dense stands on Kauai.

TOTAL INVASIVE IMPACTS SCORE: 7

Feasibility of Control Score

Feasibility of Control Scoring and rationale for *B. javanica* 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 *B. javanica* was given a score of 2 because production of viable seed has been noted in a female tree immediately adjacent to a male tree and bird-dispersed seeds may have spread > 1000 m from known sites. Known sites occur on 4 TMKs which are adjacent to several residences and land-owner cooperation is required to survey forested areas. Flyer drops and other outreach efforts within the neighborhood are necessary to detect individuals

that may be out of sight from roadways. The detection of a single plant in a nursery is worrisome because although the owner indicated that it is not currently being sold, plants may have been sold and distributed throughout the island in the past. Kauai-wide outreach is necessary to increase the probability that plants on private residences are detected.



Figure C5- 3. Map of *B. javanica* locations in Princeville. 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 *B. javanica* was given a score of 1 because the trees on the golf course are large and may require a certified arborist to remove. Past communications with the landowners suggest that they may not be amenable to removing the trees. Additionally, a plan to remove debris after the trees are felled is necessary and may require additional equipment. For other trees, chemical control of this plant has been well-studied and trees are effectively killed with a single glyphosate treatment (Itou et al. 2015).

Monitoring:

Score 3 = Minimal Effort

Feasibility of monitoring for *B. javanica* was given a score of 3 because although *B. javanica* is known to form persistent seed banks (Yamashita et al. 2003, Yazaki et al. 2015), only one female tree has been noted to produce viable seeds. This tree is located on an intensely cultivated golf course, and thus regeneration from seed is unlikely. This score may be downgraded if additional seed-producing females are detected.

FEASIBILITY OF CONTROL SCORE: 6

COMBINED: 7 + 6 = 13

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