KISC KAUAI INVASIVE SPECIES COMMITTEE	*Kauai Status*	*KISC Status*	*HPWRA*	*Invasive Impacts Score*	*Feasibility Score*	*Combined Score*
Ligustrum sinense (Chinese privet)	**NATURALIZED**	**EARLY DETECTION**	**HIGH RISK (20)**	**9**	**2**	**11**

Initial Prioritization Report completed: January 2018
Report updated as of: N/A
Current Recommendation for KISC: pending scoring rank and committee review
Knowledge Gaps and Contingencies:

1) Delimiting surveys surrounding known locations are required to gain knowledge of the extent of populations.
2) An understanding of partnership roles may increase the likelihood/rate of success.

Background

Ligustrum sinense (Oleaceae), or "Chinese privet", is a small tree or large shrub that is occasionally cultivated as an ornamental but is more commonly regarded as a serious weed from multiple locations around the globe (Greene and Blossey 2012, HPWRA 2017). Numerous ecological restoration methods and potential biocontrol agents are being investigated to manage this plant outside of Hawaii (Brown and Pezeshki 2000, Ding et al. 2006, Zhang et al. 2011) Control efforts against *L. sinense* on Kauai are led by Kokee Resource Conservation Program (KRCP), and KISC has occasionally assisted with field control on a non-regular basis. Additionally, KISC has included *L. sinense* in the 2016 Kauai Pono Endorsement program to limit its dispersal through the nursery trade. The purpose of this prioritization assessment report is to consider the potential invasive impacts of *L. sinense* and evaluate whether KISC should attempt whole-island eradication in cooperation with partnering agencies (i.e. accept as "Partnership" species status). This will be informed by scoring and comparing *L. sinense* to other "Early Detection" species known to Kauai (See Table 5 in KISC Plant Early Detection Report for status terminology).

Detection and Distribution

L. sinense was first vouchered on Kauai in 1997 (D. H. Lorence 8149, PTBG) and subsequently deemed naturalized around cabin sites in Kokee State Park (Lorence and Flynn 1999). Statewide it is considered naturalized on Kauai and Hawaii island (Imada 2012). 2010 and 2015-2017 Surveys have not detected this plant naturalizing outside of Kokee in Kauai, although 2010 surveys noted 2 cultivated plants at lower elevations: one in Kapaa and one in Kalaheo (Figure C30- 1). These lowland sites were not confirmed during 2015-2017 surveys, but plants are often maintained as closely trimmed hedges, so are easy to miss. Species-specific surveys of the cultivated sites in Kapaa and Kalaheo have not been completed and are necessary to confirm these plants are still present. The size of the infestation in Kokee is largely unknown although KRCP may have additional distribution data that is not considered in this report. Known locations of survey points and herbarium vouchers represent an area of approximately 200 ha (~500 acres). However, as seeds of this plant are dispersed long distances by birds and surveys are mostly limited to roads and trails, it is likely that the infested area is larger than this estimate. 2015-2017 surveys detected only sporadic, immature plants rather than monotypic, mature stands that are characteristic of this species in other parts of its invaded range (Greene and Blossey 2014). This distribution likely represents the removal of dense infestations by KRCP in the core of the infestation and the new establishment of plants via bird-dispersed seeds on the outer edges of the known area. Although our distribution data is very sparse, points from herbarium data and reoccurring early detection surveys indicate that the population may be expanding (Figure C30- 2). The current naturalized distribution of *L. sinense* in Kokee includes 1 judicial district (Waimea) and 3 watersheds (Kauhao, Waimea, Waikaea); it is cultivated in two additional judicial districts (Koloa, Kawaihau) and two additional watersheds (Wailua, Lawai).

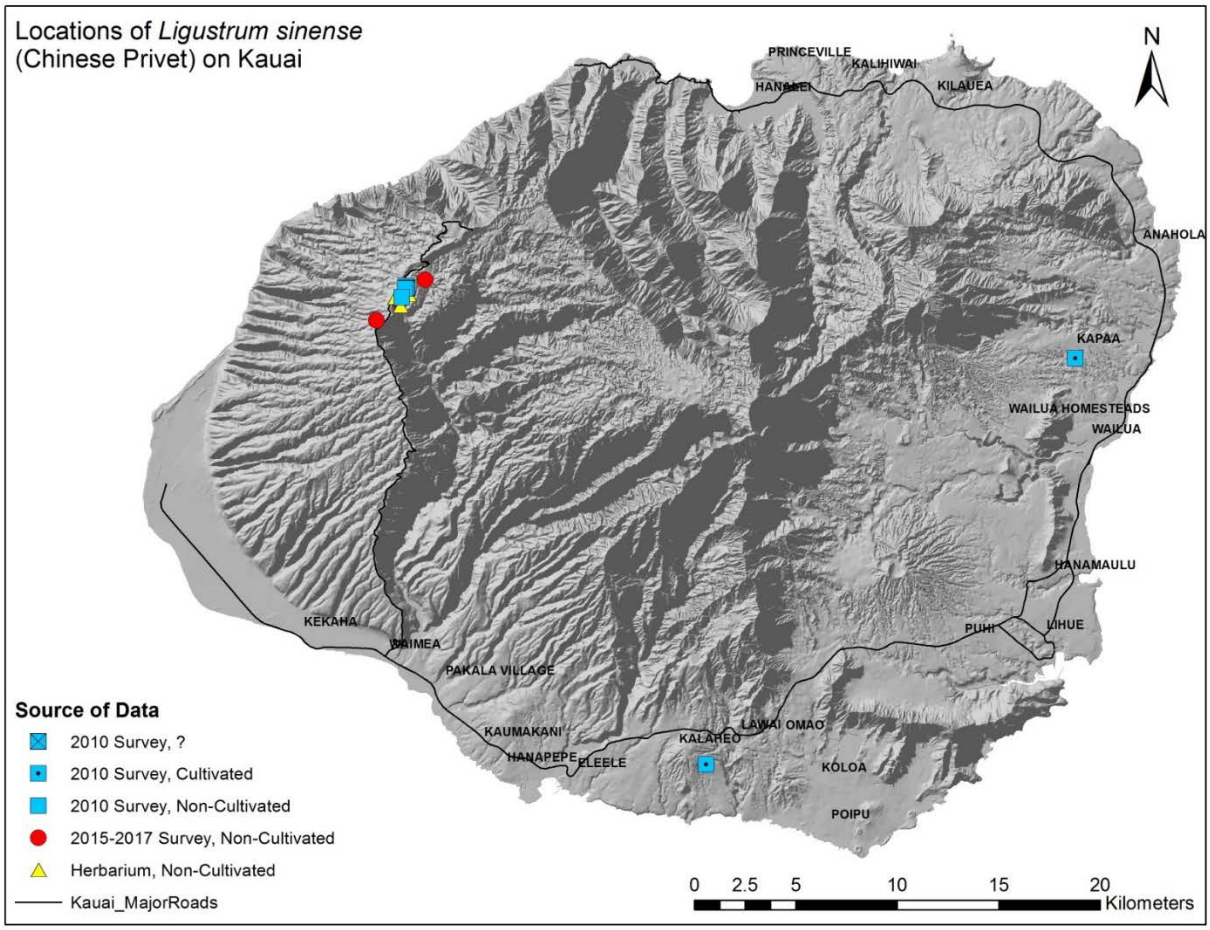

Figure C30- 1 Locations of *L. sinense* on Kauai. Locations where presence of the plant was confirmed during 2015-2017 surveys are denoted by red circles.

Hawaii Pacific Weed Risk Assessment (HPWRA) Score

L. sinense is designated as "High Risk", receiving a score of 20 (Daehler et al. 2004, HPWRA 2017). 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 • Broad climate suitability • Naturalized outside of its native range • Shade tolerant • Tolerates a wide range of soil conditions • Produces viable seed • Reproduces by vegetative fragmentation • Self-compatible or apomictic • Propagules dispersed intentionally by people • Propagules dispersed by water and birds • Propagules survive passage through the gut • Benefits from disturbance	• Environmental weed • Agricultural/Forestry/Horticultural weed • A congeneric weed, sharing a genus with other known invasive species (i.e. implies inheritance of tendencies to inflict invasive impacts) • Toxic to animals and humans • Forms dense thickets

Refer to the full Weed Risk Assessment for *L. sinense*, including how these traits and characteristics traits affect HPWRA scoring, at https://sites.google.com/site/weedriskassessment/assessments/Download-Assessments.

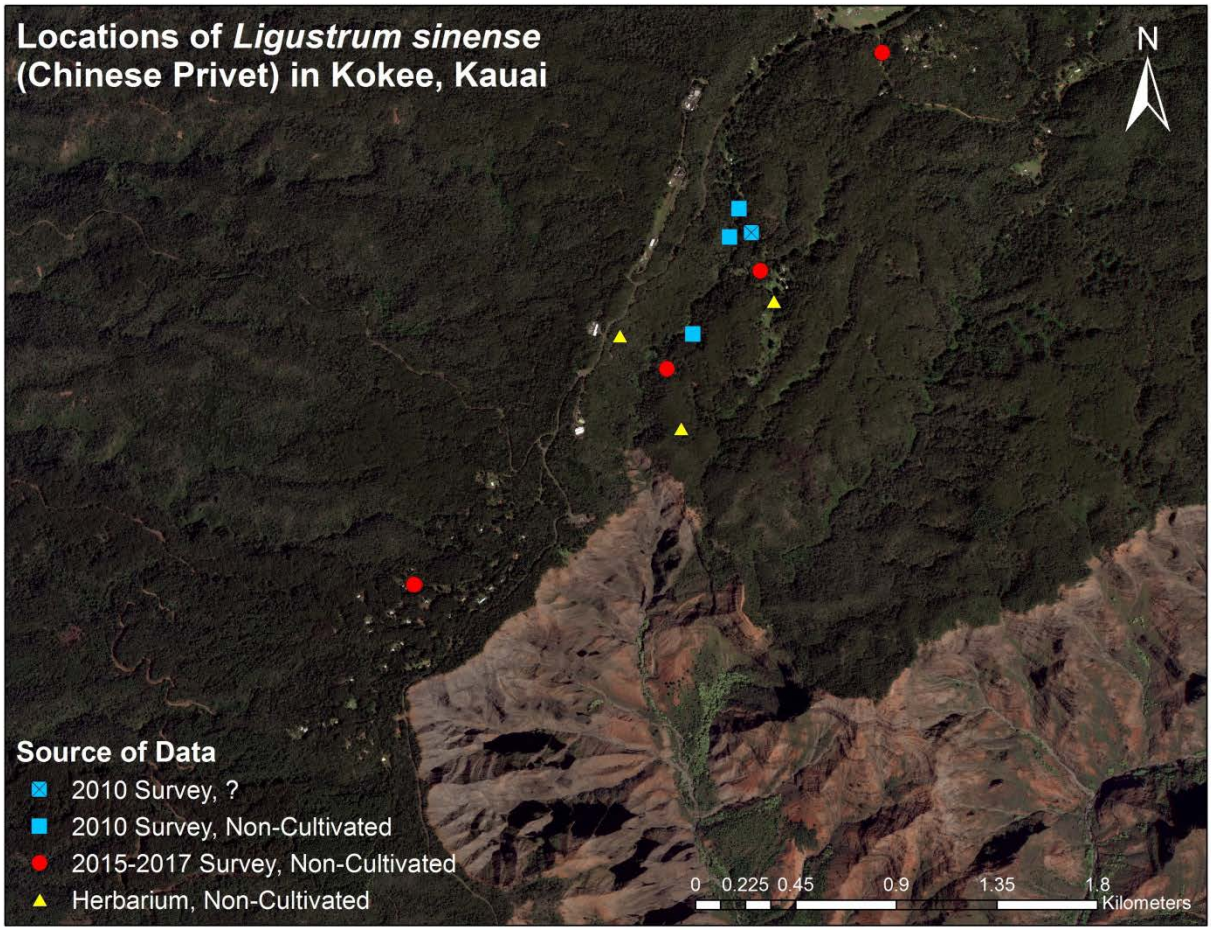

Figure C30- 2. Map of L. sinense infestation in Kokee, with red circles denoting locations found during 2015-2017

Invasive Impacts Score

1. Impact on natural community structure and/or composition

Score: 3 = Major impacts

L. sinense was assigned a score of 3 because several studies have demonstrated the ability of this plant to change ecosystem structure and decrease biodiversity in natural communities at large spatial scales (Merriam 2003, Wilcox and Beck 2007, Hanula et al. 2009, Greene and Blossey 2012, Hart and Holmes 2013, Greene and Blossey 2014, Hudson et al. 2014, Dahn et al. 2015). It is a known environmental weed in Australia, New Zealand, Argentina and North America (from the Carolinas south to Florida and west through Texas) and has naturalized in South Africa (HPWRA 2017). *L. sinense* has been reported as an ecosystem transforming weed throughout much of its invaded range where dense stands greatly exclude the regeneration of native trees and low herbs, converting large areas of forest into monotypic shrublands (Merriam 2003, Greene and Blossey 2012, Hart and Holmes 2013, Greene and Blossey 2014). However, it should be noted that some invaded areas referenced in this report include open woodlands with no shrub layer, leaving an available niche for *L. sinense* to exploit (Greene and Blossey 2014). Invasions are quick: one study showed that *L. sinense* was able to form 100% cover in the understory of a mixed hardwood forest in 20 years. Seeds are dispersed by birds, allowing it to spread large distances quickly (HPWRA 2017). Furthermore, some studies indicate that grazing or mutilation by some animals may promote suckering, which forms thickets immediately surrounding the parent plant (Rossell et al. 2014). It is not clear whether deer, which are known to graze *L. sinense* in Kokee, have the same effect or if they instead slow growth and delay seed production. Although *L. sinense* may more quickly invade open areas, plants

are shade tolerant and are able to mature under a dense canopy, which has been observed on Kauai. *L. sinense* is thought to prefer moist areas as over 1 million hectares of riparian forest and floodplain habitat has been invaded in mainland USA (Hanula et al. 2009, Hudson et al. 2014). However, this plant is notable for its ability to invade a great variety of habitats from the edges of open marshes to the understory of mesic forests. Hundreds of young seedlings can be observed in the main infested area being treated by KRCP, suggesting that high density populations are possible in Kokee. Additionally, it grows from 200 to 2700m above sea level in its native range of tropical and subtropical China (HPWRA 2017). These data indicate that *L. sinense* may be capable of becoming a generalist invader in Kauai, suppressing native ecosystems in a variety of habitats. However, as reports of invasiveness in tropical lowland areas have not been reported, *L. sinense* may be more problematic at higher elevations on Kauai. No lowland naturalized populations are known on Kauai despite record of cultivated plants in these zones; however, these sites should be continuously monitored to determine its ability to proliferate to these climates. The HPWRA lists the climatic suitability of this plant to Hawaii as "High" but must also account for cooler zones present on higher islands such as Maui and Hawaii (HPWRA 2017).

Figure C30- 3. An example of *L. sinense* forming thickets (photo credit David Moorhead).

2. Impacts to Agriculture, Culture and other Human Systems

Score: 3 = Major impacts

L. sinense received a score of 3 in this category because it grows very rapidly in disturbed areas in Kokee, and will likely invade yards and other cultivated areas. Its ability to form thickets may hinder the movement of hunters, conservationists and other recreationalists in invaded areas. Additionally, berries are very toxic and can occasionally be fatal if ingested by humans, especially children (Quattrocchi 2012, HPWRA 2017). Berries are also poisonous to livestock and pets, and deaths of horses and cows have been reported in the invaded range of New Zealand that are suspected to have ingested *L. sinense* (HPWRA 2017).

3. Impacts to biotic and abiotic processes

Score: 3 = Major impacts

L. sinense was assigned a score of 3 because several studies have investigated a variety of impacts to biotic and abiotic processes in southeastern USA. A study in North Carolina found that *L. sinense* decomposed 2.5x faster than native vegetation and significantly altered ratios of carbon and nitrogen in the soil (Mitchell et al. 2011). Also, studies of soil interactions have shown that the presence of *L. sinense* promoted the establishment of two other alien plants in native forest (*Lonicera mackii and Rhamnus davurica*) (Kuebbing et al. 2014, Kuebbing et al. 2016). Invasion of ecosystems by *L. sinense* is associated with persistent biodiversity, loss of pollinators and beetles in the southeastern USA (Ulyshen et al. 2010, Hudson et al. 2013). However, one study revealed that restoration efforts were able to reestablish native pollinator diversity, such that restored plots had almost 3x as many pollinator species as invaded plots (Hudson et al. 2013). Additional studies indicate that *L. sinense* may exhibit allelopathy or the ability to alter soil fungi communities, which may explain the low germination and diversity of species regenerating below dense stands, but more studies are needed to confirm this (Greene and Blossey 2012, HPWRA 2017). Although ecosystems in the southeastern US are very different from those in Kauai, these findings and its ability to form dense stands suggest that *L. sinense* will likely promote long-term change to soil and biotic communities throughout its invaded range.

TOTAL INVASIVE IMPACTS SCORE: 9

Feasibility of Control Score

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

Delimiting Survey:

Score: 0.5 = Impossible - Major Effort

Feasibility of a delimiting survey for *L. sinense* was given a score of 0.5 because much work has already been done by KRCP, and the opportunity to carefully delimit the infestation with the help of their data and staff may be possible. However, this score should be reassessed after discussions with KRCP. As plants establish in the understory, delimiting surveys must be conducted on foot. A large area must be delimited due to the dispersal of seeds by birds, which may require the recruitment of additional staff from conservation agencies or from volunteers. This score is likely to decrease to 0 (impossible) if KISC is unable to partner with another conservation agency (although KRCP is already treating this plant when funding and scheduling allow) or if the population proves to be much larger than estimated.

Initial control:

Score: 0.5 = Impossible - Major Effort

Feasibility of initial control for *L. sinense* was given a score of 0.5, although this is dependent on the population size (number of individuals), which is currently not known. Nonetheless, many days would likely be required to travel to, and treat plants over the known infested area. Regenerating seedlings in the central portion infestation area are common. Herbicides are known to be effective, but often do not kill 100% of the plants treated (Harrington and Miller 2005, Enloe et al. 2016) and herbicide applicators must be careful not to treat native plants in the area. Additionally, dense carpets of seedlings are common around mature plants, which may require hand pulling. Significant effort is likely necessary to make this a feasible goal for eradication, and may require additional funding and recruitment of staff or volunteers. This score should be reassessed after discussions with KRCP.

Monitoring:

Score: 1 = Major Effort

Feasibility of monitoring for *L. sinense* was given a score of 1 because seeds are thought to be short lived, with most germinating immediately and others mostly not persisting for more than 1 year (Panetta 2000). Additionally, plants may take up to three years to mature, although they may mature more quickly in Kauai's climates due to less seasonality. Thus, follow-up removal to control the seedlings can be scheduled over a couple of years. These traits may allow gains toward eradication to be made once all mature trees are detected and removed, but follow up visits to control regenerating seedlings will likely take many days.

FEASIBILTY OF CONTROL SCORE: 2

COMBINED SCORE= 9 + 2 = 11

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