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May 20, 2022

To: Advisory Committee on Plants and Animals

From: Matthew Tracy Johnson, Ph.D.
United States Department of Agriculture Forest Service

Through: Christopher Kishimoto
Entomologist
Plant Quarantine Branch
Hawaii Department of Agriculture

Subject: Request to: (1) Preliminarily Review the Currently Unlisted Beetle, *Syphraea uberabensis* (Coleoptera: Chrysomelidae) for Future Placement on the List of Restricted Animals (Part A) As a Biocontrol Agent of *Tibouchina herbacea* and other related species in the family Melastomataceae*,* by the United States Department of Agriculture Forest Service (USDA FS);

(2) Determine If the Release of the Beetle *Syphraea uberabensis* as a Biocontrol Agent of *Tibouchina herbacea* and other related species in the family Melastomataceae*,* by the USDA FS Poses No Significant Impact on the Environment;

(3) Provided the Beetle *Syphraea uberabensis i*s Placed on the List of Restricted Animals (Part A), Allow the Release from Laboratory Quarantine of the beetle *Syphraea uberabensis,* by Permit, For Biocontrol of *Tibouchina herbacea* and Other Related Species In the Family Melastomataceae by USDA FS;

(4) Provided the Beetle *Syphraea uberabensis* is Placed on the List of Restricted Animals (Part A), Allow the Importation and Release of the beetle *Syphraea uberabensis*, by Permit, For Biocontrol of *Tibouchina herbacea* and other related species in the family Melastomataceae, by the USDA FS; and

(5) Provided the Beetle *Syphraea uberabensis* is Placed on the List of Restricted Animals (Part A), Establish Permit Conditions For the Importation and Release of the beetle *Syphraea uberabensis* As a Biocontrol Agent of

Tibouchina herbacea and other related species in the family Melastomataceae, by the USDA FS.

I. Summary Description of the Request

PQB NOTES: *The Plant Quarantine Branch (PQB) submittal for requests for import or possession permits, as revised, distinguishes information provided by the applicant, Dr. Matthew Tracy Johnson, from procedural information and advisory comment and evaluation presented by PQB. With the exception of PQB notes, hereafter "PQB NOTES," the text shown below in section III from page 4 through page 9 of the submittal was taken directly from the applicant's application and subsequent written communications provided by the applicant. For instance, the statements on pages 6 through 8 regarding effects on the environment are the applicant's statements in response to standard PQB questions and are not PQB's statements. This approach for PQB submittals aims for greater applicant participation in presenting import requests in order to move these requests to the Board of Agriculture (Board) more quickly, while distinguishing applicant provided information from PQB information. The portion of the submittal prepared by PQB, including the procedural background, summary of proposed list additions, environmental assessment, advisory review, and proposed permit conditions, are identified as sections II, IV, V, VI, and VII of the submittal, which start at pages 3, 9, beginning of page 10, ending of page 10, and 16 respectively.*

COMMODITY: Various shipments of the beetle, *Syphraea uberabensis* (Coleoptera, Chrysomelidae, Galerucinae, Alticini).

SHIPPER: M. Vitorino
Universidade Regional de Blumenau
Rua Antonio da Veiga, 140 89012-570 Blumenau
Santa Catarina, Brazil

IMPORTER: Dr. Matthew Tracy Johnson
USDA Forest Service
Hawaii Volcanoes National Park Quarantine Facility
Kilauea Research Station, Building 34
Volcano, HI 96718

CATEGORY: *Syphraea uberabensis* is currently an unlisted animal. Animals not found on any list are considered prohibited until placed on a list. Additionally, Chapter 4-71, Hawaii Administrative Rules (HAR), allows importation of unlisted animals into Hawaii under special permit for the purpose of remediating medical emergencies or ecological disasters, or

conducting scientific research that is not detrimental to agriculture, the environment, or humans by special permit, on a case-by-case basis, as approved by the Board.

PQB NOTES: *The applicant is requesting that the Board place Syphraea uberabensis on the List of Restricted Animals (Part A) for import and release for biological control of Tibouchina herbacea and other related weed species in the family Melastomataceae.*

Syphraea uberabensis was originally brought into the Hawaii Volcanoes National Park Quarantine Facility from Brazil in July 2005 for biocontrol research and host range testing. The applicant is not currently requesting a special permit at this time.

In January 2020, a draft environmental assessment was submitted to the Office of Environmental Quality Control (OEQC) with an Anticipated Finding of No Significant Impact. The draft was published in OEQC's Environmental Notice on January 23, 2020 (See Attachment 2).

II. Procedural Background

USDA FS has requested that one of the lists in Chapter 4-71, Hawaii Administrative Rules (HAR), be amended to include the beetle, *Syphraea uberabensis.* The species may be placed on the List of Conditionally Approved Animals, List of Restricted Animals (Part A or B), or the Prohibited List. Species on the Restricted and Conditionally Approved Lists may enter the State of Hawaii under permits with conditions approved by the Board. Until placement on a list, species are considered prohibited except as provided by Section 150A-6.2(c), Hawaii Revised Statutes (HRS).

Species on the List of Restricted Animals (Part A) are available for research by universities and government agencies, exhibition in municipal zoos and government-affiliated aquariums, and for other institutions for medical and scientific purposes as determined by the Board. All species listed for import require a permit for entry into the State. Based on the Board's decision, species preliminarily reviewed for future list placement on a specific list will be compiled in-house for a future rule amendment. The Board's action to preliminarily place a species on a list has no legal effect until the rule has been changed. This procedure is solely for administrative ease in preparation for amendments to the various lists.

Provided the Board acts favorably on this request for future list placement, at a future date, the proposed amendments will be brought to the Board for preliminary approval to go to public hearings. A species is listed in the rules only after: (1) following Chapter 91, HRS, rulemaking procedures, which include the public hearing process, Board adoption, and Governor's approval: or (2) alternatively, the expedited amendment

procedure through Board orders, which involves an abbreviated process available in certain circumstances. Generally speaking, once a species has been placed on a respective list, it is eligible for import and/or possession. PQB can then process a permit application by having the Board approve the future importation and establishment of appropriate permit conditions for the organism and proposed purpose.

III. Information Provided by the Applicant in Support of the Application

PURPOSE:

Syphraea uberabensis, a small beetle native to Brazil, has been selected and evaluated as a new biological control for managing invasive melastome weeds in Hawaii. It is a narrowly host-specific leaf-feeding beetle intended for statewide field release to cause suppression of non-native plants in the genera of *Tibouchina*, *Melastoma* (designated as noxious weeds), and *Pterolepis*. The beetle is expected to cause severe defoliation of targeted weeds, without affecting any native or otherwise valued plants. Suppression of these weeds will benefit forest watersheds statewide.

DISCUSSION:

1. Person Responsible:

Dr. Matthew Tracy Johnson, Institute of Pacific Island Forestry**,** USDA FS, Pacific Southwest Research Station**,** Mailing address: P.O. Box 236, Volcano, HI 96785

2. Safeguard Facility and Practices:

Initial quarantine will be at USDA Forest Service, Hawaii Volcanoes National Park Quarantine Facility, Kilauea Research Station, Bldg. 34. The *Syphraea uberabensis* colony will originate from insects collected from southern Brazil and shipped under USDA Plant Protection and Quarantine permit P526P-20-02009 to the Volcano quarantine, for rearing and screening to eliminate associated natural enemies. Tracy Johnson will positively identify the insects and determine them to be free of natural enemies in preparation for release.

3. Method of Disposition:

Any unused material will be autoclaved within the quarantine facility. Roughly 30 insects at a time will be removed from quarantine as newly pupated adult beetles, independent of host plant material and other potential contaminants. Adults will be used to establish colonies reared in petri dishes at USDA and Hawaii Department

of Agriculture insectaries in Volcano, Hilo, and Honolulu. Offspring from rearing colonies will be used for environmental releases at selected locations statewide

4. Abstract of Organism:

Syphraea uberabensis is a small beetle that has been evaluated in its native Brazil between 1993 and 2009 and in containment in Hawaii between 2005 and 2015. Adults and larvae feed externally on foliage and soft stems of *Tibouchina herbacea*, causing enough damage to kill small plants. *Syphraea uberabensis* is host specific to a subset of species within the melastome family, which contains no native taxa in Hawaii.

Taxonomy:
Syphraea uberabensis Bechyné is a flea beetle, classified under the tribe Alticini and the leaf beetle family Chrysomelidae. Flea beetles are similar to other leaf beetles but are characterized by having enlarged hind legs, which afford them the ability to leap/spring when disturbed, hence the common name. Flea beetles are herbivores that feed on various parts of the plant; some flea beetle species are important agricultural pests. They do not bite humans or animals. The genus *Syphraea* Baly (1876) includes more than 100 species and is found throughout South and Central America (Scherer 1983).

Description of Adults:
Body elongated, slightly broader posteriorly; robust legs; thorax, abdomen, legs and antennae covered with fine short hairs; coloration deep metallic blue, females 3.3 mm and males 3.0 mm in length, on average (Souder 2008).

Description of Larvae:
Mature larva. Length: 4.4–6.30 mm; width of pronotum: 0.75–1.41 mm. Eruciform, general integument cream/yellowish with brown head; antennae, maxillae and legs partially membranous; thorax and abdomen with setous sclerotized plates or setous sclerotized tubercles, brown or yellowish-brown, clearer to apex direction; ventral tubercles clearer than dorsal. Segments separated by transverse grooves forming plicae. Setae club-like, whitish, wide with widened apex; ventral setae narrower than dorsal (Casari and Teixeira 2011).

Distribution:
Syphraea uberabensis is native to southern Brazil. The distributional range of the species is not well studied.

Life History:
A life history study conducted in the quarantine facility in Hawaii showed that *S. uberabensis* reared on *T. herbacea* had an adult life span ranging from 2 to 127

days and averaged 78.2 days. *Syphraea uberabensis* samples of the quarantine colony had a sex ratio close to 1:1. Males and females developed and emerged at similar rates (Souder 2008).

Survival and development of *S. uberabensis* was evaluated in the laboratory at five constant temperatures ranging from 12 to 28 ºC. No egg or larval development occurred below 16 ºC. Complete development to adulthood was only seen at 20 and 24ºC. Mean time for development from egg to adult was 50.5 days at 20ºC and 31.5 days at 24ºC, fitting the expected pattern for insects in general: faster development at increasing temperatures. Although development was slightly faster at 28ºC than at 24ºC, beetle survivorship was reduced and no adults developed at 28ºC. Reduced development and increased mortality of beetle larvae at 16 and 28ºC is an indication that the minimum and maximum temperature thresholds were being approached (Souder 2008).

Habitat/Ecology:
Syphraea uberabensis is tolerant of cool and moderate temperatures and is not expected to be restricted in range by temperatures in Hawai‘i, except perhaps in exceptionally warm habitats (Souder 2008). However, the potential of *S. uberabensis* as a biological control could be limited by humidity at the microhabitat level. In Brazil, *S. uberabensis* is found with its melastome hosts in boggy soils, similar to the areas where Tibouchina and Pterolepis thrive in Hawaii. On the other hand, Melastoma in Hawai‘i can grow in relatively drier areas, such as young lava flows. *S. uberabensis* could be less effective against Melastoma in the drier parts of its range, because its externally feeding larvae appear to be susceptible to drying out (Raboin et al. 2009).

Natural Enemy:
There is very little information regarding the natural enemies of *S. uberabensis*. Two unidentified generalist Hemipterans were observed attacking the adult insects in its native range (Wikler and Souza 2008). Under laboratory conditions, larvae and pupae were reported to succumb to a ubiquitous entomopathogenic fungus, *Beauveria bassiana*.

Effect on Target Weed:
Syphraea uberabensis was selected to be used in the control of *T. herbacea* due [to] the extensive damage it caused to the target plant in Brazil. Both larvae and adults feed on the leaves as well as the soft exterior of young stems. *Tibouchina herbacea* demonstrated little regenerating capacity after attack of *S. uberabensis*, drying after a period of 2 weeks of insect feeding, both in the field and in the laboratory. The leaves were skeletonized, leaving only the stem and vein structures. Plant growth was reduced, and flowering and consequently seed production were prevented. (Wikler and Souza 2008).

5. Potential Effects on the Environment and Health:

Specificity tests indicated the host range of *Syphraea uberabensis* is restricted to a few melastome species, all non-native and considered invasive in Hawaii. The results of no-choice starvation tests and multi-choice testing consistently identified the potential Hawaiian hosts as: *Tibouchina herbacea, Tibouchina longifolia, Pterolepis glomerata, Melastoma septemnervium* and *Melastoma sanguineum*.

Potential host preferences were evaluated on a total of 58 plant species in 30 families. Test plants were selected based on the centrifugal phylogenetic method proposed by Wapshere (1974). The test list included six plant species requested by the U.S. Fish and Wildlife Service because of their ecological importance, as well as a variety of species with economic significance in Hawaii (see attached host specificity results for plant species lists and more information).

Testing revealed *Syphraea uberabensis* to be narrowly host-specific within the family Melastomataceae and able to complete development on only the five plant species listed above. Larvae and naïve adults showed a somewhat broader range of feeding compared to mature adults in tests lasting a few days, however low levels of feeding outside the normal host range is a common result of no-choice tests, in which insects are unable to seek out preferred hosts (Heard 2002). Longer test periods demonstrated that only a few melastome species support survival to maturity and oviposition. Choice tests demonstrated the same few melastome species to be highly preferred over other related plants.

The preferred melastome hosts of *S. uberabensis* are all considered serious weeds in Hawaii (HDOA 1992, Jacobi and Warshauer 1992, Almasi 2000, Motooka et al. 2003). Of these plants, *T. longifolia* has the most limited distribution and appears least likely to have significant ecological interaction with the potential biocontrol agent. If *T. herbacea* and *M. septemnervium* can maintain substantial populations of *S. uberabensis*, these might help suppress *T. longifolia* and prevent it from spreading. The species *T. herbacea* and *M. septemnervium* overlap geographically across large areas, which could facilitate establishment and impacts of *S. uberabensis* generally. *M. sanguineum* is ecologically similar to *M. sanguineum* but less widely distributed. Impacts of biocontrol by *S. uberabensis* would likely be swifter and more severe on *T. herbacea* than *M. septemnervium* and *M. sanguineum*, which grow to large woody shrubs. Increased herbivory of *M. septemnervium*, which has been targeted but not adequately impacted by past introductions of other biocontrols (Conant et al. 2013), would have potential benefit to extensive forest watersheds in Hawaii (Jacobi and Warshauer 1992). The final host, *P. glomerata*, is a less prominent invader but broadly distributed in wet forests and pastures, including mountain areas on the island of Oahu where it has

limited overlap with the other melastome hosts. Although *P. glomerata* appears to be equally suitable as a host for *S. uberabensis*, longer development times on this plant might delay the impacts of biocontrol (Souder 2008).

S. uberabensis is tolerant of cool and moderate temperatures and is not expected to be restricted in range by temperatures in Hawaii, except perhaps in exceptionally warm habitats (Souder 2008). However, the potential of *S. uberabensis* as a biological control could be limited by humidity at the microhabitat level. In Brazil, *Syphraea* is found with its melastome hosts in boggy soils, similar to the areas where *Tibouchina* and *Pterolepis* thrive in Hawaii, so these hosts should be highly susceptible. On the other hand, *Melastoma* in Hawaii can grow in relatively drier areas – such as young lava flows. *S. uberabensis* could be less effective against *Melastoma* in drier habitats, because its eggs and larvae appear to be susceptible to drying when humidity is not high.

In conclusion, our testing indicates that *S. uberabensis* is narrowly host specific and will not feed or survive on any native or otherwise important plants in Hawaii. Given that Melastomataceae are entirely alien to Hawaii, and the host range of *S. uberabensis* includes only five weedy melastome species here, this flea beetle appears to hold great potential benefit and minimal environmental risk as a future biological control agent.

References:

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Heard, T.A. 2002. Host specificity testing of biocontrol agents of weeds. Technical Report 129. Pacific Cooperative Studies Unit University of Hawaii at Manoa.

Jacobi, J.D. & Warshauer, F.R. 1992. Distribution of six alien plant species in upland habitats on the island of Hawai'i. Pp. 155-188, In: Stone, C. P., Smith, C. W., & Tunison, J.T., (eds.), *Alien Plant Invasions in Native Ecosystems of Hawai'i: Management and Research*. University of Hawai'i Press, Honolulu.

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Scherer, G. 1983. Diagnostic key for the Neotropical Alticine genera (Coleoptera, Chrysomelidae, Alticinae). *Entomologische Arbeiten aus dem Museum G. Frey* 31/32:1–89.

Souder, S.K. 2008. Host specificity and biology of *Syphraea uberabensis* (Coleoptera: Chrysomelidae) for the potential biological control of *Tibouchina herbacea* (Melastomataceae) in Hawaii. MS thesis, University of Hawaii, Hilo.

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IV. Summary of Proposed Additions to the List of Restricted Animals, Part A

The USDA FS permit application is requesting the following addition to the List of Restricted Animals (Part A) in Chapter 4-71, HAR:

§4-71-6.5, HAR, List of Restricted Animals (Part A)

Adds "Scientific Name: "Syphraea uberabensis" and Common Name "biocontrol, Tibouchina herbacea".

See Attachment 6 for proposed changes in Ramseyer Format. All other sections in Chapter 4-71, HAR will remain unchanged.

V. Environmental Assessment (EA):

Pursuant to a May 2008 Hawai'i Intermediate Court of Appeals decision ('Ohana Pale Ke Ao v. Board of Agriculture, 118 Haw. 247 (Haw. App. 2008), the Department of Agriculture's (Department's) import permit process is subject to the requirements of the Hawai'i Environmental Protection Act, chapter 343, Hawai'i Revised Statutes (HRS). Under this decision, the requirement for an EA as a condition of the import permit or related authorization applies in those circumstances where the underlying permit activity for the importation initiates a "program or project" and where the use of state or county funds or state or county lands is involved. When those circumstances are present, as they appear to be when a new organism is used in a new program or project located at a facility located at UHM or UHH (state lands), an EA is required to determine whether the proposed project or program is likely to have a significant impact on the environment. However, certain activities may be eligible for "exemption" under provisions established through the Environmental Advisory Council, provided that the project or program is determined to have little or no impact on the environment.

Analysis of Application re EA: Under the above-cited court decision, the EA requirement is triggered under certain circumstances, including when an applicant proposes an action on state lands that requires agency approval and is not specifically exempted under Chapter 343, HRS. That is the case here. The applicant's request in this instance involves the field-release of *Syphraea uberabensis* for research and biocontrol of *Tibouchina herbacea* and related species in the family Melastomaceae in the environment. So, agency approval is required for the applicant's proposed action/activity on state lands or sensitive habitats. As PQB understands the court's analysis in the 'Ohana Pale decision, the activity proposed under this permit application would initiate a project that may use state lands and/or sensitive habitats, initially triggering the EA requirement.

Dr. Johnson has submitted a Draft EA prepared by the Hawaii Department of Land and Natural Resources with an Anticipated Finding of No Significant Impact, published in the Office of Environmental Quality Control's Environmental Notice on January 23, 2020 (See Attachment 2).

VI. Advisory Review

ADVISORY SUBCOMMITTEE REVIEW: This request was submitted to the Advisory Subcommittee on Entomology for its review and recommendation. Advisory Subcommittee recommendations and comments are as follows:

1. **I recommend Approval ___/___Disapproval of future placement of the unlisted beetle, *Syphraea uberabensis* (Coleoptera: Chrysomelidae) on the**

List of Restricted Animals (Part A) as a biocontrol agent for the noxious weed *Tibouchina herbacea* and related weed species in the family Melastomataceae.

Dr. Peter Follett: Recommends Approval

Comments: "This flea beetle is highly specific to several melastomes, all of which are invasive and weedy, and should pose no risk to the environment if released. The benefits of release may be significant if the target weed and relatives are controlled or suppressed. The risk of nontarget or negative environmental effects is negligible."

Dr. Daniel Rubinoff: Recommends Approval

Comments: "This is a badly needed biocontrol agent that has been well researched and poses no threat to Hawaiian ecosystems and agriculture."

Dr. Mark Wright: Recommends Approval

Dr. Jesse Eiben: Recommends Approval

Comments: "Listing the taxon for restricted importation is the appropriate action to ensure no subsequent possibly contaminated new individuals of this species are imported."

Dr. Francis Howarth: No Response

Mr. Darcy Oishi: Recommends Approval

Comments: "For full disclosure, the *Syphraea* project is a partner project of the Plant Pest Control Branch (PPC) and the US Forest Service (FS) per the existing MOU between the two agencies. As such, comments to the subcommittee, advisory committee on plants and animals and the Board of Agriculture by myself or the entomologists of PPC should be viewed as full partners of the project.

I recommend approval for future placement of *Syphraea uberabensis* on the List if Restricted Animals part A. Evaluations done in the native range and in containment by the US forest service indicate placement on the restricted is prudent and will be a welcome tool in the management of Melastomes in Hawaii."

2. I Agree___/___Disagree that the release of *Syphraea uberabensis* as a biocontrol agent of *Tibouchina herbacea* and related weed species in the

family Melastomataceae by the USDA FS poses no significant negative impact on the environment.

Dr. Peter Follett: Agrees

Comments: "This flea beetle is highly specific to several melastomes, all of which are invasive and weedy, and should pose no risk to the environment if released. The benefits of release may be significant if the target weed and relatives are controlled or suppressed. Overall, this is a good piece of research."

Dr. Daniel Rubinoff: Agrees

Comments: "This is a very good bet to at least help limit the spread of some serious weeds at very little risk."

Dr. Mark Wright: Agrees

Comments: "Convincing data indicates extremely narrow host range is presented."

Dr. Jesse Eiben: Agrees

Comments: "Host specificity tests were appropriate. Attack of Melastome plants is an ecological benefit."

Dr. Francis Howarth: No Response

Mr. Darcy Oishi: Agrees

Comments: "After reviewing the documentation supplied by the applicant, there is no significant concerns with the statewide release of this organism."

3. Provided *Syphraea uberabensis* is placed on the List of Restricted Animals (Part A), I recommend Approval___/___Disapproval to Allow the importation and release of *Syphraea uberabensis*, by permit, for biological control of *Tibouchina herbacea* and related weed species in the family Melastomataceae by USDA FS.

Dr. Peter Follett: Recommends Approval

Comments: "It should be made clear if new beetles will be imported or if the releases will be existing beetles used in host specificity testing. In the latter

case, beetles will have passed through more than two generations and should have no contaminants."

PQB NOTES**:** *Permit condition #5 addresses Dr. Follett's concern.*

Dr. Daniel Rubinoff: Recommends Approval

Comments: "As long as imported material is confirmed to be free of parasitoids and other organisms, the importation of additional *Syphraea uberabensis* material would be important to ensure adequate genetic diversity in the biocontrol agent."

Dr. Mark Wright: Recommends Approval

Comments: "This insect appears to be a host-specific natural enemy of a significant invasive plant species."

Dr. Jesse Eiben: Recommends Approval

Dr. Francis Howarth: No Response

Mr. Darcy Oishi: Recommends Approval

Comments: "As a partner project, I recommend this species for importation and release. Dr. Johnson has a well-established track record for the prudent and careful evaluation of insects for release as a potential biocontrol agent. Exploration by PPC Staff identified this species as a viable agent for the control of *Tibouchina*. Non-target testing and evaluation is well thought out and considered and is comprehensive in nature. I similarly concur that it is unlikely that unanticipated non-target impacts will occur with this species. As such I recommend approval for importation and release."

4. Provided *Syphraea uberabensis* is placed on the List of Restricted Animals (Part A), I recommend Approval___/___Disapproval to establish permit conditions for the import and release of *Syphraea uberabensis* as a biocontrol agent of *Tibouchina herbacea* and related weed species by USDA FS.

Dr. Peter Follett: Recommends Approval.

Comments: "The researchers should be encouraged to write up the host range testing data and submit to a scientific journal for peer-review. Souder (2008) is a

Master's thesis from UH but otherwise unpublished; likewise Raboin (2009) is unpublished. USFS (2013) is unpublished. Reviewers with weed biocontrol expertise may see ways to improve the methodology, host list, and discussion of the literature. For example, a reference should be provided for the Centrifugal Phylogenetic Method. Certain ecological aspects are not discussed such as the seed bank, e.g. how long are the target's seeds viable in the soil. This may directly impact the overall success of the biocontrol agent. Does the target weed exhibit compensatory growth after feeding by the flea beetle? Etc. These are the types of comments that might surface during peer-review."

> Dr. Johnson's Response: "I intend to publish these *Syphraea* studies in the scientific literature. Regarding Dr. Follett's question about how long *T. herbacea* seeds are viable in soil, I don't know of any studies on seed longevity of *T. herbacea* or its close relatives. There has also not been any extended studies of impacts of Syphraea uberabensis herbivory on whole plants. Only a brief study with caged plants lasting a few weeks showing that severe defoliation is possible. Given that a mature plant typically dies back to near the ground in an annual cycle (especially in the native range), addressing compensatory growth experimentally is very challenging. Since the plant is adapted for annual regrowth, we can expect that long term suppression by biocontrol will depend on repeated severe defoliations year after year."

Dr. Daniel Rubinoff: Recommends Approval.

Comments: "The research on this agent has been long and thorough and it's ready to be released."

Dr. Mark Wright: Recommends Approval

Comments: "As indicated above, I believe the petitioner has provided convincing evidence that Syphraea uberabensis does not pose threats to native Hawaiian plant species and shows promise a biological control agent of *T. herbacea*."

Dr. Jesse Eiben: Recommends Approval

Comments: "As always, it is nice to see the specimens imported will be reared for potential parasitoids or other natural enemies before release from the lab colonies."

Dr. Francis Howarth: No Response

Mr. Darcy Oishi: Recommends Approval

Comments: “The permit conditions presented here are consistent with permit conditions for a restricted article that is being imported and shipped from a source outside of Hawaii not with how biological control agents for classical biological control exist within the quarantine framework of Hawaii. Per 150A-5.5b, addresses what constitutes importation. The language states that importation of “articles quarantined in the biocontrol containment facilities of the department or other government agencies engaged in joint projects… may be released upon issuance of a permit approved by the board.” This statement therefore states IMPORTATION occurs when articles are removed from the biocontrol containment facilities with a permit from the Board of Agriculture. As such, this creates a conflict with permit conditions 5 which states screening will occur after importation. This means the insect will be outside of the bounds of the containment facility therefore negating the protection these facilities inherently offer to prevent unintentional impacts. This permit condition should be changed and reflect the need for screening prior to importation or release from the containment facility. Suggested language is “Upon entry into the state, the restricted article(s) shall be screened for other species, predators, parasites, parasitoids, or hyperparasitoids for a minimum of two generations in the USDA approved Insect Containment Facility, USDA FS, Hawaii Volcanoes National Park Quarantine Facility, Kilauea Research Station, Building 34, Volcano, HI 96718 prior to release from containment. A report shall be submitted to PQB detailing the discovery of any organisms found other than the restricted article(s)” Note: as written, this will only allow screening to occur at the Volcano facility and does not include the potential to use the King St. Facility for screening and ultimately release.

Similarly, permit condition 11 is fraught with issues. HRS 150A-5.10 refers to specific ports by which entry into the state can be made. From a regulatory standpoint, biological control agents are inspected by APHIS PPQ as the first port of entry in the United States. Material is inspected by USDA at a Plant Inspection Station under permit. For Hawaii, this port of entry is at the Port of Honolulu. There can be exceptions if the first port of US entry is NOT Honolulu. However, permit condition 11, requires importation to be in the port of Honolulu. Entrance into the state and importation are two separate issues. Importation of a biocontrol agent could be removal from an approved containment facility or importation of material from other sources under permit which would mean importation and entrance would be the same. Limiting importation to the port of Honolulu creates a situation that is impractical and does not reflect reality. Requiring all shipments to ENTER through the port of Honolulu is do-able. The permit condition should be reframed to state: “All parcels containing the restricted article(s) shall be subject to inspection by the PQB prior to entering the

State. Entry should be through the port of Honolulu as designated by the Board. Entry into Hawaii through another port is prohibited". This permit condition should also be listed as permit condition 5 as entrance occurs prior to importation and release."

PQB NOTES: *PQB has consulted with legal counsel and it has been determined there is no requirement for Syphraea uberabensis to be transported back to Honolulu after the issuance of a permit.*

Permit condition #11 has been amended to comply with Chap. 150A-5.5(b).

VII. Proposed Permit Conditions

1. The restricted article(s), *Syphraea uberabensis*, which includes progeny, shall be used for field release and research, a purpose approved by the Board of Agriculture (Board), and shall not be sold, given away, or transferred in Hawaii, except as approved by the Board.

2. The permittee, Dr. Matthew Tracy Johnson, U.S. Department of Agriculture (USDA) Forest Service (FS), Hawaii Volcanoes National Park Quarantine Facility, Kilauea Research Station, Building 34, Volcano, HI 96718, shall be responsible and accountable for all restricted article(s) imported, from the time of their arrival until their final disposition.

3. The restricted article(s) shall be safeguarded and maintained at the USDA approved Insect Containment Facility, USDA FS, Hawaii Volcanoes National Park Quarantine Facility, Kilauea Research Station, Building 34, Volcano, HI 96718 or the Hawaii Department of Agriculture Plant Pest Control Branch Containment Facility, 1428 South King Street, Honolulu, Hawaii 96814, sites approved by the Plant Quarantine Branch (PQB), by trained or certified personnel designated by the permittee.

4. Upon request by the PQB, the permittee shall submit samples of the restricted article(s) prior to importation to the PQB.

5. Upon entry into a PQB approved containment facility, the restricted article(s) shall be screened for other species, predators, parasites, parasitoids or hyperparasitoids for a minimum of two generations in the USDA approved Insect Containment Facility, USDA FS, Hawaii Volcanoes National Park Quarantine Facility, Kilauea Research Station, Building 34, Volcano, HI 96718 or the Hawaii Department of Agriculture Plant Pest Control Branch Containment Facility, 1428

South King Street, Honolulu, Hawaii 96814.. A report shall be submitted to PQB detailing the discovery of any organisms found other than the restricted article(s).

6. In the event the restricted article(s) become parasitized or infected by disease, the permittee shall:

   a. Destroy the entire lot of the restricted article(s) by freezing;

   b. Autoclave all insects, dietary and oviposition media; and

   c. Subject all used cages and equipment to autoclaving or treatment with a bleach solution containing at least 0.5% sodium hypochlorite concentration.

7. At least 48 hours prior to shipping any parcel containing the restricted article(s), the permittee shall notify the PQB Chief in writing and provide the following information:

   a. Expected arrival date;

   b. Waybill, bill of lading, and/or tracking number;

   c. Name and address of the shipper;

   d. Name and address of the importer or importer's agent in the State of Hawaii;

   e. Number of packages;

   f. Description of contents of each package (including scientific name); and

   g. Port of entry into the State.

8. At least four sides of all parcels containing the restricted article(s) imported into the State shall be clearly and legibly marked: "**This parcel may be opened and delayed for agricultural inspection in Hawaii**" in 2-inch minimum sized font.

9. The restricted article(s) shall be shipped in sturdy PQB-approved containers designed to be escape-proof and leak-proof.

10. Each shipment of the restricted article(s) shall be accompanied by a complete copy of the PQB permit for the restricted article(s) and an invoice, packing list or other similar PQB-approved document listing the scientific and common names

of the restricted article(s), the quantity of the restricted article(s), the shipper, and the permittee(s) for the restricted article(s).

11. All parcels containing the restricted article(s) shall be subject to inspection by the PQB prior to entering the State and shall be imported through the port of Honolulu except as designated by the Board. Entry into Hawaii through another port is prohibited unless designated by the Board.

12. The approved site, restricted article(s), progeny, records, and any other document pertaining to the restricted article(s) and progeny under this permit, may be subject to post-entry inspections by the HDOA, PQB. The permittee shall make the site, restricted article(s), progeny, and records pertaining to the restricted article(s) available for inspection upon request by a PQB inspector.

13. Prior to release on each island, the applicant shall provide HDOA PQB and Plant Pest Control Branch the following:

    a. Date and time of release.

    b. Site of the release for each island.

    c. Approximate number of individuals to be released.

    d. Voucher specimens from the lab reared colony to be released into the HDOA Zoological Reference Collection housed at PPC.

14. It is the responsibility of the permittee to comply with any applicable requirements of municipal, state, or federal law pertaining to the restricted article(s).

15. The permittee shall submit to the PQB Chief a copy of all valid licenses, permits, certificates or their equivalent required for the restricted article(s) or for their import, possession, movement, or transfer. The permit issued by the PQB Chief may be cancelled upon revocation, suspension, or termination of any of the aforementioned documents.

16. The permittee shall submit an annual report to the PQB no later than January 31st of the following year, of the results of post release monitoring programs, and shall include the following:

    a. Amount of the restricted article(s) released and number of releases for the year;

    b. Establishment and current field populations of the restricted article(s);

c. Effect of the restricted article(s)on *Tibouchina herbacea* and other species in the family Melastomataceae; and

d. Effect of the restricted article(s) on native plant and animal species.

17. The permittee shall adhere to the use, facility, equipment, procedures, and safeguards described in the permit application, and as approved by the Board and the PQB Chief.

18. The permittee shall have a biosecurity manual available for review and approval by the PQB, at the time of the initial site inspection and any subsequent post-entry inspection(s), which identifies the practices and procedures to be adhered to by the permittee to minimize or eliminate the risk of theft, escape, or accidental release of the restricted article(s), including the risk of introduction and spread of diseases and pests associated with the restricted article(s) to the environment. The permittee shall adhere to all practices and procedures as stated in this biosecurity manual.

19. The permittee shall immediately notify the PQB Chief verbally and in writing under the following circumstances:

a. If any escape, theft, accidental release, parasitoid, hyperparasitoid, or other pest or disease outbreaks involving the restricted article(s) under this permit occurs.

b. Prior to any changes to the approved site, facility and/or procedures regarding the restricted article(s) being made, the permittee shall also submit a written report documenting the specific changes to the PQB Chief for approval.

c. If a shipment of the restricted article(s) is delivered to the permittee without a PQB “Passed” stamp, tag or label affixed to the article, container, or delivery order that indicates that the shipment has passed inspection and is allowed entry into the State, then the permittee shall not open or tamper with the shipment and shall secure, as evidence, all restricted article(s), shipping container(s), shipping document(s) and packing material(s) for PQB inspection.

d. If the permittee will no longer import or possess the restricted article(s) authorized under this permit.

20. The permittee shall be responsible for all costs, charges, or expenses incident to the inspection, treatment, or destruction of the restricted article(s) under this permit, as provided in Act 173, Session Laws of Hawaii 2010, section 13, including, if applicable, charges for overtime wages, fixed charges for personnel services, and meals.

21. Any violation of the permit conditions may result in citation, permit cancelation, and enforcement of any or all of the penalties set forth in HRS §150A-14.

22. A cancelled permit is invalid and upon written notification from the PQB Chief, all restricted article(s) listed on the permit shall not be imported. In the event of permit cancelation, any restricted article(s) imported under permit may be moved, seized, treated, quarantined, destroyed, or sent out of State at the discretion of the PQB Chief. Any expense or loss in connection therewith shall be borne by the permittee.

23. This permit or conditions of this permit are subject to cancellation or amendment at any time due to changes in administrative rules restricting or disallowing import of the restricted article(s) or due to Board action disallowing a previously permitted use of the restricted article(s).

24. These permit conditions are subject to amendment by the PQB Chief in the following circumstances:

    a. To require disease screening, quarantine measures, and/or to place restrictions on the intrastate movement of the restricted article(s), as appropriate, based on scientifically validated risks associated with the restricted article(s), as determined by the PQB Chief, to prevent the introduction or spread of disease(s) and/or pests associated with the restricted article(s); or

    b. To conform to more recent Board approved permit conditions for the restricted article(s), as necessary to address scientifically validated risks associated with the restricted article(s).

25. The permittee(s) shall agree in advance to defend and indemnify the State of Hawaii, its officers, agents and employees for any and all claims against the State of Hawaii, its officers, agents, employees, or Board of Agriculture members that may arise from or be attributable to any of the restricted article(s) that are introduced under this permit. This permit condition shall not apply to a permittee that is a federal or State of Hawaii entity or employee, provided that the State or federal employee is a permittee in the employee's official capacity.

ADVISORY COMMITTEE REVIEW: May we request your recommendation and comments at the next meeting of the Advisory Committee on Plants and Animals.

ATTACHMENT 1

PQ-7 (01/04)

State of Hawaii
Department of Agriculture
PLANT QUARANTINE BRANCH
1849 Auiki Street, Honolulu, HI 96819-3100
Phone: (808) 832-0566, FAX: (808) 832-0584

For Office Use Only

Fee: $_____ Receipt No. _____

☐ Approve Permit No._____ Date: _____
☐ Disapprove ☐Other _____

Processed by: _____ Date: _____

PERMIT APPLICATION FOR RESTRICTED COMMODITIES INTO HAWAII

Date: *April 30, 2021*

In accordance with the provision of Chapter 342 , Hawaii Administrative Rules of the Division of Plant Industry, Department of Agriculture, a permit is requested for the following commodities:

Please type or print clearly.

Quantity	Commodity	Scientific Name
300	flea beetle for biological control of melastome weeds	Syphraea uberabensis (Coleoptera; Chrysomelidae)

Name and address of shipper: USDA Forest Service, Hawaii Volcanoes National Park Quarantine Facility
Original source: M. Vitorino, Universidade Regional de Blumenau, Santa Catarina, Brazil

(Mainland or Foreign address)

Approximate
date of arrival: _____

Mode of Shipment: ☐ Mail ☐ Air Freight ☐ Boat

Type of Permit:
--- Import
☐ one time only ☑ multi-shipments
--- Intrastate shipment
☐ one time only ☑ multi-shipments
☐ Possession

Object of importation:
☐ Kept caged at all time
☑ Used for propagation
☐ Imported for exhibition
☑ Imported for liberation
☐ Other purposes - specify field release of biocontrol agent from quarantine facility

Please type or print clearly.

Applicant's Name M. Tracy Johnson

Company Name USDA Forest Service
(if applicable)

Hawaii Mailing Address PO Box 236
Volcano HI 96785

Telephone number 808-967-7122

Facsimile number 808-967-7158

Fee Amount Enclosed (cash, check or mail order) $_____

(complete reverse side)

PLEASE COMPLETE THE FOLLOWING INFORMATION (attach extra sheet if necessary)

1. State in detail the reasons for introduction (include use or purpose).

Syphraea uberabensis from Brazil has been selected and evaluated as a new biological control for managing invasive melastome weeds in Hawaii. It is a narrowly host-specific leaf-feeding beetle intended for statewide field release to cause suppression of alien Tibouchina, Melastoma (designated as noxious weeds) and Pterolepis species. The beetle is expected to cause severe defoliation of targeted weeds, without affecting any native or otherwise valued plants. Suppression of these weeds will benefit forest watersheds statewide. See attached results.

2. Person responsible for the organism (include name, address and phone number).

Dr. M. Tracy Johnson
Institute of Pacific Islands Forestry
USDA Forest Service, Pacific Southwest Research Station
P.O. Box 236
Volcano, HI 96785
tel: 808-967-7122

3. Location(s) where the organism will be kept and used (include address, contact and phone number).

USDA Forest Service, Hawaii Volcanoes National Park, Magma House, Bldg 34
M. Tracy Johnson 808-967-7122

Hawaii Dept of Agriculture, Plant Pest Control Branch, Biocontrol Section
16 E. Lanikaula Street, Hilo; 1428 S. King Street, Honolulu
Stacey Chun 808-974-4140; Darcy Oishi 808-973-9524

4. Method of disposition.

Syphraea uberabensis will be removed from a source colony maintained at the Hawaii Volcanoes National Park Quarantine Facility. This colony will originate from insects collected from southern Brazil and screened in quarantine to eliminate associated natural enemies. Roughly 30 insects at a time will be removed from quarantine as newly pupated adult beetles, independent of host plant material and other potential contaminants. Adults will be used to establish colonies reared in petri dishes at USDA and HDOA insectaries in Volcano, Hilo and Honolulu. Offspring from rearing colonies will be used for environmental releases at selected locations statewide.

5. Give an abstract of the organism with particular reference to potential impact on the environment of Hawaii (include impact to plants, animals and humans).

Syphraea uberabensis (Coleoptera: Chrysomelidae), a flea beetle native to Brazil, is proposed for biological control of invasive weeds in the family Melastomataceae. Adult beetles, 3-4 mm long, feed and lay eggs on leaves and soft stems of host plants. Larvae also feed on leaves. The host range of S. uberabensis is restricted to species in the tribe Melastomeae, all non-native and invasive in Hawaii. Testing consistently identified the potential Hawaiian hosts as: Tibouchina herbacea, Tibouchina longifolia, Pterolepis glomerata, Melastoma septemnervium and Melastoma sanguineum. This beetle thrives in moist habitats, similar to the areas where Tibouchina and Pterolepis occur in Hawaii, which should allow for maximal impact, including severe defoliation. Impacts may be lower on Melastoma, which can occur in drier habitats, where S. uberabensis eggs and larvae may be susceptible to drying.

****

I request permission to import the articles as listed on the permit application and further, request that the articles be examined by an authorized agent of the Department of Agriculture upon arrival in Hawaii.

I agree that I, as the importer, will be responsible for all costs, charges or expenses incident to the inspection or treatment of the imported articles.

I further agree that damages or losses incident to the inspection or the fumigation, disinfection, quarantine, or destruction of the articles, by an authorized agent of the Department of Agriculture, shall not be the basis of a claim against the department or the inspectors for the damage or loss incurred.

Signature _____ **Date** May 4 2021

(Applicant)

ATTACHMENT 2

FILE COPY

JAN 23 2020

DAVID Y. IGE
Governor

JOSH GREEN
Lt. Governor

PHYLLIS SHIMABUKURO-GEISER
Chairperson, Board of Agriculture

MORRIS M. ATTA
Deputy to the Chairperson

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 South King Street
Honolulu, Hawaii 96814-2512
Phone: (808) 973-9600 FAX: (808) 973-9613

January 13, 2020

Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 S. Beretania Street, Room 702
Honolulu, Hawaii 96813

Dear Director:

With this letter, the Hawaii Department Agriculture hereby transmits the Draft Environmental Assessment and Anticipated Finding of No Significant Impact (DEA-AFNSI) for the Proposed Statewide Field Release of the Brazilian Beetle *Syphraea uberabensis* for Biological Control of the Noxious Weed Cane Tibouchina *Tibouchina herbacea* and Related Weeds for publication in the next available edition of The Environmental Notice.

Enclosed is a completed OEQC Publication Form, two copies of the DEA-AFNSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Christopher Kishimoto, Plant Quarantine Branch Entomologist at: (808) 832-0581 or Christopher.M.Kishimoto@hawaii.gov.

Sincerely,

Jonathan Ho
Acting Manager
Plant Quarantine Branch

Enclosures:

1. OEQC Publication Form (Agency)
2. Draft Environmental Assessment for the Proposed Statewide Field Release of the Brazilian Beetle *Syphraea uberabensis* for Biological Control of the Noxious Weed Cane Tibouchina *Tibouchina herbacea* and Related Weeds

Island Fresh

20-184

AGENCY
PUBLICATION FORM

Project Name:	Proposed Statewide Field Release of the Brazilian Beetle *Syphraea uberabensis* for Biological Control of the Noxious Weed Cane Tibouchina *Tibouchina herbacea* and Related Weeds
Project Short Name:	Tibouchina Biological Control DEA
HRS §343-5 Trigger(s):	(1) Propose the use of state or county lands or the use of state or county funds
Island(s):	Statewide
Judicial District(s):	Statewide
TMK(s):	N/A
Permit(s)/Approval(s):	USDA-APHIS-PPQ and Board of Agriculture (HDOA Plant Quarantine Branch)
Proposing/Determining Agency:	Department of Agriculture (DOA), State of Hawai'i
Contact Name, Email, Telephone, Address	Christopher Kishimoto; christopher.m.kishimoto@hawaii.gov; (808) 832-0581; 1849 Auiki Street, Honolulu, Hawai'i 96819
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	Garcia and Associates; please use Proposing Agency contact for any questions
Contact Name, Email, Telephone, Address	Huang-Chi Kuo; kuo@garciaandassociates.com; 146 Hekili St., Suite 101, Kailua, Hawai'i 96734

Status (select one)	**Submittal Requirements**
__X__ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.

____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary
Provide a description of the proposed action and purpose and need in 200 words or less.

The HDOA, in collaboration with the Hawai‘i Department of Land and Natural Resources, proposes the release of a beetle from Brazil, *Syphraea uberabensis*, for biocontrol of invasive cane tibouchina, *Tibouchina herbacea*, and related weeds. Tibouchina and its relatives are noxious weeds in Hawai‘i, where they form dense stands in pastures and forests, outcompeting native species.

Syphraea uberabensis is a small beetle whose adults and larvae feed on cane tibouchina in its native region of Brazil, causing extensive damage to the leaves as well as the soft exterior of young stems. Heavy feeding is expected to reduce plant density and prevent reproduction and spread to new areas, benefiting native ecosystems in Hawai‘i.

This Draft Environmental Assessment supports the release of the biocontrol agent, *Syphraea uberabensis*, to control cane tibouchina and related weeds. Observations in Brazil and extensive testing in Brazil and Hawai‘i have shown that *S. uberabensis* is narrowly host-specific to cane tibouchina and a few closely related plants that are also weeds in Hawai‘i.

Draft Environmental Assessment

Statewide Field Release of the Brazilian Beetle *Syphraea uberabensis* for Biological Control of the Noxious Weed Cane Tibouchina *Tibouchina herbacea* and Related Weeds

Prepared For:

Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl St., Room 325
Honolulu, Hawai‘i 96813

Prepared By:

Garcia and Associates
146 Hekili St., Suite 101
Kailua, Hawai‘i 96734

GANDA Report No. 2327-1

GANDA

January 2020

PROJECT SUMMARY

Project Name: Statewide Field Release of the Brazilian Beetle *Syphraea uberabensis* for Biological Control of the Noxious Weed Cane Tibouchina *Tibouchina herbacea* and Related Weeds

Proposing Agency: Department of Agriculture
State of Hawai‘i

Project Location: Statewide

Property Owner: State of Hawai‘i

State Land Use Classification: Not Applicable

Agency Determination: Anticipated Finding of No Significant Impact (AFNSI)

Agencies, Organizations, and Other Stakeholders Consulted:

FEDERAL AGENCIES

- US House of Representatives, Representative Tulsi Gabbard
- US House of Representatives, Representative Colleen Hanabusa
- US Senate, Senator Mazie Hirono
- US Senate, Senator Brian Schatz
- National Park Service, Hawai‘i Volcanoes National Park
- National Park Service, Haleakalā National Park
- Natural Resources Conservation Service, Pacific Islands Area
- US Army Garrison, Commander Col. Stephen E. Dawson
- US Army Garrison, Environmental Division
- US Army Garrison, Natural Resource Section
- US Fish & Wildlife Service
- US Fish & Wildlife Service, O‘ahu National Wildlife Refuge Complex
- US Geological Survey, Pacific Island Ecosystems Research Center

STATE AGENCIES

- Aha Moku Councils
- BLNR O‘ahu Member
- Department of Business, Economic Development & Tourism
- Department of Hawaiian Homelands
- Department of Health
- Department of Health, Office of Environmental Quality Control

- DLNR Division of Forestry & Wildlife
- DLNR Division of State Parks
- DLNR Land Division
- DLNR Office of Conservation & Coastal Lands
- DLNR State Historic Preservation Administration
- DLNR Watershed Partnership Program
- Land Use Commission
- Natural Area Reserves System Commission
- Office of the Governor
- Office of Hawaiian Affairs
- University of Hawai‘i, College of Tropical Agriculture and Human Resources
- University of Hawai‘i, Environmental Center
- University of Hawai‘i, Pacific Cooperative Studies Unit

CITY AND COUNTY AGENCIES

- Honolulu City Council
- City & County of Honolulu, Office of the Mayor
- City & County of Honolulu, Board of Water Supply
- City & County of Honolulu, Planning Department
- Hawai‘i County Council
- Hawai‘i County, Office of the Mayor
- Hawai‘i County, Department of Water Supply
- Hawai‘i County, Department of Planning
- Kaua‘i County Council
- Kaua‘i County, Office of the Mayor
- Kaua‘i County, Department of Planning
- Kaua‘i County, Department of Water Supply
- Maui County Council
- Maui County Office of the Mayor
- Maui County, Department of Planning
- Maui County, Department of Water Supply

ORGANIZATIONS

- Big Island Invasive Species Committee
- Bishop Museum
- Conservation Council of Hawai‘i

- Environment Hawai‘i Inc.
- Hawai‘i Audubon Society
- Hawai‘i Cattlemen’s Council
- Hawai‘i Conservation Alliance
- Hawai‘i Forest and Trail
- Hawai‘i Forest Industry Association
- Hawaiian Botanical Society
- Hawaiian Trail and Mountain Club
- KAHEA
- Kamehameha Schools
- Kaua‘i Invasive Species Committee
- Ko‘olau Mountains Watershed Partnership
- Maui Invasive Species Committee
- Moloka‘i Invasive Species Committee
- Native Hawaiian Advisory Council
- Native Hawaiian Legal Corporation
- O‘ahu Invasive Species Committee
- Pig Hunters Association of O‘ahu
- Plant Extinction Prevention Program
- Sierra Club, O‘ahu Chapter
- The Nature Conservancy of Hawai‘i

CONTENTS

FIGURES

TABLES

PROJECT SUMMARY DESCRIPTION

The Hawai‘i Department of Agriculture and the Hawai‘i Department of Land and Natural Resources propose the field release on State lands in Hawai‘i of a beetle from Brazil, *Syphraea uberabensis* (Coleoptera, Chrysomelidae, Galerucinae, Alticini), for biological control of cane tibouchina, *Tibouchina herbacea* (Melastomataceae).

Tibouchina herbacea is a noxious weed native to Southern Brazil, Uruguay, and Paraguay. In Hawai‘i, it naturalized and is locally abundant in disturbed mesic to wet forest on the islands of Hawai‘i, Lāna‘i, Maui, Moloka‘i, and O‘ahu. It is able to invade native forest through abundant production of tiny, easily dispersed seeds. Once established it forms dense stands and displaces native vegetation.

Syphraea uberabensis is a natural herbivore of *T. herbacea* in the plant's native range in Brazil. Of the potential natural control agents evaluated in Brazil, *S. uberabensis* demonstrated the most potential for successful control of cane tibouchina. Further testing has shown that *S. uberabensis* is narrowly host-specific to *T. herbacea* and a few closely related plants that are also weeds in Hawai‘i.

Release of the biocontrol agent is currently proposed on State lands on all islands where *T. herbacea* has naturalized. Populations of *S. uberabensis* are expected to increase to effective levels on the target plant within a few years at release sites. Spread of the insect from the initial release sites will occur naturally and artificially via redistribution efforts by state and federal agencies involved in management of cane tibouchina and related weeds. Within several years of initial release, *S. uberabensis* is expected to range statewide in all areas infested by cane tibouchina and four related weed species. The state and federal agencies responsible for biocontrol introductions and weed management will closely monitor the establishment of the beetle and its effectiveness for long term weed control.

The proposed action requires Plant Protection and Quarantine permits from the US Department of Agriculture, Animal and Plant Health Inspection Service; a permit for import and liberation of restricted organisms from the Hawai‘i Department of Agriculture, Plant Quarantine Branch; and a permit for release and monitoring of the insect on State forest land from the Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife.

An alternative to the proposed action considered in this assessment is no action. Under this alternative *S. uberabensis* would not be released on State forest land, and management of cane tibouchina would be limited to mechanical and chemical controls, solutions which are applicable only to relatively small areas.

Because *S. uberabensis* is specialized on a few species of melastomes, all of which are invasive, the environmental consequences of its release are expected to be beneficial to the native forests and agricultural economy of Hawai‘i, and adverse effects are expected to be negligible. Therefore, the anticipated determination from this Draft Environmental Assessment is an Anticipated Finding of No Significant Impact (AFNSI).

1.0 INTRODUCTION

This Draft Environmental Assessment (DEA) supports a proposed field release of a small beetle, *Syphraea uberabensis*, in the State of Hawai‘i for biocontrol of *Tibouchina herbacea* and related weeds in the melastome family. The proposing agency for this program is the State of Hawai‘i Department of Agriculture (HDOA).

The proposed action of releasing the biological control agent has the potential to impact the local environment and involves the use of state and federal funds and approval of permits. Therefore, in accordance with the Hawai‘i Revised Statutes (HRS) Chapter 343, Hawai‘i Environmental Policy Act, and the National

Environmental Policy Act, the proposing agencies are conducting an Environmental Assessment (EA) of the proposed project.

This Environmental Assessment identifies proposed and alternative actions of the project; describes the affected physical, biological, cultural, and socioeconomic environments; and analyzes potential environmental impacts to the existing environment resulting from the proposed action.

1.1 Purpose and Need

The Hawai‘i Department of Agriculture defines “noxious weeds” in HRS Chapter 152 as “any plant species which is, or which may be likely to become, injurious, harmful, or deleterious to the agricultural, horticultural, aquacultural, or livestock industry of the State and to forest and recreational areas and conservation districts of the State, as determined and designated by the department from time to time.” The criteria for designating noxious weeds, and the list of species currently designated as such, are available in Hawai‘i Administrative Rules (HAR) Chapter 68.

The Hawai‘i Department of Agriculture’s Plant Pest Control Branch is responsible for limiting plant pest populations that have the potential to cause significant economic damage in the state. This is achieved through statewide programs using chemical, mechanical, biological, and integrated control measures to eradicate or control plant pests, including insects and mites, molluscs, weeds, and plant pathogens.

1.1.1 Biocontrol

Biological control, or biocontrol, has a long history of managing pests. Classical biocontrol involves the use of natural enemies that act as herbivore, predator, pathogen, or parasite of pests in order contain, reduce, or otherwise suppress the pests’ populations and their negative impacts. There are three basic types of biological pest control strategies: conservation, augmentation, and importation. Conservation involves taking measures, such as providing food or improving habitats, to increase naturally occurring natural enemies. Augmentation involves breeding and releasing locally available natural enemies to improve control. Importation (also known as classical biological control) involves the importation and release of an organism outside its natural range for controlling a pest species. The current proposed biocontrol is through importing a natural enemy from the invasive weed’s native range.

When introduced to a new location, a species often arrives without the natural enemies that controlled it in its native range. Lack of top-down control from the natural enemies can contribute to the successful colonization and unusually high population size of invasive species. The Enemy Release Hypothesis has been used to explain the success of invasive plants (Keane and Crawley 2002). Because natural enemies evolved with the pests in their native range, they can be among the most specific and effective ways of controlling the pests.

The use of biocontrol agents for invasive weeds in natural areas has important advantages over mechanical or chemical control. Mechanical and chemical controls are often less selective and tend to cause unintended impact to the environment. In contrast, biocontrol agents can be selected to target a very specific set of pests. While mechanical and chemical control methods may be cost prohibitive for remote or large areas, biocontrol can provide a long-term, cost-effective, and environmentally-friendly solution (Howarth 1991; Mack et al. 2000).

The major concern for biological control is the potential adverse effects on non-target species. If care is not taken, it can have significant and irreversible adverse effects, perhaps even leading to biological extirpation (Howarth 1991; Simberloff and Stiling 1996). The risks of non-target effects from biocontrol can be minimized by extensive testing of host specificity and selecting agents and targets that have the least environmental risk and the most predicted effectiveness (Markin et al. 1992; Louda et al. 2003).

1.2 Primary Target Species: *Tibouchina herbacea* - Cane Tibouchina

Figure 1. Cane tibouchina (*Tibouchina herbacea*); Photo by Forest & Kim Starr

Taxonomy: *Tibouchina herbacea* (DC.) Cogn. (Synonyms: *Arthrostemma herbacea* DC.; *Arthrostemma hirsutissimum* DC.; *Pterolepis herbacea* (DC.) Triana) belongs to the pantropical melastome family (Melastomataceae). *Tibouchina* Aubl. is a genus containing about 350 species ranging from Mexico, West Indies, to northern Argentina. The center of diversity is in southeastern Brazil. *Tibouchina* is classified in the tribe Melastomeae, which contains several related genera (e.g. *Arthrostemma*, *Dissotis*, *Melastoma*, and *Pterolepis*) that also have naturalized in Hawai‘i (Wagner et al. 1999). A phylogenetic study indicates that *Tibouchina* is a well-supported phylogenetic group (clade), although several derived genera nest within the clade (Michelangeli et al. 2012).

Description: *Tibouchina herbacea* is a semi-woody upright shrub (Figure 1 and Figure 2). Young stems angled, hairy. Leaves opposite, 3 inches long by 1.4 inches wide, hairy, with 5–7 prominent veins. Flowers pink, 4 petals, bright yellow anthers. Fruit cuplike, small, 0.2 inches long by 0.2 inches wide. Seeds very small, numerous (Motooka et al. 2003). Many of the hairs covering leaves, stems and fruits are gland-tipped, so that plants leave an oily, scented residue when touched. The growth form is notably different between the populations in Brazil and Hawai‘i. In Brazil, it rarely grows above l m in height and dies back each year. In Hawai‘i, it can grow up to 3–4 m and the previous year’s stems can survive the dormant period forming rank sprawling stems from which new shoots arise the following year. It forms dense thickets that are difficult to traverse and smother adjacent vegetation, gradually increasing the size of the infestation (Almasi 2000; Smith 2002).

Distribution: *Tibouchina herbacea* is native to South America, including Brazil, Argentina, Paraguay, and Uruguay. *Tibouchina herbacea* was introduced to Hawai‘i as an ornamental (Motooka et al. 2003) and was first collected in Hawai‘i Island in 1977. It subsequently colonized Maui by 1982. It is widely established on Hawai‘i and Maui and has been found on Lāna‘i, Moloka‘i, and O‘ahu (Wagner et al. 1999; Wysong et al. 2007; Imada 2012). Attempts at eradication have continued since its discovery in 2008 at Poamoho on O‘ahu (Neville 2020).

Habitat: *Tibouchina herbacea* is found in swamps, meadows, and forests in its native range (Wagner et al. 1999). It naturalized in mesic and wet areas between 100 m and 1600 m in Hawai‘i (SPREP 2000). A habitat modeling study in Kohala Mountain indicates that *T. herbacea* is most frequently found in partially-shaded wet forests above 300 m and is positively associated with feral pig disturbance (Purell 2006).

Reproduction and Dispersal: This invasive plant spreads by prolific production of seeds that are the size of grains of sand, as well as vegetatively. Each multi-stemmed plant can produce hundreds of 5-mm wide seed capsules (fruiting hypanthia), with each capsule producing up to 700 seeds that fall or blow distances up to several meters (Almasi 2000). The tiny seeds can be transported by birds, rats, pigs, water, and human foot and vehicular traffic. Plants also can reproduce vegetatively by growing roots along leaf nodes or producing new shoots from rhizomes (Almasi 2000). Rats and birds are claimed to be dispersers in Hawai‘i, despite the fact that the plant does not produce fleshy fruit (Almasi 2000; Motooka et al. 2003). Pigs likely spread the seeds externally and could conceivably spread stem fragments, as areas disturbed by pigs are often completely taken over by this plant (Buddenhagen 2013).

Impact: *Tibouchina herbacea* invades wet and mesic forests that are disturbed (especially by pigs and landslides), though it can grow in shaded areas. It forms dense stands in pastures and disturbed forests, out-competing native species. It is listed amongst the invasive plants that are considered the most serious habitat modifying species (Medeiros and Loope 2013). Along with other *Tibouchina* species, it has been placed on the Hawaii State Noxious Weed List (HAR 68), and it has a Weed Risk Assessment rating of 24. Visit http://www.hpwra.org for more information on Weed Risk Assessments.

Figure 2. *Tibouchina herbacea* growing along Waihe‘e Ridge Trail, Maui; Photo by Forest & Kim Starr

Management: Various herbicide applications have been reported to control *T. herbacea*. These include application of 1) undiluted triclopyr ester to the stem base; 2) triclopyr amine in foliar sprays with a surfactant and in cut-stump treatments; 3) glyphosate at 2% product in water in foliar spray; and 4) 10% Garlon 3A as a foliar spray. Based on work with other melastomes, *T. herbacea* is probably sensitive to 2,4-D, dicamba, triclopyr, and metsulfuron (Motooka et al. 2003; Loh et al. 2014). Mechanical removal is not effective as the cut plants will sprout and the broken pieces can root and form new plants if left in place. Because of its wide distribution and ability to invade remote areas, the use of chemical and mechanical controls is economically prohibitive for controlling advanced infestation, therefore biocontrol is considered the only sustainable control method at the landscape scale.

Natural Enemies: Exploration for potential biological control agents was conducted in the native range of *T. herbacea* in southeastern Brazil. Surveys in the 1990s yielded several insects and plant diseases that were considered in initial screening for potential biocontrol agents. Plant diseases found to infect *T. herbacea* include *Cryphonectria cubensis*, a canker disease affecting a wide range of hosts including *Eucalyptus* spp. (Seixas et

al. 2004); and leaf spots caused by cercopsoroid fungi (asexual stage of Mycosphaerellaceae), including *Cercospora apii*, *Passalora tibouchinae*, *Pseudocercospora subsynnematosa*, *Pseudocercospora tamonae*, *Pseudocercospora tibouchina-herbaceae*, and *Pseudocercospora tibouchinicola* (Killgore 2002; Parreira et al. 2014). Insects found to feed on *T. herbacea* include a flea beetle, *Syphraea uberabensis* (Coleoptera, Chrysomelidae, Alticini); a weevil, *Anthonomus partiarius* (Coleoptera, Curculionidae); a moth, *Schreckensteinia* sp. (Lepidoptera: Schreckensteiniidae); and another flea beetle, *Margaridisa* sp. (Coleoptera: Chrysomelidae). The proposed biological control agent *Syphraea uberabensis* is considered the most suitable after extensive studies of its effectiveness and its potential host range in Hawai‘i.

1.3 Biocontrol Agent: *Syphraea uberabensis*

Syphraea uberabensis is the insect that is proposed for release for biocontrol of *T. herbacea* and related weeds in Hawai‘i. *Syphraea uberabensis* is a small beetle that has been evaluated in its native Brazil between 1993 and 2009 and in containment in Hawai‘i between 2005 and 2015. Adults and larvae feed externally on foliage and soft stems of *T. herbacea.*, causing enough damage to kill small plants. *Syphraea uberabensis* is host specific to a subset of species within the melastome family, which contains no native taxa in Hawai‘i.

Taxonomy: *Syphraea uberabensis* Bechyné is a flea beetle, classified under the tribe Alticini and the leaf beetle family Chrysomelidae. Flea beetles are similar to other leaf beetles but are characterized by having enlarged hind legs, which afford them the ability to leap/spring when disturbed, hence the common name. Flea beetles are herbivores that feed on various parts of the plant; some flea beetle species are important agricultural pests. They do not bite humans or animals. The genus *Syphraea* Baly (1876) includes more than 100 species and is found throughout South and Central America (Scherer 1983).

Description of Adults: Body elongated, slightly broader posteriorly; robust legs; thorax, abdomen, legs and antennae relatively covered with fine short hairs; coloration deep metallic blue, females 3.3 mm and males 3.0 mm in length, on average (Souder 2008).

Description of Larvae: Mature larva. Length: 4.4–6.30 mm; width of pronotum: 0.75–1.41 mm. Eruciform, general integument cream/yellowish with head brown; antennae, maxillae and legs partially membranous; thorax and abdomen with setous sclerotized plates or setous sclerotized tubercles, brown or yellowish-brown, clearer to apex direction; ventral tubercles clearer than dorsal. Segments separated by transverse grooves forming plicae. Setae club-like, whitish, wide with widened apex; ventral setae narrower than dorsal (Casari and Teixeira 2011).

Distribution: *Syphraea uberabensis* is native to southern Brazil. The distributional range of the species is not well studied.

Life History: A life history study conducted in the quarantine facility in Hawai‘i showed that *S. uberabensis* reared on *T. herbacea* have an adult life span ranging from 2 days to 127 days and averaged 78.2 days. *Syphraea uberabensis* samples of the quarantine colony had a sex ratio close to 1:1. Males and females developed and emerged at similar rates (Souder 2008).

Survival and development of *S. uberabensis* was evaluated in the laboratory at five constant temperatures ranging from 12 to 28 ºC. No egg or larval development occurred below 16 ºC. Complete development to adulthood was only seen at 20 and 24ºC. Mean time for development from egg to adult was 50.5 days at 20ºC and 31.5 days at 24ºC, fitting the expected pattern for insects in general: faster development at increasing temperatures. Although development was slightly faster at 28ºC than at 24ºC, beetle survivorship was reduced and no adults developed at 28ºC. Reduced development and increased mortality of beetle larvae at 16 and 28ºC is an indication that the minimum and maximum temperature thresholds were being approached (Souder 2008).

Habitat/Ecology: *Syphraea uberabensis* is tolerant of cool and moderate temperatures and is not expected to be restricted in range by temperatures in Hawai‘i, except perhaps in exceptionally warm habitats. (Souder 2008). However, the potential of *S. uberabensis* as a biological control could be limited by humidity at the microhabitat level. In Brazil, *S. uberabensis* is found with its melastome hosts in boggy soils, similar to the areas where *Tibouchina* and *Pterolepis* thrive in Hawai‘i. On the other hand, *Melastoma* in Hawai‘i can grow in relatively drier areas, such as young lava flows. *S. uberabensis* could be less effective against *Melastoma* in the drier parts of its range, because externally feeding larvae appear to be susceptible to drying (Raboin et al. 2009).

Natural Enemy: There is very little information regarding the natural enemies of *S. uberabensis*. Two unidentified generalist Hemipterans were observed attacking the adult insects in its native range (Wikler and Souza 2008). Under laboratory conditions, larvae and pupae were reported to succumb to a ubiquitous entomopathogenic fungus, *Beauveria bassiana*.

Effect on Target Weed: *Syphraea uberabensis* was selected to be used in the control of *T. herbacea* due the extensive damage it caused to the target plant in Brazil. Both larvae and adults feed on the leaves as well as the soft exterior of young stems. *Tibouchina herbacea* demonstrated little regenerating capacity after attack of *S. uberabensis*, drying after a period of 2 weeks of insect feeding, both in the field and in the laboratory. The leaves were skeletonized, leaving only the stem and vein structures (Figure 3). Plant growth was reduced, and flowering and consequently seed production were prevented. (Wikler and Souza 2008)

Figure 3. Adults and larvae of *Syphraea uberabensis* feeding on *Tibouchina herbacea*

1.3.1 Host Specificity

Understanding host specificity is critical for identifying potential direct effects of a candidate biocontrol agent on non-target species. Host specificity depends upon acceptability and suitability of plants to insects. Acceptability can be evaluated in terms of willingness of larvae and adult beetles to feed and deposit eggs on test plant species. Suitability of potential host plants can be evaluated by the ability of larvae to survive and develop to adulthood, and adults to survive and reproduce.

Host specificity of *S. uberabensis* has been tested on a wide variety of native and non-native plants both in Brazil and in Hawai‘i to identify its ability to feed and reproduce on potential target and non-target plants. The Centrifugal Phylogenetic Method was used for selecting the plants to be tested. This method is based on the knowledge that host specificity usually correlates with phylogenetic affinity/proximity. In other words, a plant that is closely related to a known host is more likely to be a suitable host than a distantly related plant. Using this

method, sampling of potential hosts starts from closely related species, usually within the same genus, then centrifugally expanding to higher taxonomic ranks, for example species in the same family, order, etc.

Results of host specificity studies indicate that *S. uberabensis* does not have the capacity to colonize native or economic plants in Hawai‘i, and the host range is limited to *T. herbacea* and several melastomes in the tribe Melastomeae in the melastome family, specifically *Tibouchina longifolia, Pterolepis glomerata*, *Melastoma septemnervium*, and *Melastoma sanguineum*. All *Tibouchina* and *Melastoma* species are listed as noxious weeds in the state, and *Pterolepis glomerata* has invaded native habitats and been targeted for eradication or control in conservation areas. Results of the host specificity studies are summarized below; more information can be found in the cited literature.

Wikler and Souza (2008): Tests were conducted on 20 plant species across ten families in Brazil, including two *Tibouchina* species in the Melastomataceae, eight species from another three families in the order Myrtales, and ten more species outside the Myrtales, including a monocot. The results showed that among the 20 species tested *S. uberabensis* only fed and reproduced on the two *Tibouchina* species (*T. herbacea* and *T. cerastifolia*).

Souder (2008): Host specificity tests were carried out in the quarantine facility in Hawai‘i. No-choice tests (also known as starvation tests) were conducted on 35 plant species found in Hawai‘i, including 12 native species that are considered significant components of native plant communities. Feeding by beetles was mainly, but not completely, restricted to the family Melastomataceae (Figure 4 and Figure 5). Larvae and young adult beetles fed at very low levels on a few introduced non-melastomes, mainly *Terminalia catappa* (Combretaceae) and *Cuphea* species (Lythraceae). Persistence of beetle populations on these plants did not appear to be possible, because they did not support larval development to adulthood, and they were not accepted by mature beetles for oviposition (

Table 1 and Figure 5). High levels of mature beetle feeding and oviposition occurred only on four melastomes: *Tibouchina herbacea*, *Melastoma septemnervium* (syn. *M. candidum*), *Tibouchina longifolia*, and *Pterolepis glomerata*. Less suitable potential hosts (all belonging to melastome family) were *Heterocentron subtriplinervium*, *Dissotis rotundifolia*, and *Tetrazygia bicolor*. When exposed over a long period, *S. uberabensis* did not persist on these four melastomes. Although occasional non-target feeding may occur on some non-melastomes, no plants outside this family are expected to experience significant damage from this insect. Native and endemic plants appear very unlikely to experience direct adverse effects from *S. uberabensis*.

Raboin et al. (2009): Multi-choice testing with *S. uberabensis* adults began in early 2009 as a follow-up to the Souder (2008) study. Multi-choice tests used a subset of 12 plants from Souder's tests to determine the relative preferences in a setting that better resembles the composition of the natural environment. The results indicate that *S. uberabensis* is unlikely to impact the weeds *Tibouchina urvilleana*, *Miconia calvescens*, and *Clidemia hirta*, and showed significant preferences for feeding and egg laying on *Tibouchina herbacea, T. longifolia*, *Pterolepis glomerata*, and *Melastoma septemnervium*, all of which are invasive weeds in Hawai‘i (Figure 6).

Additional no-choice testing conducted by USFS in 2013 with leaves exposed for two days to adult *S. uberabensis* in 10 cm petri dishes included *Tibouchina herbacea, Melastoma sanguineum, Melastoma septemnervium*, *Heterocentron subtriplinervium*, and 24 other common Hawaiian plants, most of which were not previously tested. Results again demonstrated high specificity of *S. uberabensis* in feeding and egg-laying for *Tibouchina* and *Melastoma* species (Figure 7).

Extensive host specificity testing of *S. uberabensis* for the biological control of *T. herbacea* has been performed to ensure that it poses minimal risk to other plants in Hawai‘i. The above studies demonstrated that *S. uberabensis* is host-specific to a subset of melastomes. It is highly unlikely to attack native and introduced plants outside of the melastome family.

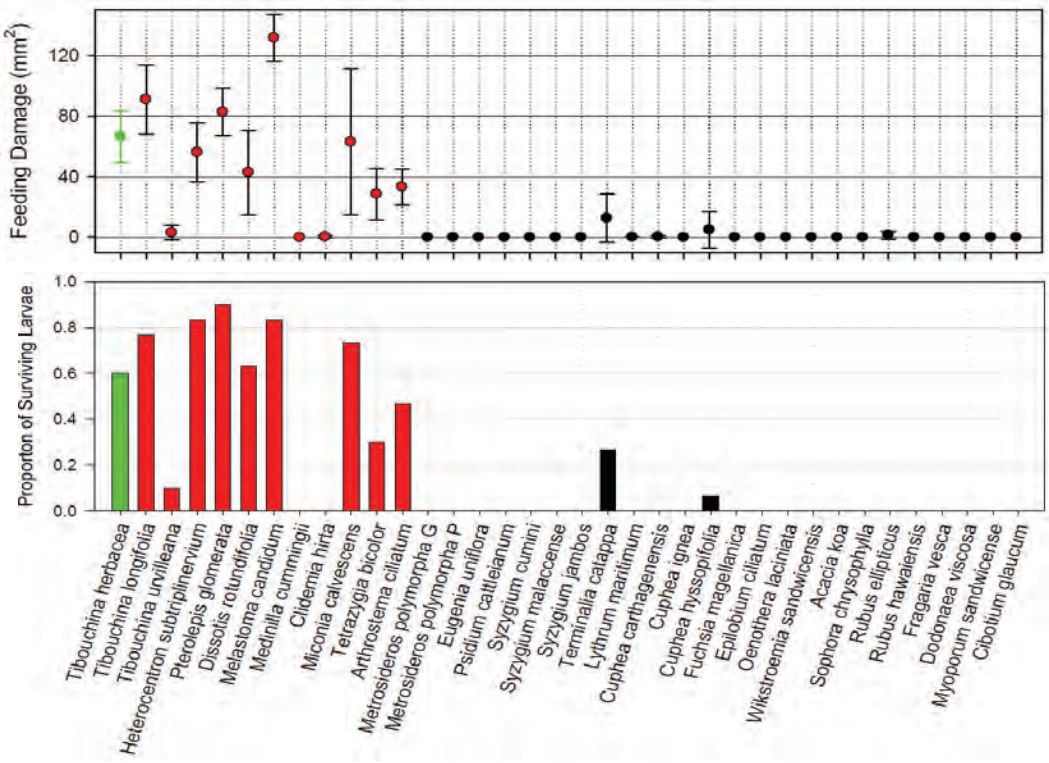

Figure 4. Feeding damage and survival of young larvae after 7 days of no-choice test. Green plot represents the target weed and red plots represent members of the family Melastomataceae. Phylogenetic relationship to the target weed decreases from left to right. Two forms of *Metrosideros polymorpha* were tested: G for glabrous, P for pubescent (Souder 2008).

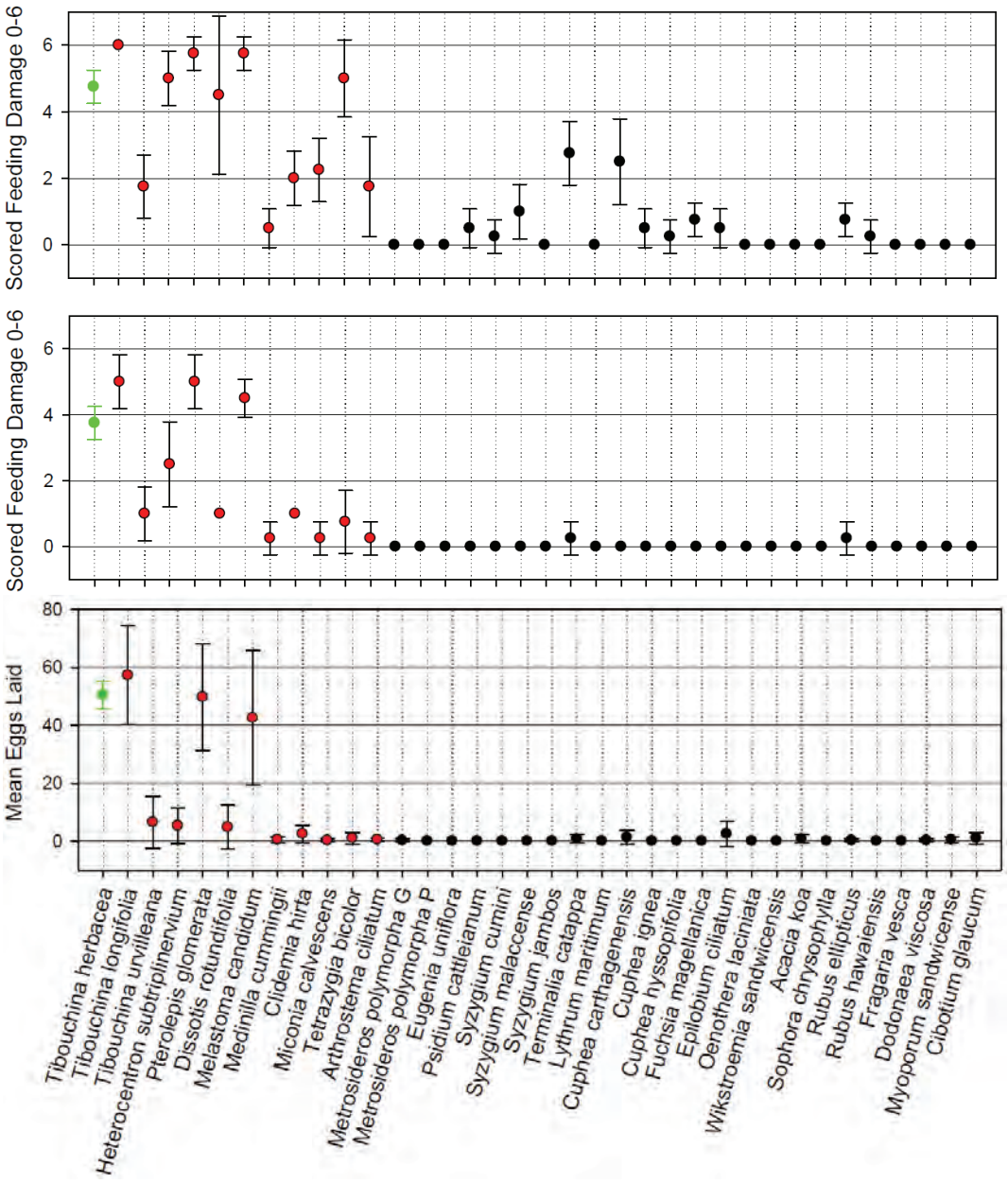

Figure 5. Results of specificity tests with adult *Syphraea uberabensis*. Feeding damage was assessed for young adults (upper graph) and mature adults (middle graph) on a scale of 0 (no damage) to 6 (>4 cm^2 of leaf area damaged). Oviposition tests recorded number of eggs laid by two mature females in 4 days (Souder 2008).

Table 1. Survival on Test Plant Species that Experienced Feeding Damage in No-Choice Larval Test*

	Number Alive				
Test Plant	**1st Instar**	**2nd Instar**	**3rd Instar**	**Pupa**	**Adult**
Tibouchina herbacea	40	32	28	27	23
Tibouchina longifolia	40	33	31	30	25
Tibouchina urvilleana	40	0	-	-	-
Heterocentron subtriplinervium	40	20	12	10	6
Pterolepis glomerata	40	36	34	32	27
Dissotis rotundifolia	40	17	11	7	5
Melastoma candidum	40	33	30	27	25
Medillina cummingii	40	0	-	-	-
Clidemia hirta	40	0	-	-	-
Miconia calvescens	40	15	9	0	-
Tetrazygia bicolor	40	13	7	4	0
Arthrostema ciliatum	40	0	-	-	-
Terminalia catappa	40	6	0	-	-
Cuphea carthagenensis	40	0	-	-	-
Cuphea hyssopifolia	40	0	-	-	-

* Larvae were evaluated in 100 x 100 x 15 mm petri with leaf cuttings. This test was replicated four times with 10 beetles each replicate (Souder 2008).

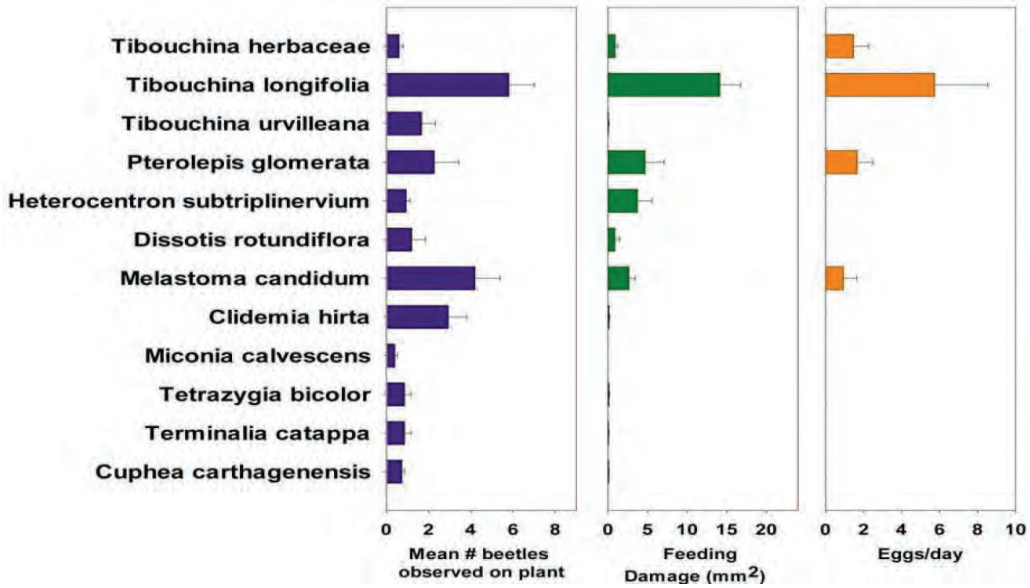

Figure 6. Results of multi-choice host preference tests with adult *Syphraea uberabensis* (Raboin et al. 2009).

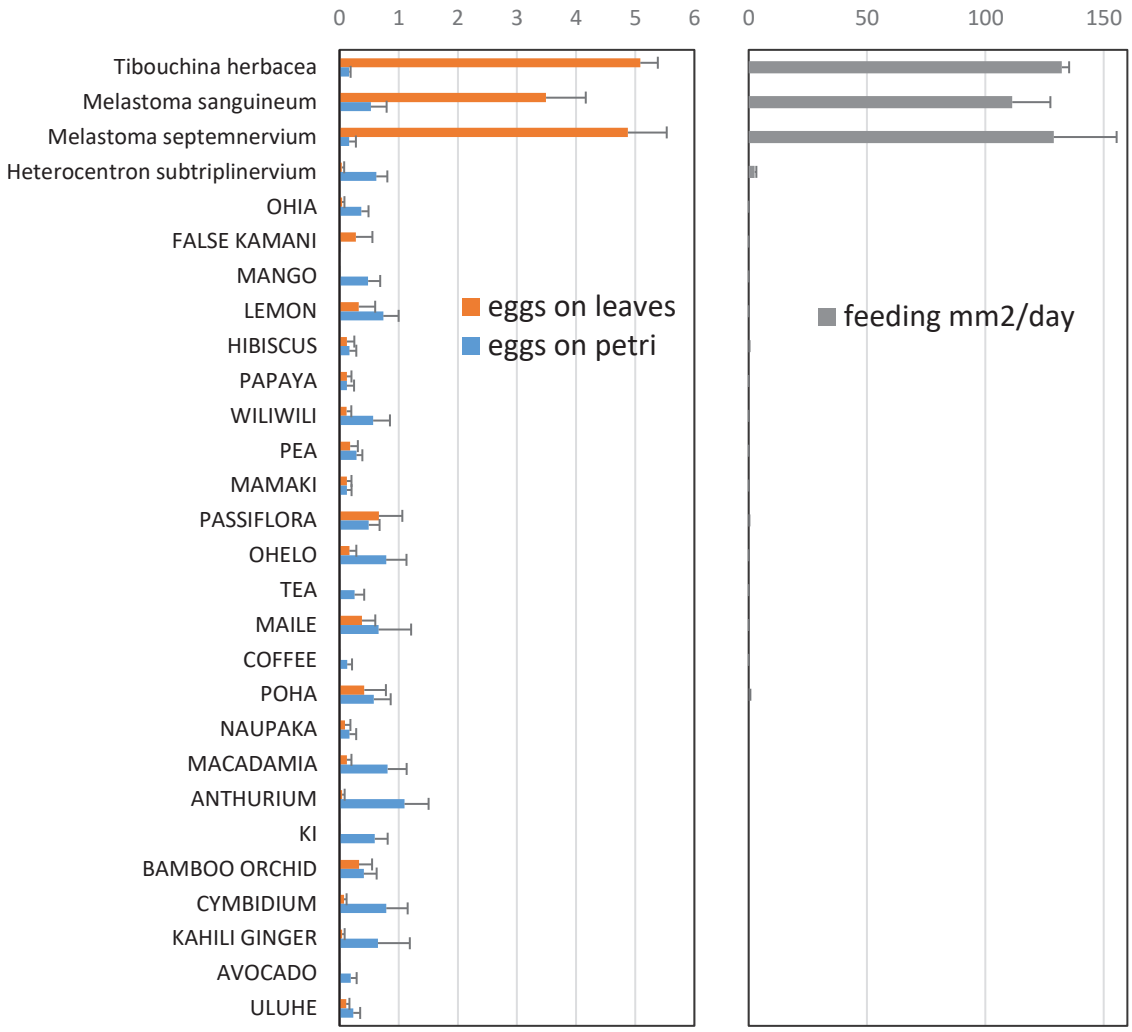

Figure 7. Results of no-choice specificity tests with adult *Syphraea uberabensis* exposed to leaves in small petri dishes for two days. Tests were replicated 4 times per plant species. Egg laying on all but three host plants occurred at negligible levels below or near the rate of egg laying on petri dish surfaces. The same three host plants were accepted equally for feeding, while non-hosts were consistently rejected (USFS unpublished data).

1.4 Secondary Target Species: Related Weeds in Melastomataceae

During host specificity tests, it was found that *S. uberabensis* fed and successfully developed and reproduced on several invasive melastomes that are suitable targets for the proposed release of *S. uberabensis* (Souder 2009; Raboin et al. 2009). These include *Tibouchina longifolia*, *Pterolepis glomerata*, *Melastoma sanguineum*, and *Melastoma septemnervium*, all of which have invaded native wet forest habitats in Hawai‘i. *Melastoma septemnervium*, in particular, is widely distributed on Hawai‘i Island, where it has been recognized as a threat for many years (Jacobi and Warshauer 1992). Each of these melastome species is likely to increase in population and expand in range in the absence of additional management attempts such as biocontrol by *S. uberabensis*.

1.4.1 *Melastoma septemnervium* - Asian melastome

Figure 8. Asian melastome (*Melastoma septemnervium*); Photo by Forest & Kim Starr

Taxonomy: *Melastoma septemnervium* Lour. belongs to the tribe Melastomeae and the genus *Melastoma* L., which comprises 22 species centered in Southeast Asia and extending to India, South China, Japan, northern Australia, and Oceania. *Melastoma septemnervium* was previously known in Hawaii by the synonyms *Melastoma candidum* D. Don and *Melastoma malabathricum* auct. non L.: Sims.

Description: Shrubs or small trees 2-5 m tall; young branches quadrangular, densely covered with appressed brown scales (Figure 8). Leaves elliptic to ovate, 4–11 by 2–6 cm, 7 nerved but marginal nerves sometimes inconspicuous, upper surface rough with bristly hairs, lower surface with fine hairs but also with scales on the nerves like those of the young branches, margins entire, apex acute, base obtuse to rounded, petioles 5-12 mm long. Inflorescences 2-7 flowered, petals usually 5, purple to pink, 2.5-3.2 cm long, 1.5-2.3 cm wide; anthers of larger stamens 10-11 mm long, anthers of smaller stamens 8.5-10 mm long; fruit a bell-shaped, 5-celled, fleshy capsule, 8–12 by 7–10 mm, densely covered with scales. (Wagner et al. 1999; Meyer 2001).

Distribution: Native to northern Vietnam, southern China, and Taiwan (Meyer 2001). In Hawai‘i, it is naturalized on Kaua‘i (Wahiawa Bog), O‘ahu (Kalihi, Maunawili Valleys), and Hawai‘i Islands. One individual was found on the island of Maui in 2002 and removed (Penniman et al. 2011).

Reproduction and Dispersal: The fruit is a bell-shaped fleshy capsule roughly 1 cm in diameter, which ruptures at maturity, exposing red-black pulp and yellow seeds (Meyer 2001). Fruits are dispersed by birds (Smith 1985).

Impact: *Melastoma septemnervium* was cultivated and is now naturalized in mesic to wet areas and bog margins from sea level to 700 m in Hawai‘i. (Wagner et al. 1999). It forms dense stands up to 2 m tall shading out understory (Smith 1985; Jacobi and Warshauer 1992)

Management: Sensitive to hormone-type herbicides 2,4-D, dicamba, and triclopyr at 1 lb./acre, and to metsulfuron at 0.45 oz./acre. Sensitive to basal bark and stump bark applications of 2,4-D and triclopyr at 4% product in diesel (Motooka et al. 2003). The HDOA conducted a biological control program on *M. septemnervium* in 1957–1965. Three moth species were released; two of which became established: *Ategumia*)

(=*Bocchoris*) *fatualis* (Lederer) (Crambidae) and *Rhynchopalpus brunellus* Hampson (= *Selca brunella*) (Noctuidae) (Krauss 1965; Conant and Hirayama 2001). *Rhynchopalpus burnellus* is considered partially effective, occasionally causing severe damage to the plant (Conant and Hirayama 2001).

1.4.2 *Melastoma sanguineum* - fox-tongued melastoma

Figure 9. Fox-tongued melastoma (*Melastoma sanguineum*); Photo by Forest & Kim Starr

Taxonomy: *Melastoma sanguineum* Sims has three recognized varieties: *M. sanguineum* var. *sanguineum*, var. *laevifolium,* and var. *ranauense* (Meyer 2001). *Melastoma sanguineum* var. *sanguineum* is known to hybridize with *M. candidum* in southeastern China (Liu et al. 2014).

Description: Shrubs or small trees 2-4 (up to 8) m tall; quadrangular young branches and petioles sparsely covered with spreading, smooth hairs 5-15 mm long, and appressed, smooth, awl-shaped hairs approximately 1 mm long; leaves lanceolate-elliptic, 10-20 cm long, 2-6 cm wide, surface rough or smooth; nerves 5 or 7, the marginal nerves inconspicuous, covered with appressed or semi-erect scales, nerves often red; petiole 10-30 mm long, with red bristles, 5–9 mm long, margins entire, apex tapering to a point, base obtuse to rounded (Figure 9). Inflorescences 2-7-flowered, petals usually 6, purplish pink, 2.5-4.7 cm long, 2.7-3.5 cm wide; anthers of larger stamens 12-15 mm long, anthers of smaller stamens 9-11 mm long; fruits bell-shaped, 6-celled, fleshy capsules, 8–19 by 8–18 mm, covered with spreading or incurved, basally flattened hairs. (Wagner et al. 1999; Meyer 2001).

Reproduction and Dispersal: Like *M. septemnervium*, the fruit is a fleshy capsule which splits open exposing yellow pulp with orange seeds, which are bird-dispersed.

Distribution: In China, it occurs on open slopes, thickets, grasslands, woodland margins on low hills, trailside; below 400 m (Chen and Renner 2007). In Hawai‘i, it was once cultivated and has naturalized since at least 1957, occurring on the Island of Hawai‘i in Keaukaha and along the highway between Volcano and Hilo. One individual was found on the island of Maui in 2004 and removed (Penniman et al. 2011).

Impact: Although *M. sanguineum* has not dispersed on the same scale as *M. septemnervium,* it is thought to have similar potential to form dense monotypic thickets and crowd out native vegetation (Penniman et al. 2011).

1.4.3 *Pterolepis glomerata* - false meadowbeauty

Figure 10. False meadowbeauty (*Pterolepis glomerata*); Photo by Gerald Crank

Taxonomy: *Pterolepis glomerata* (Rottb.) Miq. belongs to a genus of 15 herbs and small shrubs with center of diversity in Brazil (Renner 1994; Almeda and Martins 2015). Taxonomic treatment of the Hawaiian population of *P. glomerata* by Wagner et al. did not include sub-specific ranking, which the authors considered weakly defined (Wagner et al. 1999). *Pterolepis* is closely related to the old world Melastomeae, which diverged around 11–12 million years ago (Renner and Meyer 2001).

Description: Erect, basally woody herbs or subshrubs up to 0.5 m tall; young branches somewhat squared, with stiff hairs (Figure 10). Leaves ovate to elliptic, 1.4–4.5 cm long, 0.6–1.6 cm wide, 3-nerved, both surfaces sparsely to moderately bristled, petioles 1–5 mm long. Flowers usually 3–5 in terminal tight clusters; 4 petals white, pink or violet, 10–15 mm long, 10–14 mm wide; larger anthers pink, 3–4 mm long, smaller anthers yellow, 2.5–3.5 mm long. Fruiting hypanthium 4–6 mm long, 2–5 mm wide, covered with simple and branched hairs. Seeds ca. 0.5 mm long (Wagner et al. 1999).

Distribution: *Pterolepis glomerata* occurs from the Dominican Republic (Hispaniola) and Puerto Rico over the Lesser Antilles and Trinidad to Venezuela, the Guianas, and south to Santa Catarina in Brazil; reaching adjacent Paraguay and Bolivia (Renner 1994; Wagner et al. 1999). In Hawai‘i, it naturalizes on Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, and Hawai‘i Islands (Imada 2012). It was first collected on O‘ahu in 1949 (Wagner et al. 1999).

Reproduction and Dispersal: *Pterolepis glomerata* reproduces by seeds and vegetative fragmentation. About 500 seeds can be found in a capsule. The seeds are dispersed by birds and water (Ramirez and Brito 1988; Wagner et al. 1999).

Habitat/Ecology: In Hawai‘i, the species is not cultivated, but weedy and locally naturalized in mesic to wet disturbed sites and trail margins (Wagner et al. 1999). It is considered among the invasive plants that threaten many endangered plants on O‘ahu (USFWS 2012).

Management: Control efforts in the Waianae Mountains of O‘ahu were carried out by the O‘ahu Army Natural Resources Program. It was suggested that a pre-emergent herbicide, such as ‘Oust’, should be used to achieve eradication (OANRP 2010).

Natural Enemies: *Rhynchopalpus brunellus*, a moth introduced to Hawai‘i from Malaysia for biocontrol of *Melastoma septemnervium*, is known to feed on *P. glomerata*. Foliar damage to the population of *P. glomerata* in the observed site (Waiakea Timber Management Area in the Waiakea Forest Reserve off of Stainback Highway, Island of Hawai‘i) was light overall, but heavy on certain plants (Conant and Hirayama 2001).

1.4.4 *Tibouchina longifolia*

Figure 11. *Tibouchina longifolia*; Photo by Forest & Kim Starr

Taxonomy: *Tibouchina longifolia* (Vahl) Baill. ex Cogn. (Synonyms: *Rhexia longifolia* Vahl.) belongs to the pantropical melastome family (Melastomataceae). *Tibouchina* Aubl. is a genus containing about 350 species ranging from Mexico, West Indies, to northern Argentina (Wagner et al. 1999). The center of diversity is in southeastern Brazil. *Tibouchina* is classified in the tribe Melastomeae, which contains several related genera (e.g. *Arthrostemma*, *Dissotis*, *Melastoma*, and *Pterolepis*) that also have naturalized in Hawai‘i (Wagner et al. 1999). A phylogenetic study indicates that *Tibouchina* is a well-supported phylogenetic group (clade), although several derived genera nest within the clade (Michelangeli et al. 2012).

Description: *Tibouchina longifolia* is a weedy shrub 0.5-2 m tall (Figure 11). Leaves are narrowly elliptic to lanceolate with dense smooth hairs, 3.5-11.5 cm long and 1-3 cm wide. Flowers are white and approximately 0.5 inches in diameter with 5 petals 5-7 mm long and 2.5-4 mm wide. Anthers 1.5-2 mm long, fruiting hypanthium 4-4.5 mm long and 3-4 mm wide. Seeds are very small, typically 0.25-0.5 mm long (Wagner et al. 1999).

Distribution: *Tibouchina longifolia* is native to the Neotropics and widespread from Mexico and the West Indies to Bolivia and Brazil (Wagner et al. 1999). It was first collected in Hawai‘i in 1983 in the Puna District and is now established in the wild (Wagner et al. 1999).

Reproduction and Dispersal: In Hawai‘i, *T. longifolia* is now naturalized in native ‘ōhi‘a forests on Hawai‘i Island. It has been propagated by cuttings and cultivated by humans in the past, however it is now recognized as

a noxious weed. Mechanisms for natural dispersal are not documented but are likely the same as for related species. (USGS, 2003).

Management: Methods for control of *T. longifolia* are not documented. Its distribution appears to be limited with no active spread beyond some locations in East Hawaii (USGS 2003). It has not been the target of active management.

1.5 Proposed Action

The HDOA Plant Pest Control Branch will submit an application to the HDOA Plant Quarantine Branch for a permit to release a beetle species, *Syphraea uberabensis* (Coleoptera: Chrysomelidae: Alticini), into the environment of the State of Hawai‘i under the provisions of HRS Chapter 141, Department of Agriculture, and Chapter 150A, Plant and Non-Domestic Animal Quarantine. *Syphraea uberabensis* will be released into the environment to control infestations of *Tibouchina herbacea* and related weeds (*Melastoma sanguineum*, *M. septemnervium*, *Tibouchina longifolia* and *Pterolepis glomerata*) in the melastome family.

The US Department of Agriculture (USDA) Forest Service has planned detailed monitoring of the impacts of the biocontrol after establishment. This effort will focus on selected sites, following up on pre-release measurements of invasive weeds already obtained in collaboration with the University of Hawai‘i.

1.5.1 Project Cost

Although rearing of *S. uberabensis* requires specialized knowledge, the costs for distributing the insect for management will be relatively low after it is approved for release. Facilities, equipment, and personnel needed for rearing the insect are simple and minimal. Establishing self-sustaining populations in field sites statewide likely can be accomplished within one year with a few staff working only part-time (estimate: $40,000 for 1 FTE technician over one year). Agencies contributing to this effort are expected to include the USDA Forest Service, HDOA, and State of Hawai‘i Department of Land and Natural Resources. Invasive species committees, watershed partnerships, and others involved in weed management are expected to be active partners in identifying release sites and helping to monitor initial establishment at some release sites.

The pre-release study was conducted over two years with $75,000 of Forest Service funding. A similar investment will likely cover costs of post-release monitoring. Long-term monitoring of the status of the targeted weeds, to determine whether the biocontrol is ultimately successful, will likely require a partnership of researchers and managers. The potential to utilize remote sensing technology for this purpose is high, although it has not yet been applied to this project’s target weeds.

1.6 Affected Area

The proposed release of *S. uberabensis* will be statewide. Although initial release of the beetle will focus on locations of high-density infestation, the beetle has the potential to expand its range throughout the state in suitable environments where the target weeds occur.

The first stage of release will focus on the locations of *T. herbacea* infestations on Maui and Hawai‘i, as well as locations of *P. glomerata* infestation on O‘ahu, where that host plant is most abundant. Once successfully established, the beetle may expand its range to other locations or islands both naturally and by additional releases.

1.7 Sources of Primary Environmental Impact

Primary impacts are defined in HAR §11-200-1 as “effects which are caused by the action and occur at the same time and place.” Primary impacts from the release of a biocontrol agent are the damages directly caused by the biocontrol agent; for example, feeding damages on non-target species. The potential impacts of this action are analyzed in Section 2.

1.8 Sources of Secondary Environmental Impact

Secondary impacts are defined in HAR §11-200-1 as "effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." The principal sources of secondary impact may include the long-term and indirect effects such as change of vegetation composition after successful control of *T. herbacea*.

1.9 Agency Identification

The Hawai'i Department of Agriculture is the proposing agency assuming responsibility for the proposed action in accordance with HRS Chapter 343 and the National Environmental Protection Act.

1.10 Required Approvals

The proposed action requires the following permits and approvals:

- Plant Protection and Quarantine permit from the USDA, Animal and Plant Health Inspection Service;
- a permit for import and liberation of restricted organisms from the HDOA Plant Quarantine Branch upon review and approval by the Hawai'i Board of Agriculture; and
- a permit for access for release and monitoring of the insect on State forest land from the State of Hawai'i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW).

1.11 Alternatives Considered

The no action alternative and preferred alternative (proposed action) are discussed below. Table 2 summarizes the advantages and disadvantages of each alternative.

1.11.1 No Action Alternative

No action alternative is not to issue permits for the release of *S. uberabensis* in the State of Hawai'i for biocontrol of *Tibouchina herbacea* and the four related weeds (*Melastoma sanguineum, M. septemnervium*, *Tibouchina longifolia*, and *Pterolepis glomerata*) in the melastome family.

Under the no action alternative, *S. uberabensis* will not be released for biocontrol of the target weeds. Control of the target weeds will be limited to mechanical and chemical control methods. For incipient infestations that are easily accessible and limited in size, mechanical or chemical control can be a preferred method as these have the advantage of short response time and minimal initial resource investment required. However, for infestations in large areas or remote locations, mechanical and chemical controls are infeasible or economically prohibitive, and likely will lead to continued population increase and range expansion of the target weeds (Helen Spafford personal communication).

Environmental impacts associated with mechanical and chemical controls may include impacts on native biota, soil, and water quality. Given the current extent of infestation, the environmental impacts required to achieve adequate control of the target weeds will be unacceptable. For the No Action Alternative, the environmental impacts caused by the target weeds will continue and likely increase, as the weeds will continue to invade suitable habitats and islands that are not currently colonized. The main environmental consequence of the No Action alternative is continued degradation of the native forests, which harbors large numbers of native plants and animals, including threatened and endangered species that rely on the ecosystem to survive and recover.

The "No Action" alternative is considered undesirable for this project.

1.11.2 Proposed Action (Preferred Alternative)

Proposed action is to issue permits for the release of a beetle species, *Syphraea uberabensis*, in the State of Hawai‘i for biocontrol of *Tibouchina herbacea* and the four related weeds (*Melastoma sanguineum, M. septemnervium*, *Tibouchina longifolia,* and *Pterolepis glomerata*) in the melastome family.

The preferred alternative has the advantage of providing long-term control of the target weeds and is the only economically sustainable option for controlling the target weeds at a landscape scale. Although the initial investment in research and development is often high for biological control, as compared to conventional mechanical and chemical controls, the costs in this case have been invested in the past few decades and are ready for use. Benefits of successful biocontrol can accrue for many decades into the future, with benefits amounting to many times the cost. For example, estimates of benefit:cost over 100 years of weed biocontrol efforts averaged 23:1 including all projects, even those that were not successful. (McFadyen 2008)

Although field release will be permanent and there is risk of non-target effects, the extensive host range tests have shown that the biocontrol agent has a very limited host range within the Melastome family, of which all naturalized species in Hawai‘i are considered noxious weeds.

Table 2. Summary of Alternatives Considered and Their Associated Advantages/Disadvantages Compared to the Proposed Action

	Actions	Advantages	Disadvantages
No Action	Not releasing *S. uberabensis*; Management of *T. herbacea* and the related weeds will rely on mechanical and chemical controls.	1. Effective for incipient infestations if response is timely. 2. Low developmental investment required. 3. Short-term negative effects are likely reversible.	1. Only provide short-term control; continual efforts required. 2. Economically prohibitive for widespread infestation. 3. Not able to reach inaccessible areas. 4. Given the resources available, the environmental impact of the invasive plants will worsen.
Proposed Action	Field release of the beetle *Syphraea uberabensis* in the State of Hawai‘i for biocontrol of *Tibouchina herbacea* and the related weeds in the melastome family.	1. Provide long-term control. 2. Ecological and economic benefits accrue permanently. 3. Able to reach areas that are infeasible by mechanical and chemical controls.	1. Require significant investment in research and monitoring. 2. Irreversible once established. 3. Risk of non-target effects exist.

2.0 AFFECTED ENVIRONMENT AND IMPACT ASSESSMENT

This section presents an overview of baseline physical, biological, socio-economic, and cultural environments that the project may affect and the assessment of potential impacts and mitigation measures, when negative impacts are anticipated.

2.1 Biological Environment

The proposed action will have its foremost effect on the biological environment. The biological environment affected by the proposed action is expected to include all ecosystems that are currently occupied by the target weeds.

The introduction of a natural enemy to control target weeds involves direct interaction between the biological control agent and the target weeds. In addition to the direct effects, complex indirect interactions

between other biological and physical components of the environment will both affect and be affected by the direct effects of the proposed action.

Due to these complexities, the end outcome of a biological control release is often difficult to predict, but would fall between no effect (if the biological control agent fails to establish) and widespread suppression of the target species. There is risk for a biological agent to affect non-target species, however, rigorous tests on the host range can minimize this risk.

2.1.1 Direct Effect on the Target Species

The direct effect on the target weeds is the reduction of abundance through herbivory. *Syphraea uberabensis* feeding has the potential to significantly reduce the abundance and distributional range of the target weeds wherever the insect and the plants interact. The level of control, however, will likely depend on the physical and biological environments and is expected to vary by location.

If *S. uberabensis* successfully establishes at release sites, it is expected to disperse and expand its range throughout each island over time. Unaided dispersal between islands is unlikely, however, human-mediated dispersal of *S. uberabensis*, especially as eggs or larvae along with the host plants, is possible. Therefore, the effect is expected to occur on all the main Hawaiian Islands.

2.1.2 Direct Effect on Non-Target Species

Extensive studies have demonstrated that the host range of *S. uberabensis* is limited to a subset of genera (*Tibouchina*, *Melastoma*, and *Pterolepis*) within the melastome family. *Syphraea uberabensis* is not expected to attack plants outside of the melastome family. Because there are no native melastomes and all naturalized melastome species are considered noxious weeds in Hawai‘i, non-target plant use is unlikely to directly affect any native or economically important plants of Hawai‘i.

2.1.3 Indirect Effect on Flora

If *S. uberabensis* successfully controls the target species, the sites previously occupied can become available to other plants. In the less degraded wet forest, native plants may benefit from the natural resources previously occupied by the target species. In more degraded plant communities, the target species are more likely be replaced by other non-native species present nearby. Controlling existing populations of *T. herbacea* will help to prevent spread to new locations and between islands. If biological control is successful, its effects are likely to develop gradually over a period of years, allowing time for appropriate management responses.

2.1.4 Indirect Effect on Fauna

Native fauna is expected to benefit from the proposed action after the successful control of the target species, which pose threats to the remaining native ecosystems. There is no evidence that native fauna use the target species to an appreciable degree. A small number of native fauna might be indirectly affected by the proposed action if the target weeds are utilized for food or shelter. However, the effect is expected to be insignificant, as the native fauna that adapted to use the introduced species would be generalists, capable of using alternative plant species. Successful control or elimination of the target weeds will not threaten the existence of these generalist species.

The release of *S. uberabensis* has the potential to affect predator or pathogen populations and indirectly affect alternative prey or host species. However, the effect is expected to be insignificant. The family of insects to which *S. uberabensis* belongs, Chrysomelidae, is not native to Hawai‘i and is represented by relatively few introduced species. Although there are a few pest chrysomelids in Hawai‘i, they have not been actively targeted for biocontrol. Therefore, there is not a known threat of specialized natural enemies affecting *S. uberabensis*. Its populations can be expected to be subject to predation by some generalist predators and diseases that affect

beetles broadly. These natural enemies may increase in abundance where populations of *S. uberabensis* grow large, but such interactions are expected to be localized and temporary given the fluctuating nature of the beetle populations on their host plants.

Indirect effects on pollinating insects is a potential concern, in the event that biocontrol successfully reduces target weeds serving as a food source for pollinators. Native yellow-faced bees in the genus *Hylaeus* (Hymenoptera: Colletidae) can be found across the state, in sea level to sub-alpine habitats that include the invasive plants targeted for biocontrol with *S. uberabensis*. *Hylaeus* species are adapted to forage on pollen and nectar resources from a diversity of native plants, and rarely use non-native floral forage (Daly et al. 2003). Native yellow-faced bees have not been observed to forage on invasive melastomes, and any use of the targeted plants would be peripheral to their primary foraging on native species (K. Magnacca, personal communication). The seven *Hylaeus* species which are currently listed as T/E are known from dry to mesic forest habitats. Their range does not overlap significantly with the range of *Tibouchina herbacea* or other targeted melastomes, which are invasive predominantly in wet to mesic forests. Controlling the spread of invasive melastomes is likely to benefit rare, but yet unlisted, yellow-faced bees which inhabit wet forests, as they are known to suppress the growth of native plants that the bees prefer, and homogenize the composition of native wet forest habitat. The effect of the proposed action is expected to be beneficial for native pollinators.

2.1.5 Uncertainty of Non-Target Effect

There is no action that has consequences that are completely predictable, and thus there is uncertainty associated with any proposed action, including this one. Uncertainty must be weighed against potential benefits of an action and adverse impacts that are likely to occur if an action is not undertaken. In this case, there is a consensus among biologists in Hawai‘i that tibouchina and related melastomes are deleterious to local ecosystems and that the severity of ecosystem damage is continually increasing. The uncertainty associated with this biocontrol introduction appears to be low due to the rigorous testing of this biocontrol agent and the general success of biocontrol projects in Hawai‘i. Balanced against the certainty of the damage posed by the continued spread of tibouchina and related melastomes, the magnitude of their threat to Hawai‘i’s endangered species and ecosystems, and the urgent need for more effective methods for protecting these resources at risk, the levels of uncertainty associated with the proposed action appear acceptable.

2.2 Physical Environment

In general, a biological control program would have minimal impact on the physical environment as the action is based on the herbivore-host interaction between the biological control agent and the target species and not directly on the physical environment. The proposed action will have no or negligible effects on geology and topography, air-quality, noise, hazardous substance, and natural hazards. The results of the biocontrol, however, may indirectly affect the physical environment by altering the ecological functions that may affect the physical environment. Most importantly, successful biological control of invasive plants can change composition of the vegetational communities, which consequently can alter local microclimate, transpiration rate, and soil characteristics. The following assesses potential impacts on the elements of physical environment that may be affected by the proposed action.

2.2.1 Climate

The proposed action will have no to negligible effect on long-term or regional climate patterns. The proposed action may affect microclimates that are influenced by the invasive vegetation. Successful control of the invasive weeds is expected to enable the native vegetation to recolonize the invaded area, which will reduce the negative effect of the invasive weeds on the microclimates and should be beneficial to native biota.

2.2.2 Hydrology

Although the proposed action will not directly affect hydrology, the successful control of the target weeds has the potential to indirectly affect hydrology. The successful control of the invasive weed is expected to benefit watershed function of the invaded wet forests which plays an important role in the hydrological cycle. Specifically, forest composition can affect evaporation-transpiration rates and water input from interception of mist and fog.

A study conducted in a lowland wet forest in Hawai‘i demonstrated that native trees are more conservative in overall water use than invasive trees (Cavaleri et al. 2014). This study involves the most dominant native wet forest species, ‘ōhi‘a lehua (*Metrosideros polymorpha*), and one of the target weeds, *Melastoma septemnervium*. The study shows that the wet forest sites dominated by ‘ōhi‘a lehua that are mixed with invasive species has higher transpiration rates (i.e., water loss) compared to the sites where invasive species were removed.

2.2.3 Soils

Soil erosion is not expected due to the slow acting nature of biocontrol and the ability of other native and non-native plants to fill in areas where *T. herbacea* cover might be reduced. The successful establishment of *S. uberabensis* and control of *T. herbacea* and other melastomes is expected to decrease the abundance of the invasive weeds. In the mesic to wet environments where the target weeds occur, other plant species are expected to grow rapidly to replace their decreasing densities. The proposed action, therefore, will not have significant impact on soils.

2.2.4 Wildland Fires

The proposed action is expected to have negligible effects on wildland fire. The biocontrol has the potential to create small amounts of dead biomass of *T. herbacea* or related melastomes. However, the affected area is usually in mesic to wet environments, where the biomass is expected to decompose at a high rate and fire hazard is generally low. The proposed action is unlikely to significantly increase wildland fire hazard.

2.3 Cultural Resources

ASM Affiliates Hawai‘i, a Heritage and Cultural Resource Management firm, prepared a Cultural Impact Assessment (CIA) for the proposed action, which is attached as Appendix B and summarized below. The CIA report was prepared in adherence with the Office of Environmental Quality Control (OEQC) *Guidelines for Assessing Cultural Impacts*, adopted by the Environmental Council, State of Hawai‘i, on November 19, 1997 and pursuant to Act 50, approved by the Governor on April 26, 2000.

In general, CIA studies are intended to inform environmental studies that are conducted in compliance with HRS Chapter 343. The purpose of a CIA is to gather information about the practices and beliefs of a particular cultural or ethnic group or groups that may be affected by the actions subject to HRS Chapter 343.

The primary focus of the report is on understanding the cultural and historical context of *T. herbacea* and other weedy melastomes with respect to Hawai‘i’s host culture. It includes a cultural-historical context of the settlement of the Hawaiian Islands by early Polynesian settlers and the transformation of their beliefs and practices associated with the land following western contact, an overview of the history of biocontrol in Hawai‘i, and a discussion of the introduction of *T. herbacea* to the Hawaiian Islands. It also includes a discussion of potential impacts as well as appropriate actions and strategies to mitigate such impacts.

2.3.1 Location

Conventional CIAs assess the potential impacts on cultural practices and features within a geographically defined “project area,” which are often defined by an established Tax Map Key number or numbers. However,

CIAs conducted for biocontrol projects differ in that the assessment must consider statewide impacts with emphasis on areas where the target species can be found in abundance. In Hawai‘i, *T. herbacea* and related melastomes are naturalized and locally abundant in disturbed mesic to wet forest on the islands of Hawai‘i, Lāna‘i, Maui, Moloka‘i, and O‘ahu.

2.3.2 Consultation

As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of the oral interview process is to identify potential cultural resources, practices, and beliefs associated with *Tibouchina* and related melastomes and the habitats they occupy. Gathering input from community members with genealogical ties and long-standing residency or relationships to the anticipated area of impact or to the target species is vital to the process of assessing potential cultural impacts on resources, practices, and beliefs.

In an effort to identify individuals knowledgeable about traditional cultural practices and/or uses associated with the subject affected environment, a public notice was submitted by ASM Affiliates to the Office of Hawaiian Affairs (OHA) for publication in the May 2019 issue of their monthly newspaper, *Ka Wai Ola*. While no responses were received from the public notice, 45 individuals were contacted via email and/or phone regarding the preparation of the CIA report. A list of those individuals is available upon request. Of the 45 individuals contacted, 20 responded to the request with either brief comments, referrals, or acceptance of the interview request (see Table 3). ASM Affiliates conducted a total of eight interviews, the summaries of which can be found in the CIA.

The interviewees were asked a series of questions regarding their background, and their experience and knowledge of the target species. Additional questions focused on any known cultural uses, traditions, or beliefs associated with any of the target species. The interviewees were then asked about their thoughts on the cultural appropriateness of using biocontrol agents and whether they were aware of any potential cultural impacts that could result from the use of biocontrol and whether they had any recommendations to mitigate any identified cultural impacts or any other thoughts about the proposed action.

Table 3. Persons that responded to request for consultation.

Name	*Affiliation, Island*	*Initial Contact Date*	*Comments*
Shalan Crysdale	The Nature Conservancy, Ka‘ū Preserve, Hawai‘i	3/6/2019	See summary in CIA
John Repogle	Retired from The Nature Conservancy, Ka‘ū Preserve, Hawai‘i	3/6/2019	See summary in CIA
Nohealani Ka‘awa	The Nature Conservancy, Ka‘ū Preserve, Hawai‘i	3/6/2019	See summary in CIA

Arthur Medeiros	Auwahi Forest Restoration Project, Maui	3/7/2019	Responded via email on March 11, 2019, stating "Thank you for your valuable work supporting this essential action to attempt to slow the loss of Hawaiian biota."
Jen Lawson	Waikōloa Dry Forest Initiative, Hawai'i	4/3/2019	See summary in CIA
Robert Yagi	Waikōloa Dry Forest Initiative, Hawai'i	4/3/2019	See summary in CIA
Wilds Brawner	Ho'ola Ka Manaka'ā at Ka'ūpūlehu, Hawai'i	4/9/2019	See summary in CIA
Sam 'Ohu Gon III	The Nature Conservancy, O'ahu	4/22/2019	Responded to interview request but was unable to provide input on this project.
Mike DeMotta	National Tropical Botanical Gardens, Kaua'i	4/22/2019	See summary in CIA
Wili Garnett	Cultural practitioner, Moloka'i	5/7/2019	Responded via email stating "I have mostly been involved with Erythrina gall wasp parasite release and monitoring, but experience watching *Tibouchina* and *Schinus* degrade watershed on many islands, including Molokai and even cultural resources at Kalaupapa."
Emily Grave	Laukahi Network, O'ahu	5/7/2019	Responded via email stating that she was not aware of cultural uses of this plant.
Kim Starr	Starr Environmental, Maui	5/9/2019	See summary in CIA
Forest Starr	Starr Environmental, Maui	5/9/2019	See summary in CIA
Manaiakalani Kalua	Cultural practitioner, Hawai'i	5/30/2019	See summary in CIA
Talia Porter	Honolulu Botanical Gardens, O'ahu	6/3/2019	Responded to interview request but was unable to secure an interview.

Robert Keano Kaʻupu	Cultural practitioner, Oʻahu	6/16/2019	Responded via phone that he has been interested in learning about the cultural uses of *wiliwili* but was not aware of any uses or of anyone else who used the wood for cultural purposes. Did not address *T. herbacea*
Hinaleimoana Wong-Kalu	Cultural practitioner, Oʻahu	7/16/2019	Responded to interview request but was unable to secure an interview.
Pelehonuamea Harman	Cultural practitioner, Hawaiʻi	7/31/2019	Referred ASM staff to Dennis Kanaʻe Keawe.
Dennis Kanaʻe Keawe	Cultural practitioner, Hawaiʻi	8/12/2019	See summary in CIA
Iliahi Anthony	Cultural practitioner, Hawaiʻi	8/30/2019	See summary in CIA

2.3.2 Summary of Findings, Identification of Cultural Impacts, and Proposed Mitigative Measures

A review of the cultural-historical background in addition to the consultation efforts has yielded no reported cultural use for *T. herbacea* nor is there any historical evidence to suggest that this plant is crucial to any particular ethnic groups' cultural history, identity, practices, or beliefs, nor does it meet any of the significance criteria outlined in the CIA. Although *T. herbacea* does not meet any of the significance criteria, what is culturally significant is the wet forest habitat in which it thrives. Hawaiʻi's wet forest habitat could be considered significant as a traditional cultural property under Criterion E, as it contains many culturally important indigenous and endemic taxa, which are still utilized in certain Hawaiian cultural practices. Some of these wet forest resources are also associated with certain Hawaiian cultural beliefs.

Based on the information derived from the cultural-historical background and from the insight shared by the consulted parties, it is the assessment of this study that the release of the proposed biocontrol agent, *Syphraea uberabensis*, will not result in impacts to any valued cultural, historical, or natural resources. Conversely, if no action is taken to further reduce remaining populations of *T. herbacea* and other highly invasive melastomes from claiming more of Hawaiʻi's wet forest habitat, impacts to this valued resource would be anticipated.

While no specific cultural impacts were identified through the CIA, the consulted parties shared valuable insight, concerns, and recommendations that could reduce the potential for any future impacts and improve public transparency regarding the effectiveness of biocontrol as a conservation management strategy. Several key themes emerged from the consultation efforts, all of which are further described in the CIA:

1) maintain stringent pre and post-release testing and monitoring;
2) improved community transparency and input;
3) active and ongoing public outreach and education;
4) improve efforts to limit the introduction of potentially harmful invasive species.

While the consulted parties did not explicitly oppose the use of biocontrol, especially to aid in the recovery of Hawaiʻi's native forest habitat, they all shared a sense of concern and spoke about the risks inherent in biocontrol activities.

The CIA recommends that conducting background research, consulting with community members, and taking steps toward mitigating any potential cultural impacts is done in the spirit of *Aloha ʻĀina*, a contemporary movement founded on traditional practices and beliefs that emphasize the intimate relationship that exists between Native Hawaiians and the *ʻāina* (land).

2.4 Socio-economic Environment

The release of the any biocontrol agent poses a risk to socioeconomic environment when the biocontrol agent causes negative effects on non-target species that are socio-economically important. This may be caused by direct predation, competition, or secondarily when the results of the action cause socio-economic impact.

The action is not expected to negatively affect the socio-economic environment. The successful control of invasive weeds will benefit the environment and can release the resources used in chemical and mechanical control efforts for other purposes.

2.4.1 Population

The proposed action is expected to have negligible effect on population. The target species are of minimum economic value and the locations of the biocontrol are largely uninhabited natural areas with no existent population. The successful control of the invasive weeds is not expected to cause significant socio-economic changes that would affect population.

2.4.2 Existing Land Use

The proposed locations of biocontrol release will largely consist of conservation areas that are mainly used for watershed protection, conservation of native flora and fauna, and public recreation. A small part of the affected areas may be used for agriculture or the harvest of forest resources. The proposed action will not significantly change the land use of the affected areas. The successful control of the invasive weeds, however, is expected to benefit the intended uses. The results of successful control of the invasive weeds would improve the integrity of the native forest, which is crucial to the conservation of biodiversity as well as watershed value.

2.4.3 Recreation

Recreational use of the affected area is expected to benefit from the proposed action. The target species are environmental weeds that can degrade the recreational value of natural areas. The invasive weeds colonize areas including trails and forests, which can decrease the value of the natural areas for recreational use. Therefore, the proposed action is expected to benefit recreation.

2.4.4 Scenic and Visual Resources

The proposed action is expected to have negligible effect on scenic and visual resources. The effect of successful biocontrol will take place gradually over the span of years to decades. The change in scenic or visual value of the invaded area, therefore, will not dramatically change in a short time period. The areas of infestation are expected to be replaced by other vegetation and have minimal visual change at landscape level. The proposed action will have insignificant effect in scenic value and visual resources.

2.4.5 Household Nuisance

Syphraea uberabensis lives and feeds on its host plants as adults and larvae and pupates in the soil under these host plants. Although populations of the insects may grow large, these populations are expected to remain localized on and near the host plants, and populations will decline as the leaves of their host plants are consumed. Due to this intimate association with its host plants, which are not cultivated and grow mainly in wild environments and unmanaged areas, humans are unlikely to come into contact with *S. uberabensis*. This insect and its relatives are not known to be a nuisance elsewhere, for example, by exhibiting attraction to lights or mass migration or aggregation. *S. uberabensis* is unlikely to become nuisance to residents and visitors.

2.5 Consistency with Government Plans and Policies

The proposed action is consistent with all government plans and policies, especially those that call for conservation of natural resources.

2.5.1 Hawai‘i State Plan

The *Hawai‘i State Plan* was adopted in 1978. It was revised in 1986 and again in 1991 (HRS Chapter 226, as amended). The Plan establishes a set of goals, objectives, and policies that are meant to guide the State's long-run growth and development activities. The proposed project is consistent with State goals and objectives that call for increases in employment, income and job choices, and a growing, diversified economic base extending to the neighbor islands.

Chapter 226-4 sets forth goals associated with the *Hawai‘i State Plan*:

1. A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawai‘i's present and future generations.

2. A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

3. Physical, social, and economic well-being, for individuals and families in Hawai‘i, that nourishes a sense of community responsibility, of caring, and of participation in community life.

The aspects of the plan most pertinent to the proposed classification are the following:

Chapter 226-11 *Objectives and policies for the physical environment—land-based, shoreline, and marine resources*. Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of prudent use of Hawai‘i's land-based, shoreline, and marine resources and effective protection of Hawai‘i's unique and fragile environmental resources. To achieve the land-based, shoreline, and marine resource objectives, it shall be the policy of the State to:

- Exercise an overall conservation ethic in the use of Hawai‘i's natural resources.
- Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.
- Take into account the physical attributes of areas when planning and designing activities and facilities.
- Manage natural resources and environs to encourage their beneficial and multiple uses without generating costly or irreparable environmental damage.
- Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.
- Encourage the protection of rare or endangered plant and animal species and habitats native to Hawai‘i.
- Pursue compatible relationships among activities, facilities, and natural resources.
- Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.

The proposed action is consistent with the goals, objectives and policies of the *Hawai‘i State Plan*. Specifically, it will encourage the protection of rare or endangered plant and animal species and habitats through the control of the invasive weeds.

2.5.2 Hawai‘i County General Plan

The County of Hawai‘i’s General Plan is the policy document expressing the broad goals and policies for the long-range development of the Island of Hawai‘i. The plan was adopted by ordinance in 1989 and amended in 2005. The chapter of Natural Resources and Shoreline are the most relevant to the proposed project and include the following goals and policies.

Natural Resources and Shoreline – Goals:

- Protect and conserve the natural resources from undue exploitation, encroachment, and damage.
- Protect rare or endangered species and habitats native to Hawai‘i.
- Protect and effectively manage Hawai‘i’s open space, watersheds, shoreline, and natural areas.

Natural Resources and Shoreline – Policies:

- Coordinate programs to protect natural resources with other government agencies.
- Encourage public and private agencies to manage the natural resources in a manner that avoids or minimizes adverse effects on the environment and depletion of energy and natural resources to the fullest extent.
- Encourage an overall conservation ethic in the use of Hawai‘i’s resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawai‘i.
- Encourage the protection of watersheds, forest, brush, and grassland from destructive agents and uses.
- Work with the appropriate State, Federal agencies, and private landowners to establish a program to manage and protect identified watersheds.

The proposed action would help to protect and conserve native species and habitats and is consistent with the policies for encouraging conservation ethics, watershed protection, and interagency coordination for the management of natural resources.

2.5.3 Kaua‘i County General Plan

The General Plan for the County of Kaua‘i is the document expressing the broad goals and policies for the long-range development and resource management for the Island of Kaua‘i. First adopted in 1971, the Plan was revised in 1984 and 2000. The General Plan is thematically arranged, discussing issues including management of public facilities, preservation of rural character, and caring for land, water, and culture, among others. The General Plan also includes a chapter entitled “*Vision for Kaua‘i 2020”* that states:

> In 2020, management of development, agriculture, and other activities on Kaua‘i is based on the related principles of ahupua‘a and watershed. Land is developed and used in ways that conserve natural streams and streamflows; conserve habitat for native species of plants and animals, both on land and in the ocean; and preserve sandy beaches and coral reefs. Best management practices used by government agencies, agricultural companies, other businesses, and individuals are effective in avoiding increases in floodwaters downstream; preventing beach loss; and minimizing pollution of ocean waters. All of Kaua‘i’s waters are fishable and swimmable.

The proposed action is consistent with the vision of the Kaua‘i County General Plan, specifically the successful control of the target weeds would contribute to conserving habitat for native plants and animals.

2.5.4 Maui County General Plan

The Maui County General Plan is a long-term, comprehensive blueprint for the physical, economic, environmental development, and cultural identity of the county. The Countywide Policy Plan, adopted on March 24, 2010, provides broad goals, objectives, policies, and implementing actions that portray the desired direction of the County's future. Furthermore, this Countywide Policy Plan provides the policy framework for the development of the Maui Island Plan and nine Community Plans. The Countywide Policy Plan is the outgrowth of and includes the elements of the earlier General Plans of 1980 and 1990. The portions of the plan pertaining to the Protection of the Natural Environment are the most relevant to the proposed project and include the following goals and objective.

Goals: Maui County's natural environment and distinctive open spaces will be preserved, managed, and cared for in perpetuity.

Objective: Improve the opportunity to experience the natural beauty and native biodiversity of the islands for present and future generations. Policies to achieve the objective include:

- Perpetuate native Hawaiian biodiversity by preventing the introduction of invasive species, containing or eliminating existing noxious pests, and protecting critical habitat areas.
- Preserve and reestablish indigenous and endemic species' habitats and their connectivity.
- Restore and protect forests, wetlands, watersheds, and stream flows, and guard against wildfires, flooding, and erosion.
- Expand coordination with the State and nonprofit agencies and their volunteers to reduce invasive species, replant indigenous species, and identify critical habitat.

The proposed action is consistent with the goal, objective, and policies of the Maui County General Plan for the protection of natural environment through the control of the target weeds to conserve and restore native ecosystems and watersheds.

2.5.5 City and County of Honolulu General Plan

The City and County of Honolulu General Plan (1992 edition, amended in 2002) is a comprehensive statement of objectives and policies which sets forth the long-range aspirations of O‘ahu's residents and the strategies of actions to achieve them. It is the focal point of a comprehensive planning process that addresses physical, social, economic, and environmental concerns affecting the City and County of Honolulu. This planning process serves as the coordinative means by which the City and County government provides for the future growth of the metropolitan area of Honolulu.

The policies most relevant to the proposed action are in the section of Natural Environment with the objective to protect and preserve O‘ahu's natural environment including:

- Seek the restoration of environmentally damaged areas and natural resources.
- Protect plants, birds, and other animals that are unique to the State of Hawai‘i and the Island of O‘ahu.
- Increase public awareness and appreciation of O‘ahu's land, air, and water resources.

The proposed action is consistent with the objective and policies concerning the natural environment of the plan. Specifically, the proposed action would contribute to the restoration of natural environment and protection of native plants and animals through the control of the invasive weeds.

2.5.6 Hawai‘i’s State Wildlife Action Plan

The 2015 edition of Hawai‘i’s State Wildlife Action Plan (SWAP) details the strategy and plans of the Department of Land and Natural Resources and its partners to address the conservation needs of over 10,000 species native to Hawai‘i. This is an update of the Comprehensive Wildlife Conservation Strategy 2005 plan and outlines a statewide strategy for conserving native wildlife species.

The SWAP identified the major threats to Hawai‘i’s native wildlife which include:

- Loss and degradation of habitat resulting from human development, alteration of hydrology, wildfire, recreational overuse, natural disaster, and other factors;
- Invasive species (e.g., habitat-modifiers, including weeds, ungulates, algae and corals, predators, competitors, disease carriers, and disease);
- Ecological consequences of climate change;
- Limited information and insufficient information management;
- Uneven compliance with existing conservation laws, rules, and regulations;
- Overharvesting and excessive extractive use;
- Management constraints; and
- Inadequate funding.

The SWAP sets goals to guide conservation efforts across the state to ensure protection of Hawai‘i’s Species of Greatest Conservation Need and the diverse habitats that support them. The following seven objectives have been identified as elements necessary for the long-term conservation of Hawai‘i’s native wildlife:

- Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive;
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication;
- Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs;
- Strengthen existing and create new partnerships and cooperative efforts;
- Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawai‘i;
- Support policy changes aimed at improving and protecting native species and habitats; and
- Enhance funding opportunities to implement needed conservation actions.

The target weeds of the proposed biological control are invasive plants that pose threats to the native ecosystem. The proposed project will address the threat of invasive species and provide a tool for the resource managers to combat invasive species that would otherwise not be feasible due to management constraints and inadequate funding. The proposed project is consistent with the goals of SWAP by providing a cost-effective tool for resource managers to combat the invasive weeds targeted by the project. The project will also contribute to maintain, protect, manage, and restore native species and habitats.

2.5.7 Hawai‘i’s Interagency Biosecurity Plan

The 2017-2027 Hawai‘i Interagency Biosecurity Plan (HIBP) is the State’s first multi-agency, comprehensive biosecurity plan that includes coordinated strategies to protect Hawaii’s agriculture, environment, economy and health from invasive species. The HIBP identifies gaps in the current biosecurity system which consists of a

network of state agencies and partners working within the areas of preborder, border, and postborder as well as public engagement. The plan creates a shared path forward to address these gaps through 147 actions.

This project is consistent with the actions identified in the HIBP related to biological control which is an essential tool to address widespread invasive species that are difficult to control through conventional methods. Those actions are:

- Increase funding and staffing for Hawai‘i’s biological control programs;
- Hiring a biological control program coordinator, doubling the size of HDOA’s Biological Control Section Staff; and
- Building state-of-the-art biocontrol facilities equipped to develop effective biocontrol for high-impact target species.

2.5.8 Hawai‘i Forest Action Plan

The 2016 Hawai‘i Forest Action Plan (FAP) is an update to the original assessment and strategy produced in 2010 called the Hawai‘i Statewide Assessment of Forest Conditions and Trends. The Department of Land and Natural Resource Division of Forestry and Wildlife is the lead agency in the development of the FAP, which covers all forest land ownerships (state, private, and federal) and enables DOFAW to continue to seek funding for landscape-scale management and to integrate the many programs the division administers through one planning document. The plan identifies nine priority areas for Hawai‘i’s forests including:

- Water quality and quantity;
- Forest health, invasive species, insects and disease;
- Wildfire;
- Urban and community forestry;
- Climate change and sea level rise;
- Conservation of native biodiversity;
- Hunting
- Nature-based recreation; and
- Tourism.

The target weeds of the proposed biological control are invasive plant species and pose threats to other priority areas such as water quality and quantity and conservation of native biodiversity. The FAP identifies plants that are non-native, invasive, and habitat-modifying as one of the current, most pervasive threats to native biodiversity in Hawai‘i and discusses the negative impacts that invasive plants can have on the hydrological processes of forested watersheds.

The proposed project in consistent with the goals of the FAP, which supports and suggests a substantial increase in resources for biocontrol as a necessary tool in invasive species management and identifies biocontrol as one of the management approaches in the FAP.

3.0 ANTICIPATED DETERMINATION

Section 11-200-12 of the HAR sets forth the criteria by which the significance of environmental impacts shall be evaluated. The following discussion restates these criteria individually and evaluates the project's relation to each.

1. *The project will not involve an irrevocable commitment or loss or destruction of any natural or cultural resources.*

The proposed action involves specific interactions between the biological control agent and the target weeds and is not expected to involve irrevocable commitment or loss or destruction of any natural or cultural resources.

2. *The project will not curtail the range of beneficial uses of the environment.*

The proposed action involves specific interactions between the biological control agent and the target weeds and is not expected to curtail any beneficial uses of the environment.

3. *The project will not conflict with the State's long-term environmental policies.*

The proposed action is expected to benefit the environment by reducing the negative impact caused by the target weeds. This is in line with the State's long-term environmental policies.

4. *The project will not substantially affect the economic or social welfare of the community or State.*

The proposed action involves specific interactions between the biological control agent and the targeted noxious weeds. The proposed action is not expected to affect the economic or social welfare of the community or State.

5. *The project does not substantially affect public health in any detrimental way.*

The proposed action involves specific interactions between the biological control agent and the targeted noxious weeds, both are not public health concerns.

6. *The project will not involve substantial secondary impacts, such as population changes or effects on public facilities.*

The proposed action involves specific interactions between the biological control agent and the targeted noxious weeds and is not expected to cause substantial secondary impacts.

7. *The project will not involve a substantial degradation of environmental quality.*

The proposed action involves specific interactions between the biological control agent and the target weeds and is expected to improve environmental quality by reducing the negative impact caused by the noxious weeds.

8. *The project will not substantially affect any rare, threatened, or endangered species of flora or fauna or habitat.*

The proposed action is expected to benefit many rare, threatened, or endangered species of flora or fauna by reducing the negative impact caused by the noxious weeds to the ecosystems.

9. *The project is not one which is individually limited but cumulatively may have considerable effect upon the environment or involves a commitment for larger actions.*

The proposed action does not involve a commitment for larger actions. The cumulative effect is expected to be beneficial by reducing the overall impact of invasive species to the native ecosystems.

10. The project will not detrimentally affect air or water quality or ambient noise levels.

The proposed action involves specific interactions between the biological control agent and the target weeds and is not expected to affect air or ambient noise levels. Although the proposed action has the potential to reduce vegetation cover and affect water quality, the effect is expected to be temporary and off-set by reducing the long-term impact on watershed integrity caused by the noxious weeds.

11. The project will not affect or will not likely be damaged by being located within an environmentally sensitive area such as flood plains, tsunami zones, erosion-prone areas, geologically hazardous lands, estuaries, fresh waters or coastal waters.

The proposed action involves specific interactions between the biological control agent and the target weeds. In some cases these interactions may take place within environmentally sensitive areas, however impacts in these areas are expected to be beneficial, decreasing the detrimental effects of invasive plants, and not subject to damage by being located within these areas.

12. The project will not substantially affect scenic vistas and viewplanes identified in county or state plans or studies.

The proposed action may temporarily reduce vegetation cover in natural areas but is not expected to substantially affect scenic vistas and viewplanes.

13. The project will not require substantial energy consumption.

The proposed action involves specific interactions between the biological control agent and the target weeds and will not require substantial energy consumption.

3.1 Conclusion

For the reasons above, and in consideration of comments received during early consultation, the State of Hawai‘i Department of Agriculture, with support from the State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, has concluded that the proposed project will not have a significant impact in the context of HRS Chapter 343 and Section 11-200-12 of the HAR, and has determined an Anticipated Finding of No Significant Impact with the Draft Environmental Assessment.

4.0 AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

The following legislators, agencies, advisory commissions, and educational institutes received a letter inviting their participation in the preparation of the Draft Environmental Assessment. The information and issues raised were considered and included in the Draft Environmental Assessment. Comments received during early consultation are provided in Appendix A.

Federal Agencies

- US House of Representatives, Representative Tulsi Gabbard
- US House of Representatives, Representative Colleen Hanabusa
- US Senate, Senator Mazie Hirono
- US Senate, Senator Brian Schatz
- National Park Service, Hawai‘i Volcanoes National Park
- National Park Service, Haleakala National Park

- Natural Resources Conservation Service, Pacific Islands Area
- US Army Garrison, Commander Col. Stephen E. Dawson
- US Army Garrison, Environmental Division
- US Army Garrison, Natural Resource Section
- US Fish & Wildlife Service
- US Fish & Wildlife Service, Oʻahu National Wildlife Refuge Complex
- US Geological Survey, Pacific Island Ecosystems Research Center

State Agencies

- Aha Moku Councils
- BLNR Oʻahu Member
- Department of Business, Economic Development & Tourism
- Department of Hawaiian Homelands
- Department of Health
- Department of Health, Office of Environmental Quality Control
- DLNR Division of Forestry & Wildlife
- DLNR Division of State Parks
- DLNR Land Division
- DLNR Office of Conservation & Coastal Lands
- DLNR State Historic Preservation Administration
- DLNR Watershed Partnership Program
- Land Use Commission
- Natural Area Reserves System Commission
- Office of the Governor
- Office of Hawaiian Affairs
- University of Hawaiʻi, College of Tropical Agriculture and Human Resources
- University of Hawaiʻi, Environmental Center
- University of Hawaiʻi, Pacific Cooperative Studies Unit

City and County Agencies

- Honolulu City Council
- City & County of Honolulu, Office of the Mayor
- City & County of Honolulu, Board of Water Supply
- City & County of Honolulu, Planning Department
- Hawaiʻi County Council
- Hawaiʻi County, Office of the Mayor
- Hawaiʻi County, Department of Water Supply
- Hawaiʻi County, Department of Planning

- Kaua‘i County Council
- Kaua‘i County, Office of the Mayor
- Kaua‘i County, Department of Planning
- Kaua‘i County, Department of Water Supply
- Maui County Council
- Maui County Office of the Mayor
- Maui County, Department of Planning
- Maui County, Department of Water Supply

Organizations

- Big Island Invasive Species Committee
- Bishop Museum
- Conservation Council of Hawai‘i
- Environment Hawai‘i Inc.
- Hawai‘i Audubon Society
- Hawai‘i Cattlemen’s Council
- Hawai‘i Conservation Alliance
- Hawai‘i Forest and Trail
- Hawai‘i Forest Industry Association
- Hawaiian Botanical Society
- Hawaiian Trail and Mountain Club
- KAHEA
- Kamehameha Schools
- Kaua‘i Invasive Species Committee
- Ko‘olau Mountains Watershed Partnership
- Maui Invasive Species Committee
- Moloka‘i Invasive Species Committee
- Native Hawaiian Advisory Council
- Native Hawaiian Legal Corporation
- O‘ahu Invasive Species Committee
- Pig Hunters Association of O‘ahu
- Plant Extinction Prevention Program
- Sierra Club, O‘ahu Chapter
- The Nature Conservancy of Hawai‘i

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APPENDIX A: COMMENTS RECEIVED DURING EARLY CONSULTATION

17913

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

December 13, 2017

ATTN: Interested Agencies and Organizations

RE: Early Consultation on Environmental Assessment for the state-wide release of the flea beetle *Syphraea uberabensis* for biological control of the noxious weed *Tibouchina herbacea* and related weeds

The co-proposing agencies, Hawaii State Department of Agriculture (HDOA) and Hawai'i State Department of Land and Natural Resources (DLNR), are preparing an Environmental Assessment (EA) in support of the field release of the flea beetle *Syphraea uberabensis* in the state of Hawai'i for biological control of the noxious weed *Tibouchina herbacea*. This letter is to share information about the project and to solicit your input regarding potential environmental impacts that may be associated with proposed project actions.

Overview

Cane tibouchina (*Tibouchina herbacea*) is an herbaceous plant in the melastome family (Melastomataceae) and aggressively spreads in mesic and wet areas in Hawai'i. It is widely established on Hawai'i and Maui islands and is also naturalized on Lāna'i, Moloka'i, and O'ahu. This invasive plant spreads by prolific production of bird-dispersed seeds, as well as vegetatively. It forms dense stands in pastures and undisturbed forests, out-competing other species. The entire genus of *Tibouchina* is listed as noxious weed in the state.

Syphraea uberabensis is a small South American beetle (Chrysomelidae; Alticini) whose adults and larvae feed externally on foliage and soft stems of *Tibouchina spp.*, causing enough damage to kill small plants. *S. uberabensis* has been evaluated in containment facilities in Hawai'i as a potential biological control agent for *T. herbacea* with encouraging results. Tests have been conducted on a variety of native and non-native plants to identify the beetle's potential host range. Results indicate that it does not have the capacity to impact native or economic plants in Hawai'i and the host range is limited to *T. herbacea* and closely related weeds within the melastome family.

The proposed action of releasing the biological control agent involves the use of state land and funds as well as approval of permits. Therefore, in accordance with the Hawai'i Revised Statutes Chapter 343 or Hawaii Environmental Policy Act (HEPA) the proposing agencies are conducting an Environmental Assessment of the proposed project to evaluate potential environmental impacts.

Project Actions

State-wide release of the *S. uberabensis* for *T. herbacea* biocontrol will be the primary action considered in the Environmental Assessment. Activities associated with the project include:

1. State-wide field release of *S. uberabensis* on state lands where infestation of *T. herbacea* and related weeds in the melastome family (*Pterolepis glomerata, Melastoma septemnervium and M. sanguineum*) occurs.
2. Monitoring of *S. uberabensis* populations and the impact on *T. herbacea* population in selected release sites.

Public Input Needed

The EA will address topics including but not limited to: biological resources; cultural resources; and socioeconomic impacts. If you would like to contribute input regarding this project, or would like clarification on any aspect, please contact me at Robert.D.Hauff@hawaii.gov. Please send your comments on the project to me by **Friday, January 12th, 2018**. Thank you very much for your time.

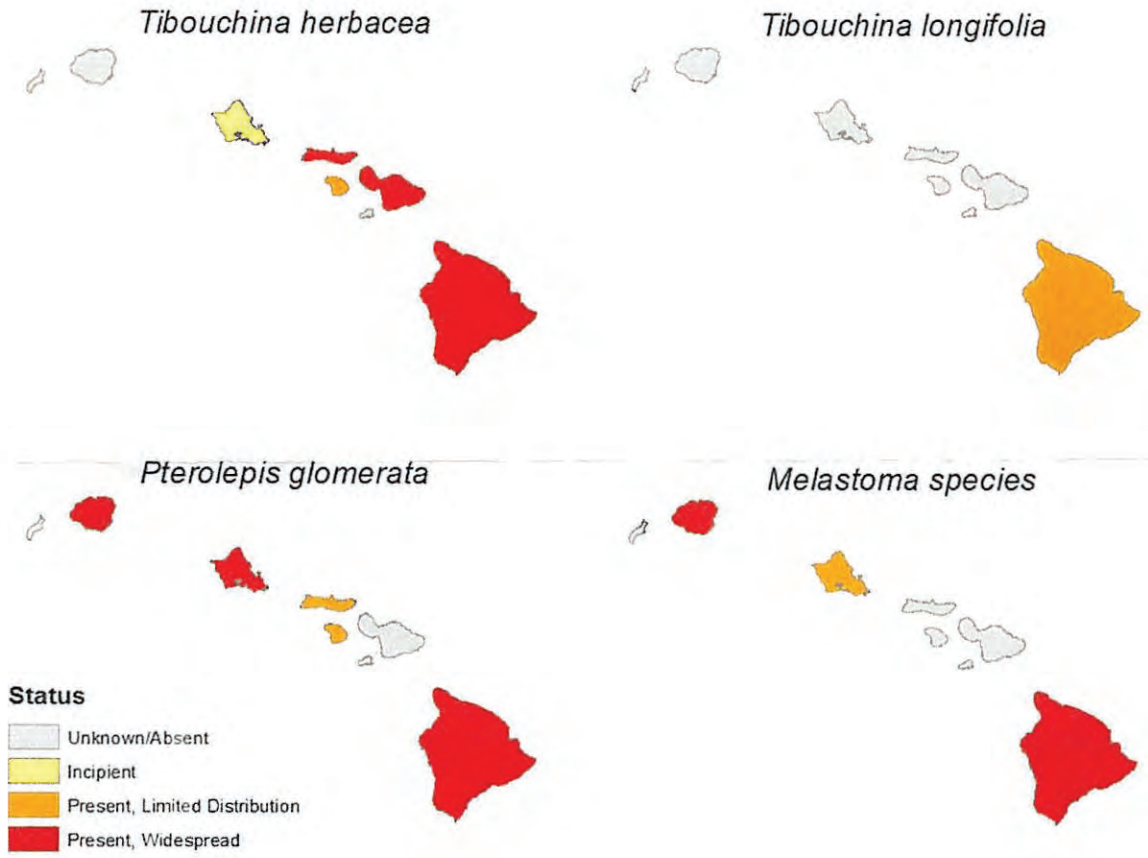
Sincerely,

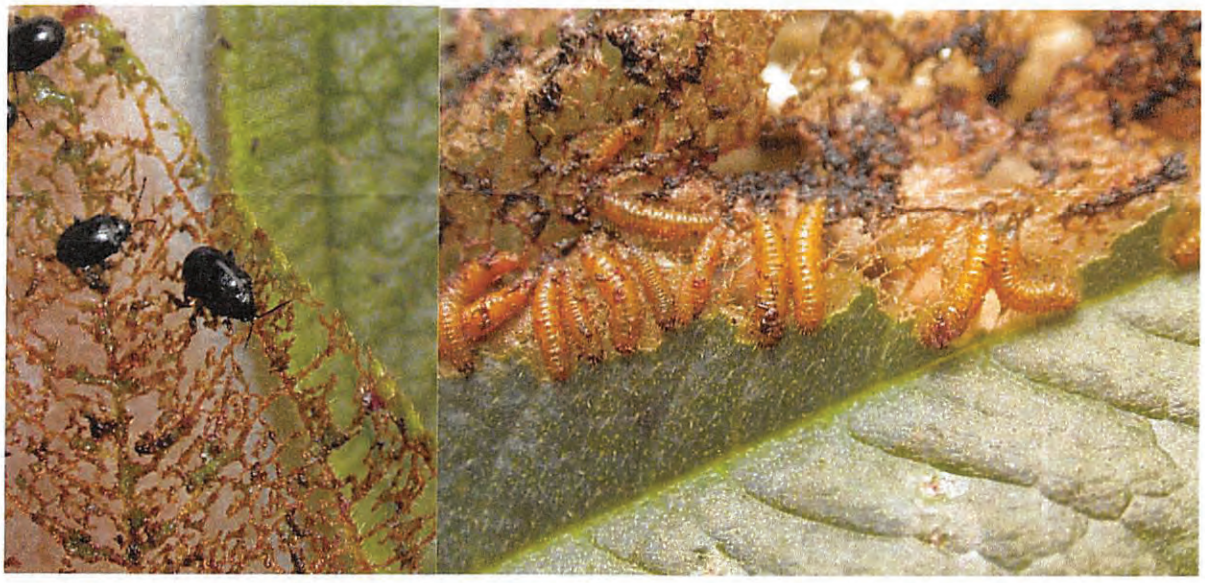
Robert Hauff

State Protection Forester

Cane Tibouchina Growing in Hawaii

Status of invasion by *Tibouchina herbacea* and relatives across the State of Hawaii





Feeding damage by adults and larvae of *Syphraea uberabensis* on the host plant *Tibouchina herbacea*.

Robert Hauff
State Protection Forester
Department of Land and Natural Resources/Division of Forestry and Wildlife
1151 Punchbowl Street Rm. 325
Honolulu, HI 96813

December 27, 2017

Dear Mr. Hauff,

The Oʻahu Invasive Species Committee (OISC) strongly supports the field release of the flea beetle *Syphraea uberabensis* as a natural enemy of the ecosystem-changing weed *Tibouchina herbacea.* OISC, the Koʻolau Mountain Watershed Partnership and DLNR/DOFAW's Native Ecosystems Protection & Management, have been attempting to eradicate this species from the Poamoho summit, where an isolated population was introduced into intact native forest. However, the challenges of finding this weed in thick underbrush over extremely steep terrain has made this difficult to accomplish, despite the species' relatively small footprint.

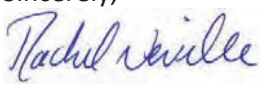
Unlike many invasive plants, *T. herbacea* does not require prior disturbance to establish in native forests. A study done in Hawaiʻi in 2000 found that *T. herbacea* can germinate and grow even in dense native underbrush. Once germinated, it grows quickly and outcompetes native plants, including tree seedlings. These traits give *T. herbacea* the ability to convert a forest of native trees into a carpet of alien weeds.

T. herbacea currently occurs along a fork of the Helemano stream and around the summit of the Poamoho trail. However, two immature plants were found along the 'Aiea Ridge Trail in 2015 and 2016 and OISC removed a single immature plant from Halawa in 2007. All these sites were surveyed thoroughly, but no additional plants were found. Our data suggest that Poamoho is the only place on the island with reproductive *T. herbacea,* but this species' history on Oʻahu shows that it can jump watersheds and islands. Releasing the flea beetle will reduce the damage that *T. herbacea* can do if it moves into new areas.

Climate change in Hawaiʻi may cause hotter, drier summers and wetter winters with less rainfall that will be delivered during intense storm events according to a 2014 University of Hawaiʻi report. Healthy forests that can direct that rainfall into the aquifer and prevent erosion will be a crucial part of Hawaiʻi's ability to withstand these climate shifts. Reducing the threat of invasive weeds using a species' natural enemies will help keep Hawaiʻi's forest healthy.

T. herbacea is one of the most damaging invasive weeds in Hawaiʻi's forests. Reducing the density of *T. herbacea* and limiting the damage it does to native forests will help Hawaiʻi stay resilient to climate change. Letting the flea beetle destroy plants that field crews would otherwise have to will free up funds for other invasive species projects. For these reasons, we support the field release of this natural enemy. Mahalo for the opportunity to comment.

Sincerely,



Rachel Neville
OISC Manager

United States Department of the Interior

NATIONAL PARK SERVICE
Hawai'i Volcanoes National Park
Post Office Box 52
Hawai'i National Park, Hawai'i, 96718

IN REPLY REFER TO:

HAVO I.D. (L7619)

December 28, 2017

Mr. Robert Hauff
Dept. of Land & Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawaii 96813

Dear Mr. Hauff,

The National Park Service (NPS), Hawai'i Volcanoes National Park, received your letter requesting input regarding the proposed state-wide release of the flea beetle *Syphraea uberabensis* for biological control of the noxious weed *Tibouchina herbacea* and related weeds. Hawai'i Volcanoes National Park also has some populations of *T. herbacea* that we control in our Special Ecological Areas. We are supportive of safe effective methods to control invasive plants and look forward to further details in the environmental assessment.

We appreciate the opportunity to provide input during early consultation. Please include us on the Environmental Assessment distribution list. If you have any questions, please contact Danielle Foster, Environmental Protection Specialist at danielle_foster@nps.gov or 808-985-6073.

Sincerely,

Cynthia L. Orlando
Superintendent

cc: Robert.D.Hauff@hawaii.gov

Huang-Chi Kuo

From: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Sent: Friday, January 19, 2018 12:53 PM
To: Huang-Chi Kuo
Subject: FW: Proposed release of biological control agent for Tibouchina

From: Helen Spafford [mailto:hspaffor@hawaii.edu]
Sent: Wednesday, January 03, 2018 12:41 PM
To: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Cc: CTAHR Dean <dean@ctahr.hawaii.edu>
Subject: Proposed release of biological control agent for Tibouchina

Dear Rob,

A graduate student and I have been evaluating the population of Tibouchina herbacea in Hawaii over the last two years. We found the numbers and size of plants to be increasing at all locations and across all elevations on two islands. This plant, and its relatives, are significant weeds. Given the accessibility issues related to the current and expanding areas of infestation, biological control of tibouchina is the only reasonable option for management.

The proposed agent is not host-specific, i.e. it does not feed only on Tibouchina herbacea. However, its host range is limited to melastomes all of which are weeds in Hawaii. If there is any non-target feeding in Hawaii it will be on another weed. This is actually a positive outcome and will ensure that populations of the agent will be sustained over time and can disperse to new patches of the invasive plants.

I highly support the release of the biological control agent.

The sites that we have been monitoring over the last two years could also be used as release sites. The data we have collected can be used for assessment of post-release impact and effectiveness of the biological control agent, should it establlsh.

--
Regards,

Helen Spafford, Ph.D.
Associate Professor of Applied Entomology
Department of Plant and Environmental Protection Sciences
University of Hawaii, Manoa

Website

Huang-Chi Kuo

From: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Sent: Friday, January 19, 2018 12:53 PM
To: Huang-Chi Kuo
Subject: FW: DEADLINE ITEM: Early Consultation on Environmental Assessment
Attachments: D000260 DLNR Early Consultation on Environmental Assessment re Release of Flea Beetle.pdf

From: Daniel Rubinoff [mailto:rubinoff@hawaii.edu]
Sent: Thursday, January 04, 2018 11:30 AM
To: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Subject: Fwd: DEADLINE ITEM: Early Consultation on Environmental Assessment

Hi Rob,
I am writing in strong support of the release. It's overdue and badly needed. If there comes a time that a letter like that from me would be helpful, please just let me know!

Aloha,

Dan
---------- Forwarded message ----------
From: **Koon-Hui Wang** <koonhui@hawaii.edu>
Date: Tue, Jan 2, 2018 at 4:24 PM
Subject: Fwd: DEADLINE ITEM: Early Consultation on Environmental Assessment
To: "Pulakkatu-Thodi, Ishakh" <ishakpt@gmail.com>, "Gutierrez, Rosemary" <gr6@hawaii.edu>, Ethel M Villalobos <emv@hawaii.edu>, Paul Krushelnycky <pauldk@hawaii.edu>, "Borth, Wayne" <borth@hawaii.edu>, Julian Dupuis <jrdupuis@hawaii.edu>, Meng Mao <mengm@hawaii.edu>, Shizu Watanabe <shizuw@gmail.com>, Mohammad Arif <arif@hawaii.edu>, Zhiqiang Cheng <cheng241@hawaii.edu>, Steve Ferreira <stephenf@hawaii.edu>, "Hamasaki, Randall" <rth@hawaii.edu>, John Hu <johnhu@hawaii.edu>, "'Michael Kawate' (mkawate@hawaii.edu)" <mkawate@hawaii.edu>, Mike Melzer <melzer@hawaii.edu>, Daniel Rubinoff <rubinoff@hawaii.edu>, "Shimabuku, Robin" <ShimabukuR@ctahr.hawaii.edu>, Brent Sipes <sipes@hawaii.edu>, "Spafford, Helen" <helen.spafford@hawaii.edu>, "Sugano, Jari" <SuganoJ@ctahr.hawaii.edu>, Miaoying Tian <mtian@hawaii.edu>, Janice Y Uchida <juchida@hawaii.edu>, "Valenzuela, Hector" <hector@hawaii.edu>, Koon-Hui Wang <koonhui@hawaii.edu>, "Mark G. Wright" <markwrig@hawaii.edu>, "Graham, Jason" <jrgraham@hawaii.edu>, Camiel Doorenweerd <cdoorenw@hawaii.edu>, Christina Mogren <cmogren@hawaii.edu>, "Comerford, Nicholas" <ComerfordN@ctahr.hawaii.edu>

Dear all,

Please see an Early consultation for environmental assessment of a new biological control agent to be released for weed management from HDOA. Please send your comments if you have to Robert Hauff and Dean Comerford by Jan 12.

Thanks
Koon-Hui

---------- Forwarded message ----------
From: **Debbie Wong** <wongdebo@hawaii.edu>
Date: Tue, Jan 2, 2018 at 3:02 PM

Subject: DEADLINE ITEM: Early Consultation on Environmental Assessment
To: Catherine Chan-Halbrendt <chanhalb@hawaii.edu>, Koon-Hui Wang <koonhui@hawaii.edu>

Good afternoon Cathy & Koon-Hui,

The attached is being forwarded on behalf of Dean Comerford as you and your faculty may wish to email comment by Jan. 12, 2018 to Robert Hauff (Robert.D.Hauff@hawaii.gov). Please cc the Dean (dean@ctahr.hawaii.edu) on all comments submitted.

Thank you!

Debbie

Deborah Wong, Secretary
Office of the Dean and Director for Research and Cooperative Extension
College of Tropical Agriculture & Human Resources
3050 Maile Way, Gilmore Hall 202
University of Hawai`i at Mānoa
Honolulu, HI 96822

Telephone: (808) 956-8234

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~~~~~~

Koon-Hui Wang, Associate Professor
University of Hawaii
CTAHR Dept. Plant and Environmental Protection Sciences
http://www.ctahr.hawaii.edu/WangKH/index.html
~~~~~~

Huang-Chi Kuo

From: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Sent: Friday, January 19, 2018 12:52 PM
To: Huang-Chi Kuo
Subject: FW: Early Consultation on EA for the state wide release of the flea beetle

---

From: Susan A. Foley [mailto:Susan.Foley@mauicounty.us]
Sent: Friday, January 05, 2018 1:37 PM
To: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Subject: RE: Early Consultation on EA for the state wide release of the flea beetle

Aloha Robert,

Thank you for sending the correspondence regarding the proposal to release the flea Beetle Syphraea uberabensis in the State of Hawai'i for biological control of the noxious weed Tibouchina Herbacea to Kelly King's County Council office.

We have a few questions:

- Are there other successful examples of this project that you could share with us?
- Are we right to understand that as of this date there have only been studies in containment facilities and any not open air tests?
- What are the known negative side-effects of introducing the flea beetle into a new environment, if any?
- How much will the project cost?

Mahalo for your time and consideration,

Thanks,
Susan

Susan Foley
Executive Assistant
808.270.7108
susan.foley@mauicounty.us

Huang-Chi Kuo

From: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Sent: Friday, January 19, 2018 12:50 PM
To: Huang-Chi Kuo
Subject: FW: DEADLINE ITEM: Early Consultation on Environmental Assessment

From: Christina Mogren [mailto:cmogren@hawaii.edu]
Sent: Friday, January 05, 2018 4:48 PM
To: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Cc: dean@ctahr.hawaii.edu; Koon-Hui Wang <koonhui@hawaii.edu>
Subject: Re: DEADLINE ITEM: Early Consultation on Environmental Assessment

Robert,

I just wanted to share some thoughts on your EA for the *Tibouchina herbaceae weed*. As a pollinator ecologist, a concern that comes to mind is that widespread removal of this flowering plant may impact pollinator communities, despite it's weedy and noxious status. I would be less concerned about honey bees (since they are also introduced and capable of foraging elsewhere), but more concerned about potential impacts to native *Hylaeus*.

It may be useful to document any visitation to the flowers of *T. herbaceae* by native bees, and have a plan in place to replace stands with native flowering plants that are also utilized by these bees, if needed. An alternative could be that death of these plants results in new nesting habitat in dried out stems, and thus killed stands should be left in place. These types of plant-pollinator interactions are unfortunately not well understood in the state, so a study to see if any native pollinators are impacted would be beneficial on multiple fronts.

If these plants were originally introduced as ornamentals, then it is likely homeowners throughout the state may have them on their property. A campaign to educate citizens and landscaping companies about voluntary removal could help reduce or eliminate reintroduction, particularly in suburban areas.

I hope these comments are helpful. If you have questions, please do not hesitate to reach out!

Dr. Chrissy Mogren, PhD
Assistant Researcher/Professor
University of Hawaii, Mānoa
College of Tropical Agriculture and Human Resources
Plant and Environmental Protection Sciences
3050 Maile Way, Gilmore 310
Honolulu, HI 96822

Office: Gilmore 608

cmogren@hawaii.edu
408-421-5747 (cell)
808-956-6745 (office)

On Tue, Jan 2, 2018 at 4:24 PM, Koon-Hui Wang <koonhui@hawaii.edu> wrote:

> Dear all,

Please see an Early consultation for environmental assessment of a new biological control agent to be released for weed management from HDOA. Please send your comments if you have to Robert Hauff and Dean Comerford by Jan 12.

Thanks
Koon-Hui

---------- Forwarded message ----------
From: **Debbie Wong** <wongdebo@hawaii.edu>
Date: Tue, Jan 2, 2018 at 3:02 PM
Subject: DEADLINE ITEM: Early Consultation on Environmental Assessment
To: Catherine Chan-Halbrendt <chanhalb@hawaii.edu>, Koon-Hui Wang <koonhui@hawaii.edu>

Good afternoon Cathy & Koon-Hui,

The attached is being forwarded on behalf of Dean Comerford as you and your faculty may wish to email comment by Jan. 12, 2018 to Robert Hauff (Robert.D.Hauff@hawaii.gov). Please cc the Dean (dean@ctahr.hawaii.edu) on all comments submitted.

Thank you!

Debbie

Deborah Wong, Secretary
Office of the Dean and Director for Research and Cooperative Extension
College of Tropical Agriculture & Human Resources
3050 Maile Way, Gilmore Hall 202
University of Hawai`i at Mānoa
Honolulu, HI 96822

Telephone: (808) 956-8234

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Koon-Hui Wang, Associate Professor
University of Hawaii
CTAHR Dept. Plant and Environmental Protection Sciences
http://www.ctahr.hawaii.edu/WangKH/index.html
~~~~~~

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE
MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

January 10, 2018

State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
Attention: Mr. Robert Hauff
1151 Punchbowl Street, Room 325
Honolulu, Hawaii 96813

via email: Robert.D.Hauff@hawaii.gov

Dear Mr. Hauff:

SUBJECT: Early Consultation on Environmental Assessment for the state-wide release of the flea beetle *Syphraea uberabensis* for biological control of the noxious weed *Tibouchina herbacea* and related weeds

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division and (b) Land Divisions – Oahu District and Hawaii District on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

'17 DEC 20 AM 11:49 ENGINEERING

December 20, 2017

MEMORANDUM

TO:

DLNR Agencies:
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division
___Div. of Forestry & Wildlife
___Div. of State Parks
_X_ Commission on Water Resource Management
___Office of Conservation & Coastal Lands
_X_ Land Division – ODLO/HDLO/MDLO/KDLO
_X_ Historic Preservation

FROM

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Early Consultation on Environmental Assessment for the state-wide release of the **flea bettle *Syphraea uberabensis*** for biological control of the **noxious weed *Tibouchina herbacea*** and related weeds
LOCATION: State-wide
APPLICANT: State Departments of Agriculture and Land and Natural Resources

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments by **January 10, 2018**.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: _____

Print Name: Carty S. Chang, Chief Engineer

Date: 12/21/18

Attachments
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 20, 2017

MEMORANDUM

TO: **DLNR Agencies:**
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division
___Div. of Forestry & Wildlife
___Div. of State Parks
_X_ Commission on Water Resource Management
___Office of Conservation & Coastal Lands
_X_ Land Division – ODLO/HDLO/MDLO/KDLO
_X_ Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Early Consultation on Environmental Assessment for the state-wide release of the **flea bettle *Syphraea uberabensis*** for biological control of the **noxious weed *Tibouchina herbacea*** and related weeds
LOCATION: State-wide
APPLICANT: State Departments of Agriculture and Land and Natural Resources

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(✓) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed: Darlene Bryant-Takamatsu

Print Name: Darlene Bryant-Takamatsu
Date: 12/21/17

Attachments
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 20, 2017

MEMORANDUM

TO: **DLNR Agencies:**
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division
___Div. of Forestry & Wildlife
___Div. of State Parks
_X_ Commission on Water Resource Management
___Office of Conservation & Coastal Lands
_X_ Land Division – ODLO/HDLO/MDLO/KDLO
_X_ Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Early Consultation on Environmental Assessment for the state-wide release of the **flea bettle *Syphraea uberabensis*** for biological control of the **noxious weed *Tibouchina herbacea*** and related weeds
LOCATION: State-wide
APPLICANT: State Departments of Agriculture and Land and Natural Resources

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments by **January 10, 2018.**

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

(✓) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed: _____

Print Name: GORDON C. HEIT
Date: 1/4/18

Attachments
cc: Central Files

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honoluludpp.org • CITY WEB SITE: www.honolulu.gov

FILE
scanned

KIRK CALDWELL
MAYOR

KATHY K. SOKUGAWA
ACTING DIRECTOR

TIMOTHY F. T. HIU
DEPUTY DIRECTOR

2017/ELOG-2574 (mw)
1548785

January 10, 2018

Suzanne D. Case
Chairperson
Board of Land and Natural Resources
1151 Punchbowl Street, Room 130
Honolulu, Hawaii 96813
Attn: Robert Huff, Division of Forestry
and Wildlife

Dear Chairperson Case:

Thank you for your letter dated December 13, 2017, regarding "Early Consultation on Environmental Assessment for the state-wide release of the flea beetle...". We have reviewed the project and have the following comments:

1. The environmental assessment (EA) should fully explain how damaging the noxious weed cane tibouchina is, compared to other invasive species such as the water plant salvinia.

2. The EA should also fully disclose your findings and expectations on your ability to control the flea beetle population.

3. The EA should discuss both State and County policies on controlling invasive species. The General Plan of the City and County of Honolulu has two partially relevant policies under its Natural Environment chapter: "Protect plants, birds, and other animals that are unique to the State of Hawaii and the Island of Oahu", and "Seek the restoration of environmentally damaged areas and natural resources." (Objective A, Policies 8 and 2).

Should you have any questions, please contact Mike Watkins, of our staff, at 768-8044.

Very truly yours,

Eugene H. Takahashi
Acting Division Chief
Planning Division

EHT:bkg

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

LORRIN W. PANG, M.D., M.P.H.
DISTRICT HEALTH OFFICER

STATE OF HAWAII
DEPARTMENT OF HEALTH
MAUI DISTRICT HEALTH OFFICE
54 HIGH STREET
WAILUKU, HAWAII 96793-3378

January 11, 2018

Mr. Robert Hauff
State Protection Forester
Department of Land & Natural Resources
Division of Forestry & Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawaii 96813

Dear Mr. Hauff:

Subject: Early consultation on Environmental Assessment for the statewide release of the flea beetle Syphraea uberabensis for biological control of the noxious weed Tibouchina herbacea and related weeds.

Thank you for the opportunity to review this project. We have no comments to offer. Should you have any questions, please contact me at 808 984-8230 or email me at patricia.kitkowski@doh.hawaii.gov.

Sincerely,

Patti Kitkowski

Patti Kitkowski
District Environmental Health Program Chief

c EPO

Huang-Chi Kuo

From: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Sent: Friday, January 19, 2018 12:51 PM
To: Huang-Chi Kuo
Subject: FW: Syphraea uberabensis

From: Clifford Smith [mailto:cliff@hawaii.edu]
Sent: Thursday, January 11, 2018 1:01 PM
To: Hauff, Robert D <robert.d.hauff@hawaii.gov>
Cc: Joby <jobyrohrer@gmail.com>; Jane Beachy <beachy@hawaii.edu>; Smith, Paul F IV CIV USARMY IMCOM PACIFIC (US) <paul.f.smith133.civ@mail.mil>
Subject: Syphraea uberabensis

State-wide release of *Syphraea uberabensis* for biological control of *Tibouchina herbacea* and related species.

OANRP welcomes the preparation of an Environmental Assessment supporting the release of *Syphraea uberabensis* and would be willing to assist in monitoring the release and its impacts on *Pterolepis glomerata* in particular. UH's PCSU sponsored the earlier surveys for control agents against *Tibouchina herbacea* in Parana State, Brazil in the early 1990s as well as the life history studies by Dr. Charles Wikler at the University of Irati, Parana.

Tibouchina herbacea. The negative impacts of this species were documented on West Maui initially, which led to sponsorship of the biological investigations in Brazil. It was later found on East Maui and Hawaii. Though only an incipient infestation occurs in one valley in the Koolau range, it does not reach the stature that it attains on Maui and Hawaii. It is not a major weed needing control in Army lands at present though it could soon threaten the endangered *Gardenia mannii* habitat in Poamoho in the next few years. *Syphraea,* once established, should keep this species under control on Oahu.

Tibouchina longifolia. Essentially confined to the Big Island. However, some seedlings were found on a load of cinder from the Big Island used in our horticulture program at Schofield. Its potential to spread to the other islands is high.

Pterolepis glomerata. This species is widespread in the Koolau range. We are finding it increasingly in the Waianae range particularly along trails and fencelines. It is spreading

out from there. Its preference for disturbed areas means that it will likely spread significantly in years to come. It is considered more a nuisance and generally overgrown by shrubs and trees. Knocking it back and preventing further spread by *Syphraea* would be welcome as it appears to exacerbate pig damage by colonizing wallows.

Melastoma species. If the insect attacks any of the other established *Melastoma* species it will be welcomed by the conservation community as an important component of the fight against members of the family.

Cliff Smith

January 12, 2018

Mr. Robert Hauff, State Protection Forester
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawaii 96813

Dear Mr. Hauff:

SUBJECT: EARLY CONSULTATION COMMENTS IN PREPARATION OF A DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED STATEWIDE RELEASE OF THE FLEA BEETLE SYPHRAIA UBERABENSIS FOR BILOGICAL CONTROL OF THE NOXIOUS WEED TIBOUCHINA HERBACEA AND RELATED WEEDS ON ISLAND OF MAUI, MOLOKAI AND LANAI, HAWAII (RFC 2017/0124)

The County of Maui Department of Planning (Department) is in receipt of the above-referenced document for early consultation on an EA to consider the release of the Flea Beetle, *Syphraea Uberabensis*, to control the noxious weed, *Tibouchina Herbacea,* and related weeds throughout the State of Hawaii. The Department understands the proposed action includes the following:

> Co-proposing agencies, the Hawaii State Department of Agriculture (HDOA) and Hawaii State Department of Land and Natural Resources (DLNR), are planning the field release of the Flea Beetle, *Syphraea Uberabensis,* in the State of Hawaii in geographic areas where infestation of the noxious weed, *Tibouchina Herbacea,* and related weeds in the melastome family (*Pterolepis glomerata, Melastoma septemnervium*, *and M. sanguineeum)* occurs and are currently soliciting early consultation from Maui County regarding the project action's potential environmental impacts. Monitoring of *Syphraea Uberabensis* populations and the impact on *Tibouchina Herbacea* populations in selected release sites will also occur.

Based on the foregoing, the Department provides the following comments in preparation of the Draft EA:

1. The project area includes selected sites where infestation has occurred within the entire State of Hawaii. The Department has jurisdiction over actions affecting the islands of Maui County, which includes Maui, Lanai, Molokai, Kahoolawe, and Molokini islet. We will constrain our analysis to

these geographic boundaries but will exclude Kalawao County over which Maui County does not have jurisdiction. Maui County also does not have jurisdiction over the State Conservation District; however, we note that the proposed action is regional in nature and thus may affect areas that cross over from the State Conservation District into the State Agriculture, Rural, or Urban Land Use District boundaries.

As such, please define the geographic location(s) of the initial release and subsequent beetle releases and provide a digital copy of the boundaries of the release sites to our office. Please thoroughly discuss all phases of the project including the project's scope, scale, timing, and phases.

2. The Draft EA should include a discussion of how the proposed action will address the relevant sections of Section 11-200-17, HAR, and the regulatory and policy framework of the State Land Use Districts, Maui County General Plan, Title 19 of the Maui County Code (MCC), the Coastal Zone Management Act, and the Special Management Areas (SMA) of Maui County. The Draft EA should address:

   a. State Land Use Districts

      - Agriculture
      - Rural
      - Urban

   b. Countywide Policy Plan

      Please include a discussion on how the project will address the goals, objectives, policies and implementation actions of the Countywide Policy Plan.

   c. Maui Island Plan

      Please include a thorough discussion on how the project will address the goals, objectives, policies and implementation actions of the Maui Island Plan with particular attention given to:

      - Chapter 2, Heritage Resources (Section 2 through Section 5);
      - Chapter 4, Economic Development;
      - Chapter 6, Infrastructure and Public Facilities;
      - Chapter 7, Land Use;
      - Chapter 8, Directed Growth;
        The potential impacts to the Maui Island's Sensitive Lands (please see Table 8-2 on page 8-5) and the Protected Areas described within each community plan district; and

- Chapter 9, Monitoring and Evaluation
  Provide indicators such as those found in Table 9-2 on pages 9-5 to 9-8 of the Maui Island Plan that can be useful over time to assess the effect and success of the proposed action.

d. Community Plans

Please address how the project will implement the goals, objectives, policies and implementation actions of the Community Plans of Maui County. Please also discuss how the project conflicts with any goals, objectives, policies and implementation actions of the Community Plans and how the Applicant intends to resolve or mitigate the conflicts.

e. County Zoning

Please include a discussion on how the project will comply with Title 19 of the MCC.

f. SMA

Please include a discussion of the project's potential effects upon the Special Management Areas of each of Maui County's islands and the measures the Applicant will consider in mitigating any negative effects.

3. Please discuss the proposed strategy and methods for how the Flea Beetle, *Syphraea Uberabensis,* will effectively biologically control and/or eradicate the noxious weed, *Tibouchina Herbacea,* and related weeds.

4. Please provide relevant scientific research and technical studies that have been used to determine all potential, beneficial, and adverse impacts of the project and that your offices are relying upon to determine the viability of the project. Please discuss the rationale for proceeding with the project and the effect of not proceeding with the project. Please include a discussion of all potential adverse effects, particularly effects that are irreversible.

5. Please provide a discussion of all alternatives being considered that could attain the objectives of the action, regardless of cost, in sufficient detail to determine the basis for evaluating the best alternative to pursue. Please include a thorough alternative analysis and research that has been completed or relied upon to determine any and all potential unintended consequences, and a description of all irreversible and irretrievable commitments of resources. Please identify unavoidable impacts.

6. Please include a thorough discussion on the anticipated population growth of the Flea Beetle, *Syphraea Uberabensis*, and how population growth or unintended proliferation of the biocontrol will be managed.

7. Please include a thorough discussion of the impacts that the biocontrol will have biological resources, including animal and plant populations, including sensitive, rare, threatened, or endangered species, or their habitats.

8. Please include a thorough discussion of the predators of the Flea Beetle, *Syphraea Uberabensis*, and how the associated predatory populations will be affected and any related effects of these changes as a result of the introduction of the biocontrol.

9. Please include a thorough discussion of how the Flea Beetle may migrate into habitable areas of Maui County, and the extent to which the Flea Beetle may be a nuisance and can be controlled by residents and visitors.

10. Please discuss how the populations of the biocontrol will be managed by HDOA and DLNR. Please discuss measures that will be implemented to prevent any anticipated negative impacts.

Thank you for the opportunity to comment. Please include the Department on the distribution list of the Draft EA or Draft Environmental Impact Statement (EIS). Should you require further clarification, please contact Staff Planner Simone Bosco, by email at simone.bosco@mauicounty.gov or by phone at 808-270-5780.

Sincerely,

WILLIAM SPENCE
Planning Director

xc: Clayton Yoshida, AICP, Planning Program Administrator (PDF)
Jeff P. Dack, Current Planning Supervisor (PDF)
Simone Bosco, Staff Planner (PDF)
Robert Hauff, DLNR-Division of Forestry & Wildlife (PDF)
Project File

WRS:CIY:SB:lk
K:\WP_DOCS\PLANNING\RFC\2017\0124_FleaBeetleControl\Early Consultation Flea Beetle RFC_20170124scb.doc

DAVID Y. IGE
GOVERNOR
STATE OF HAWAII

SHAN S. TSUTSUI
LT. GOVERNOR
STATE OF HAWAII

JOBIE M. K. MASAGATANI
CHAIRMAN
HAWAIIAN HOMES COMMISSION

WILLIAM J. AILA, JR.
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

January 19, 2018

Robert Hauff, State Protection Forester
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street, Rm. 325
Honolulu, Hawaii 96813

Dear Mr. Hauff:

Subject: Early Consultation on Environmental Assessment for the state-wide release of the flea beetle *Syphraea uberabensis* for biological control of the noxious weed *Tibouchina herbacea* and related weeds

Mahalo for the notice and opportunity for early consultation on this matter.

Tibouchina herbacea and other invasive plants in the Melastome family are rapidly invading native ecosystems and replacing native flora across Hawaii. Melastomes tend to have shallow root systems that do not adequately prevent erosion and soil loss which has a negative effect on water quality in Hawaiian streams and rivers. Member of this plant family are difficult to control because of their prolific, precocious seed production and ease of dispersal.

A biological control agent has the potential to be a cost effective, long term solution for invasive plant control that reduces reliance on chemical herbicides as well as mechanical and manual control methods. To be effective and safe to use, adequate studies must confirm that 1.) the biological control agent effectively controls the target specie(s), and 2.) The biological control agent will not inadvertently spread to and negatively affect non-target species such as indigenous or endemic Hawaiian plants and important agricultural crops.

We look forward to reviewing the Draft Environmental Assessment for this biological control release and commend the

Hawaii State Department of Agriculture (HDOA) and the Department of Land and Natural Resources (DLNR) for being proactive in investigating solutions to the continued spread of invasive plant species. If the proposed biological control agent is found to be effective and safe to use, it will benefit many land owners and resource managers including the Department of Hawaiian Homes Lands and improve the health and resilience of our native forests, streams and nearshore waters.

If you have any questions, please contact Kualii Camara, at 808.933.3480 or via email at joseph.k.camara@hawaii.gov.

Aloha,

Jobie M. K. Masagatani
Chairman
Hawaiian Homes Commission

APPENDIX B: CULTURAL IMPACT ASSESSMENT FOR THE PROPOSED STATEWIDE RELEASE OF A BEETLE (*SYPHRAEA UBERABENSIS*) AS BIOCONTROL FOR *TIBOUCHINA HERBACEA* (MELASTOMATACEAE) AND RELATED WEEDS

A Cultural Impact Assessment for the Proposed Statewide Release of a Beetle (*Syphraea uberabensis*) as Biocontrol for *Tibouchina herbacea* (Melastomataceae)& Related Weeds

FINAL

State of Hawai‘i

Photo courtesy of Forest and Kim Starr

Prepared By:
Lokelani Brandt, M.A.

Prepared For:

Department of Land and Natural Resources, Division of Forestry and Wildlife
1151 Punchbowl Street, #325
Honolulu, HI 96813

October 2019

ASM affiliates
Archaeology • History • Anthropology • Architectural History
Hilo Office: (808) 969-6066 Fax: (808) 443-0065
507-A E. Lanikaula Street, Hilo, HI 96720
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ASM Project Number 31270.00

A Cultural Impact Assessment for the Proposed Statewide Release of a Beetle (*Syphraea uberabensis*) as Biocontrol for *Tibouchina herbacea* (Melastomataceae)

State of Hawai‘i

ASM affiliates

CHAPTERS

Page

FIGURES

Page

TABLE

APPENDIX

Page

1. INTRODUCTION

At the request of the Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) and Hawai‘i Department of Agriculture (HDOA), referred to hereafter as the State of Hawai‘i, ASM Affiliates (ASM) has prepared this Cultural Impact Assessment (CIA) for the proposed statewide release of a small beetle (*Syphraea uberabensis*) native to South America as a biocontrol agent targeting cane tibouchina (*Tibouchina herbacea*) as well as other weedy Melastomes (Melastomataceae) including *T. longifolia, Pterolepis glomerata*, *Melastoma sanguineum*, and *M. septemnervium*. Native to portions of South America, *T. herbacea* was first discovered on Saddle Road on Hawai‘i Island in 1977. Since then it has spread to Maui, Moloka‘i, Lāna‘i, and O‘ahu. In 1992, under Hawai‘i Administrative Rules, Chapter 68, *T. herbacea* along with other highly invasive species of the Melastome (Melastomataceae) family were officially listed as a noxious weed in the State of Hawai‘i and since then efforts to limit its spread have been undertaken (Medeiros et al. 1997). In the State of Hawai‘i the term “invasive species” is any “alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health” (Invasive Species Advisory Committee 2006:1). To control the spread of *T. herbacea*, the State of Hawai‘i is proposing to release a natural enemy, a small beetle (*S. uberabensis*).

The current CIA is intended to supplement an Environmental Assessment (EA) conducted in compliance with Hawai‘i Revised Statutes (HRS) Chapter 343. This CIA was prepared in adherence with the Office of Environmental Quality Control (OEQC) *Guidelines for Assessing Cultural Impact*, adopted by the Environmental Council, State of Hawai‘i, on November 19, 1997. As stated in Act 50, which was proposed and passed as Hawai‘i State House of Representatives Bill No. 2895 and signed into law by the Governor on April 26, 2000, “environmental assessments . . . should identify and address effects on Hawaii’s culture, and traditional and customary rights . . . native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the ‘aloha spirit’ in Hawai‘i. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on governmental agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.”

The primary focus of this report is on understanding the cultural and historical context of *T. herbacea* with respect to Hawai‘i’s host culture. This CIA is divided into four main sections, beginning with an introduction of the proposed action followed by a physical description of *T. herbacea* and the proposed biocontrol agent *S. uberabensis*. Section two of this report provides a cultural-historical context of the settlement of the Hawaiian Islands by early Polynesian settlers and the transformation of their beliefs and practices associated with the land following Western contact. An overview of the history of biocontrol in Hawai‘i is also provided, and this section concludes with a detailed discussion of the introduction of *T. herbacea* into the Hawaiian Islands; all of which combine to provide a geographical and cultural context in which to assess the proposed action. The results from the consultation process are then presented, along with a discussion of potential impacts as well as appropriate actions and strategies to mitigate any such impacts.

PROPOSED ACTION

DOFAW has been working cooperatively with HDOA and the United States Forest Service (USFS) to control the harmful impacts of certain widespread invasive plant or pest species through the use of biological control (also referred to as biocontrol). Biocontrol is the strategy of using an invasive species' natural enemies from its native range to reduce the impacts of the invasive species. Biocontrol projects typically require years of research and survey work to find potential candidates that are subjected to a host of tests. Only those candidates that are host-specific, meaning they can only complete their life cycle on their intended invasive species host and shown to only negatively impact the growth and abundance of the target invasive species are considered for release. Once testing has been successfully completed, agencies must comply with national and state regulatory requirements for the release of the biocontrol agent. As such, the proposed action involves the use of state lands and funds, which necessitates compliance with Hawai'i Revised Statutes (HRS) Chapter 343, also known as the Hawai'i Environmental Policy Act (HEPA). The proposing agencies are conducting an Environmental Assessment (EA) of the proposed action to evaluate potential environmental impacts and this CIA is an essential component of the EA to ensure compliance with HRS Chapter 343.

TIBOUCHINA HERBACEA AND THE PROPOSED BIOLOGICAL CONTROL AGENT

Native to the tropical and subtropical regions of South America, *T. herbacea* and other weedy Melastomes thrive in wet to mesic forests, wetlands, wet pastures, and disturbed areas (Figures 1 and 2). In its native range, *T. herbacea* is variable and typically grows to a height of 1.5 meters, however, in Hawai'i, *T. herbacea* can reach heights of four meters and flowers after a year of being established (Almasi 2000). *T. herbacea* produces viable seeds which are spread by avian populations and rodents and is known to "reproduce vegetatively by growing roots along its leaf nodes, or by producing new shoots from rhizomes" (ibid.:220). It is also known to grow epiphytically on tree ferns (CABI 2018). The young branches of *T. herbacea* are square-shaped and typically covered with gland-tipped hairs, which can be a skin irritant (Figure 3). The leaves are oval-shaped and measure 3.0-7.5 centimeters long and 1.3-3.5 centimeters wide and contain 5-7 parallel veins (see Figure 3). The inflorescences extend from 10-20 centimeters long with fruiting capsules that measure 4-5 millimeters long and 3.5-5 millimeters wide (Figure 4) (CABI 2018). A distinguishing feature of this species is its purple-pink four-petaled flower with large yellow anthers that emerge from the flower's center (ibid.) (Figure 5). While the other species of Melastomes (i.e. *T. longifolia, Pterolepis glomerata*, *Melastoma sanguineum*, and *M. septemnervium*; Figures 7, 8, and 9) share similar attributes with *T. herbacea*, particularly the leaf veination, they differ in growth with the latter two typically forming bush like thickets.

T. herbacea is one of several species of the Neotropical Melastome family that "are among the most aggressive invaders of the Hawaiian and other Pacific islands" (Baruch et al. 2000:107). This shrub germinates easily in the shade and can quickly establish significant populations in forests with an intact canopy (CABI 2018). Although this plant dies back annually, new sprouts will emerge from the old roots which can create thickets that evenrually consume habitat for native species (Figure 6) (Strohecker 2018). *T. herbacea* as with other species of the Melastome family are known to clog waterways and infest wet forests and upland pastures (ibid.). The reproductive vigor, small seed size, dispersion capacity, and lack of natural predators have contributed to the rapid spread of this highly invasive plant in Hawai'i (Baruch et al. 2000; Wikler and Souza 2008). In 1992, under HRS Chapter 68, *T. herbacea*, along with other highly invasive species of the Melastome family, was officially listed as a noxious weed in the State of Hawai'i (Medeiros et al. 1997). Since 1998, a biological research program to combat *T. herbacea* has developed in southern Brazil, which has led to the identification and evaluation of potential biocontrol agents. Among the identified biocontrol agents for *T. herbacea* was a flea beetle, *Syphraea uberabensis*, native to South America. The adults and larvae of *S. uberabensis* were observed feeding externally on foliage and soft stems of certain *Tibouchina spp.* in Brazil, in some cases causing enough damage to kill small plants. Wikler and Souza describe the characteristics of *S. uberabensis* as:

> …oval, compact, small black or blue-black flea beetles…[that] are 3-4mm in length and have a dark blue color. The antennas have robust articles from the base to the apex compared with the anterior tibia; the elytra have simple and very fine punctuations. (Wikler and Souza 2008:340)

On July 15, 2005, specimens of *S. uberabensis* were exported from Brazil and received at the Volcano quarantine facility, where a colony was maintained and studied by Steven Souder (Johnson 2006). *S. uberabensis* has been evaluated in containment facilities in Hawai'i as a potential biological control agent for *T. herbacea*. Tests have been conducted on a variety of native and non-native plants to identify the beetle's potential host range. Results from these studies indicate that the host range is limited to *T. herbacea* and other closely related weeds within the Melastome family, and . *S. uberabensis* does not have the capacity to impact native or economically important plants in Hawai'i.

Figure 1. Growth of *T. herbacea* at the end of the Waiheʻe Ridge Trail, Maui Island. Photo courtesy of Forest and Kim Starr.

Figure 2. *T. herbacea* growing through a thicket of *uluhe* (*Dicranopteris linearis*) along the Waiheʻe Ridge Trail, Maui Island. Photo courtesy of Forest and Kim Starr.

Figure 3. Close up of leaves and stem of *T. herbacea* in Kahikinui, Maui Island covered in fine gland-tipped hairs. Photo courtesy of Forest and Kim Starr.

Figure 4. Flowers and seed pods of *T. herbacea* found in West Maui. Photo courtesy of Forest and Kim Starr.

Figure 5. Close up of *T. herbacea* flower with large yellow anthers. Photo courtesy of Forest and Kim Starr.

Figure 6. New growth of *T. herbacea* at Kapunakea Preserve in West Maui emerging from former roots. Photo courtesy of Forest and Kim Starr.

Figure 7. *Tibouchina longifolia*. Photo courtesy of Forest and Kim Starr.

Figure 8. *Melastoma sanguineum*. Photo courtesy of Forest and Kim Starr.

Figure 9. *Melastoma septemnervium*. Photo courtesy of Forest and Kim Starr.

2. BACKGROUND

The following section contains a cultural-historical context of the settlement of the Hawaiian Islands by early Polynesian settlers and the transformation of their beliefs and practices associated with the land following Western contact. An overview of the history of biocontrol in Hawai‘i is also provided and this section concludes with a detailed discussion of the introduction of *T. herbacea* to the Hawaiian Islands and its impacts to Hawai‘i’s wet forests.

GEOGRAPHICAL AND CULTURAL CONTEXT OF HAWAI‘I

The Hawaiian Islands are located within the vast and remote Pacific Ocean, situated more than 3,200 kilometers (2,000 miles) from the nearest continent (Juvik and Juvik 1998). The 16,640 square kilometers (6,425 square miles) of land consists of eight main large volcanic islands, Hawai‘i, Maui, Kaho‘olawe, Lāna‘i, Moloka‘i, O‘ahu, Kaua‘i, and Ni‘ihau and 124 smaller islands, reefs, and shoals (ibid.) (Figures 10 and 11). Due to its geographical placement in the middle of the vast Pacific Ocean, coupled with its diverse climatic conditions, the Hawaiian Islands boasts the highest levels of endemism in both native plants and animals, with over 10,000 species found nowhere else in the world (Cannarella 2010).

While the question of the timing of the first settlement of Hawai‘i by Polynesians remains unanswered, several theories have been offered that derive from various sources of information (i.e., archaeological, genealogical, mythological, oral-historical, radiometric). However, none of these theories are today universally accepted. What is more widely accepted is the answer to the question of where Hawaiian populations came from and the transformations they went through on their way to establish a uniquely Hawaiian culture. More recently, with advances in palynology and radiocarbon dating techniques, Kirch (2011) and others (Athens et al. 2014; Wilmshurst et al. 2011) have convincingly argued that Polynesians arrived in the Hawaiian Islands, sometime between A.D. 1000 and A.D. 1200 and expanded rapidly thereafter (c.f., Kirch 2011). The initial migration to Hawai‘i is believed to have occurred from Kahiki (the ancestral homelands of Hawaiian gods and people) with long distance voyages occurring fairly regularly through at least the 13th century. It has been generally reported that the sources of the early Hawaiian populations originated from the southern Marquesas Islands (Emory in Tatar 1982). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence-level agriculture and fishing (Handy and Handy 1991). This was a period of

great exploitation and environmental modification when early Hawaiian farmers developed new subsistence strategies by adapting their familiar patterns and traditional tools to their new environment (Kirch 1985; Pogue 1978). According to Fornander (1969), the Hawaiians brought from their homeland certain Polynesian customs and belief: the major gods Kāne, Kū, Lono, and Kanaloa; the *kapu* system of law and order; the *pu'uhonua* (places of refuge), the *'aumakua* concept, and the concept of *mana*.

For generations following initial settlement, communities were clustered along the watered, windward (*Ko'olau*) shores of the Hawaiian Islands. Along the *ko'olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko'olau* region also offered sheltered bays from which deep-sea fisheries could be easily accessed, and nearshore fisheries, enriched by nutrients carried in the fresh water, could be maintained in fishponds and coastal waters. It was around these bays that clusters of houses where families lived could be found (McEldowney 1979). In these early times, Hawai'i's inhabitants were primarily engaged in subsistence-level agriculture and fishing (Handy and Handy 1972). Following the initial settlement period, areas with the richest natural resources became populated and perhaps crowded, and by about A.D. 1200, the population began expanding to the Kona (leeward side) and more remote regions of the island (Cordy 2000).

As the population continued to expand so did social stratification, which was accompanied by major socioeconomic changes and intensive land modification. Most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. During this expansion period, additional migrations to Hawai'i occurred from Tahiti in the Society Islands. Rosendahl (1972) has proposed that settlement at this time was related to the seasonal, recurrent occupation in which coastal sites were occupied in the summer to exploit marine resources, and upland sites were occupied during the winter months, with a focus on agriculture. An increasing reliance on agricultural products may have caused a shift in social networks as well; as Hommon (1976) argues, kinship links between coastal settlements disintegrated as those links within the *mauka-makai* settlements expanded to accommodate the exchange of agricultural products for marine resources. This shift is believed to have resulted in the establishment of the *ahupua'a* system sometime during the A.D. 1400s (Kirch 1985), which added another component to an already well-stratified society. The implications of this model include a shift in residential patterns from seasonal, temporary occupation, to the permanent dispersed occupation of both coastal and upland areas.

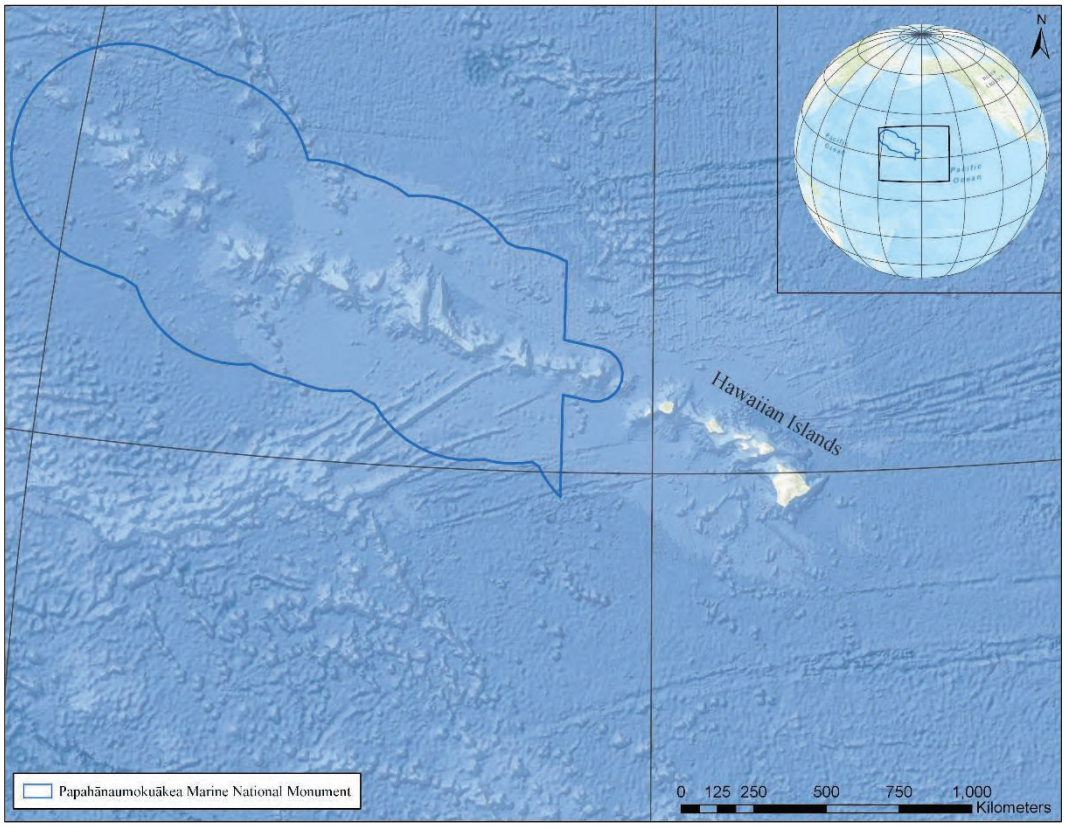

Figure 10. Map of the Hawaiian archipelago.

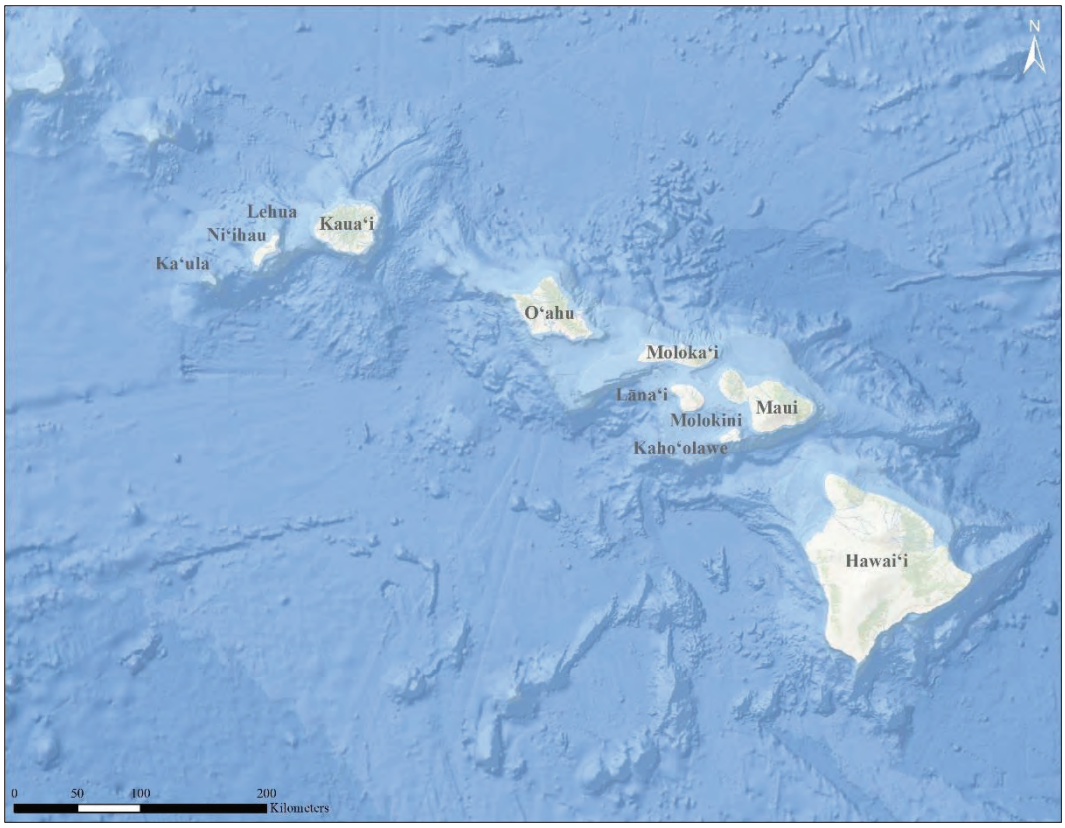

Figure 11. Map of the main Hawaiian Islands.

Adding to an already highly-complex society was the development of the traditional land division system, which included the *ahupua'a*—the principle land division that functioned for both taxation purposes and furnished its residents with nearly all of the fundamental necessities. *Ahupua'a* are land divisions that typically incorporated all of the eco-zones from the mountains to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1986). Although the *ahupua'a* land division typically incorporated all of the eco-zones, their size and shape varied greatly (Cannelora 1974). The *hoa'āina* (native tenants) and *'ohana* (families) who lived on the land had rights to the gather resources for subsistence and for tribute (Jokiel et al. 2011). As part of these rights, the *ahupua'a* residents were also required to supply resources and labor that supported the royal community of regional and/or island kingdoms. The *ahupua'a* became the equivalent of a local community, with its own social, economic, and political significance and served as the taxable land division during the annual *Makahiki* procession (Kelly 1956). During this annual procession, the highest chief of the land sent select members of his retinue to collect *ho'okupu* (tribute and offerings) in the form of goods from each *ahupua'a*. The *hoa'āina* (native tenants) who resided in the *ahupua'a* brought their share of *ho'okupu* to an *ahu* (altar) that was symbolically marked with the image of a *pua'a* (pig). *Ahupua'a* were ruled by *ali'i 'ai ahupua'a* or chiefs who controlled the *ahupua'a* resources; who, for the most part, had complete autonomy over this generally economically self-supporting piece of land (Malo 1951). *Ahupua'a* residents were not bound to the land nor were they considered the property of the *ali'i*. If the living conditions under a particular *ahupua'a* chief were deemed unsuitable, the residents could move freely in pursuit of more favorable conditions (Lam 1985). This structure safeguarded the well-being of the people and the overall productivity of the land, lest the chief loses the principle support and loyalty of his or her supporters. *Ahupua'a* lands were in turn, managed by an appointed *konohiki* or lesser chief-landlord, who oversaw and coordinated stewardship of an area's natural resources (ibid.). In some places, the *po'o lawai'a* (head fisherman) held the same responsibilities as the *konohiki* (Jokiel et al. 2011). When necessary, the *konohiki* took the liberty of implementing *kapu* (restrictions and prohibitions) to protect the *mana* of the area's resources from physical and spiritual depletion.

Many *ahupua'a* were further divided into smaller land units termed *'ili* and *'ili kūpono* (often shortened to *'ili kū*). *'Ili* were created for the convenience of the *ahupua'a* chief and served as the basic land unit to which the *hoa'āina*, retained for often long periods of time (Jokiel et al. 2011; MacKenzie 2015). As the *'ili* themselves were typically passed down in families, so too were the *kuleana* (responsibilities, privileges) that were associated with it. The right

to use and cultivate *ʻili* was maintained within the *ʻohana*, regardless of any change in title of the *ahupuaʻa* chief (Handy and Handy 1991). Malo (1951), recorded several types of *ʻili*: the *ʻili paʻa,* a single intact parcel and the *ʻili lele*, a discontinuous parcel dispersed across an area. Whether dispersed or wholly intact, the *ʻili* land division required a cross section of available resources, and for the *hoaʻāina*, this generally included access to agriculturally fertile lands and coastal fisheries. While much of the same resource principles applied to the *ʻili kūpono*, these land units were politically independent of the *ahupuaʻa* chief. This designation was applied to specific areas containing resources that were highly valued by the ruling chiefs, such as fishponds (Handy and Handy 1991).

The *aliʻi* who presided over the *ahupuaʻa* (*aliʻi-ʻai-ahupuaʻa*), in turn, answered to an *aliʻi ʻai moku* (chief who claimed the abundance of the entire *moku or* district) (Malo 1951). Although *moku* (districts) were comprised of multiple *ahupuaʻa*, they were considered geographical subdivisions with no explicit reference to rights in the land (Cannelora 1974). This form of district subdividing was integral to Hawaiian life and was the product of resource management planning that was strictly adhered to. As knowledge of place developed over the centuries and passed down intergenerationally by direct teaching and experience, detailed information of an area's natural cycles and resources were retained and well-understood. Decisions were based on generations worth of highly informed knowledge and sustainably adapted to meet the needs of a growing population. This highly-complex land management system mirrors the unique Hawaiian culture that coevolved with these islands.

Evolution of Hawaiian Land Stewardship Practices and the Impacts on Hawaiʻi's Native Forests

Ancient and ingrained philosophy of life tied Hawaiians to their environment and helped to maintain both natural, spiritual, and social order. In describing the intimate relationship that exists between Hawaiians and *ʻāina* (land), Hawaiian historian and cultural specialist, Kepā Maly writes:

> In the Hawaiian context, these values—the "sense of place"—have developed over hundreds of generations of evolving "cultural attachment" to the natural, physical, and spiritual environments. In any culturally sensitive discussion on land use in Hawaiʻi, one must understand that Hawaiian culture evolved in close partnership with its' natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture and nature begins.
>
> In a traditional Hawaiian context, nature and culture are one in the same, there is no division between the two. The wealth and limitations of the land and ocean resources gave birth to, and shaped the Hawaiian world view. The *ʻāina* (land), *wai* (water), *kai* (ocean), and *lewa* (sky) were the foundation of life and the source of the spiritual relationship between people and their environs. (Maly 2001:1)

The Hawaiian *ʻōlelo noʻeau* (proverbial saying) "*Hānau ka ʻāina, hānau ke aliʻi, hānau ke kanaka*" (Born was the land, born were the chiefs, born were the commoners), conveys the belief that all things of the land including *kanaka* (humans) were literally born (*hānau*), and are thus connected through kinship links that extend beyond the immediate family (Pukui 1983:57). *ʻĀina* or land, was perhaps most revered, as another *ʻōlelo noʻeau* notes, "*He aliʻi ka ʻāina; he kauwā ke kanaka,*" which has been translated by Pukui (1983:62) as "The land is a chief; man is its servant." The lifeways of early Hawaiians, which were derived entirely from the finite natural resources of these islands, necessitated the development of sustainable resource management practices. Over time, what developed was an adaptable management system that integrated the watershed, freshwater, nearshore fisheries, all of which are connected through the many unique ecosystems that extend from the mountains to the sea (Jokiel et al. 2011).

Kilo or astute observation of the natural world became one of the most fundamental stewardship tools used by the ancient Hawaiians. The vast knowledge acquired through the practice of *kilo* enabled them to observe and record the subtlest changes, distinctions, and correlations in their natural world. Examples of their keen observations are evident in Hawaiian nomenclature, where numerous types of rains, clouds, winds, stones, environments, flora, and fauna, many of which are geographically unique, have been named and recorded in centuries-old traditions such as *oli* (chants), *mele* (songs), *pule* (prayers), *inoa ʻāina* (place names), *ʻōlelo noʻeau* (proverbial sayings), all of which were transmitted orally through the ages. Other traditional Hawaiian arts and practices including, (but not limited to) *hula* (traditional dance), *lapaʻau* (traditional healing), *lawaiʻa* (fishing), *mahiʻai* (farming) further reinforced knowledge of and connection to the natural environment.

Their exclusive dependency on a thriving natural environment led Hawaiians to develop a sophisticated and comprehensive system of land stewardship that was reinforced through the strict adherence to practices that maintained and enhanced the *kapu* and *mana* of all things in the Hawaiian world. In Hawaiian belief, all things natural, places, and even people, especially those of high rank, possesses a certain degree of *mana* or "divine power" (Pukui et al. 1972; Pukui and Elbert 1986:235). *Mana* is believed to be derived from the plethora of Hawaiian gods (*kini akua*) who were embodied in elemental forces and natural resources, such as the land, mountains, plants, animals, water and certain material objects and persons (Crabbe et al. 2017). Buck (1993) expanded on this concept noting that *mana* was

associated with "the well-being of a community, in human knowledge and skills (canoe building, harvesting) and in nature (crop fertility, weather, etc.)" (in Else 2004:244). Hawaiian cultural practitioner and conservation biologist, Sam Gon III adds that this belief "imposes familial responsibilities on people, and engenders respect and care for native plants and animals" (Gon III 2010:1–2)

To ensure the *mana* of the resources, certain places, and people remained protected from over-exploitation and defilement, *kapu* of various kinds were implemented and strictly enforced. According to Elbert and Pukui (1986:132) *kapu* are defined as "taboo, prohibitions; special privilege or exemption..." Kepelino (1932) notes that *kapu* associated with the gods applied to all social classes, while the *kapu* associated with the chiefs were applied to the people. As the laws of *kapu* dictated social relationships, it also provided "environmental rules and controls that were essential for a subsistence economy" (Else 2004:246). Juxtaposed to the concept of *kapu* was *noa*, translated as "freed of taboo, released from restrictions, profane, freedom" (Pukui and Elbert 1986:268). Some *kapu*, particularly those associated with maintaining social hierarchy and gender differentiation were unremitting, while those *kapu* placed on natural resources were applied and enforced according to seasonal changes. The application of *kapu* to natural resources ensured that such were resources remained unspoiled and available for future use. When the *ali'i* or the lesser chiefs (including *konohiki* and *po'o lawai'a*) determined that a particular resource was to be made available to the people, a decree was proclaimed indicating that *kapu* had been lifted, thereby making it *noa*. Although transitioning a resource from a state of *kapu* to *noa* allowed for its use, people were still expected to practice sustainable harvesting methods and pay tribute to the ruling chief and the gods and goddesses associated with that resource. *Kapu* were strictly enforced and violators faced serious consequences including death (Jokiel et al. 2011). Violators who managed to escape death sought refuge at a *pu'uhonua*, a designated place of refuge or sometimes were freed by the word of certain chiefs (Kamakau 1992). After completing the proper rituals, the violator was absolved of his or her crime and allowed to reintegrate back into society.

This ancient and ingrained way of life underwent serious transformations following the arrival of Captain James Cook in 1778. This year marks the end of what is often referred to as Hawai'i's Precontact Period and the beginning of the Historic Period. While this time mark signifies an important date in Hawaiian history, it is vital to note that throughout the early Historic Period, even with Western influences, the Hawaiian chiefs still held outright rule over the land and its resources and maintained strict adherence to the *kapu* system—the very system from which their power was derived. For many Hawaiian historians, the abrogation of the *kapu* system in 1819, also marked significant socio-religious changes. Some scholars have argued that the abolishment of the *kapu* system undermined the very foundation upon which traditional Hawaiian society was built, ultimately altering the relationship between the chiefs and the people as well as their relationship to the land (Else 2004; Kame'eleihiwa 1992). At the outset of the Historic Period, there was a continued trend toward craft and status specialization, intensification of agriculture, *ali'i* controlled aquaculture, the establishment of upland residential sites, and the enhancement of traditional oral history. The veneration of traditional gods and the strict observation of the *kapu* system were at their peaks (Kent 1983; Kirch 1985). With the influx of foreigners, many of whom were quick to introduce the idea of trade for profit, Hawai'i's traditional culture, and the socio-political economy began to shift to meet the growing demands of the foreign populations.

The Arrival of Foreign Plants and Animals and the Transformation of the *Kapu* System

By the time Kamehameha had conquered O'ahu, Maui, and Moloka'i, in 1795, Hawai'i saw the beginnings of a market system economy and the work of the native tenants shifted from subsistence agriculture to the production of foods and goods that could be traded with early explorers and whalers (Kent 1983). Introduced fruit trees and garden vegetables, often grown for trade with Westerners included yams, coffee, melons, Irish potatoes, Indian corn, beans, figs, oranges, guavas, and grapes (Wilkes 1845). Animals such as goats, sheep, pigs, cattle, horses, and turkeys that were left by Cook and other early visitors between 1778 and 1803 were allowed to roam freely (Kuykendall 1938). Of all the foreign introductions, cattle had the most profound impact. Setting the foundations of Hawai'i's livestock industry, in 1793, Captain George Vancouver, who had visited the islands during Cook's 1778 voyage, gifted the first cattle to Kamehameha. The lack of quality cattle feed proved to be detrimental to the animals. To combat this, Kamehameha, at the demand of Captain George Vancouver, enforced a *kapu*, which lasted until the 1830s that prohibited the killing of the animals (Bergin 2004; Kuykendall 1938). The first head of steer and sheep that were gifted by Vancouver were driven into the upland plains of Waimea on Hawai'i Island and allowed to roam and multiply (Barrera 1983). The unrestrained populations of cattle had increased significantly and by the 1830s had become a nuisance to native farmers. Additionally, the environmental degradation of the native forests had become apparent to Kamehameha's sons and heirs who began to take steps to control the ravenous cattle population. In an effort to protect their crops, and to reduce the risk of encountering the large and often dangerous animals, native farmers began constructing taller enclosures to prevent the animals from plundering their gardens and destroying their homes. On Hawai'i Island, where

cattle populations are said to have numbered in the tens of thousands, tall rock walls that stretched for miles were built around the more densely populated areas (Bergin 2004). While the introduced plants and animals contributed to the development of Hawai‘i’s early market economy, the exportation of native hardwoods, particularly *‘iliahi* or sandalwood compounded the preexisting environmental degradation and wreaked havoc on the native lifeways.

The *‘iliahi* or sandalwood (*Santalum ellipticum*) trade established by Euro-Americans in 1790 quickly turned into a viable commercial enterprise (Oliver 1961). By 1810, and with the backing of Kamehameha and other chiefs, this industry flourished, as farmers and fishermen were ordered into the mountains of their district to cut sandalwood and carry it to the coast. Although the laborers were compensated with *kapa* (material), food and fish (Kamakau 1992), the neglect of their personal subsistent duties lead to food shortages and famine. The harsh working conditions coupled with lack of nutrition severely degraded the health and *mana* of the native people, ultimately contributing to a population decline. This industry also began to erode the relationship between the *ali‘i* and the common people (Else 2004). Kamakau (ibid.:204) described the collapse of a traditional subsistence system and the industry’s detrimental effects on the people: “…this rush of labor to the mountains brought about a scarcity of cultivated food . . . The people were forced to eat herbs and tree ferns, thus the famine [was] called Hi-laulele, Haha-pilau, Laulele, Pualele, ‘Ama‘u, or Hapu‘u, from the wild plants resorted to.” Once Kamehameha realized the dire effects this industry on his people, he “declared all the sandalwood the property of the government and ordered the people to devote only part of their time to its cutting and return to the cultivation of the land” (ibid.: 1992:204). Kamehameha also proclaimed sustainable harvesting strategies as noted by Kamakau, who wrote, “He ordered the sandalwood cutters to spare the young trees and, not to let the felled trees fall on the saplings” (ibid.:209-210).

On May 8th, 1819, Kamehameha, who had seen the onset of impacts brought about by foreign introductions, died at his royal residence at Kamakahonu in Kailua-Kona and named his son ‘Iolani Liholiho heir to his kingdom (Kamakau 1992). By May 21st ‘Iolani Liholiho (Kamehameha II) at the age of twenty-one began his rule. As traditional custom dictated and to allow for all people to rightfully mourn the loss of their chief, all *kapu* were relaxed following the death of a chief (ibid.). It was the responsibility of the new ruler to conduct the proper rituals and ceremonies to reinstate all *kapu.* However, Liholiho’s attempts to reinstate the long-standing *kapu* system was futile and the future of the *kapu* system stood in a state of uncertainty. *Kuhina Nui* (Premier), Ka‘ahumanu (the wife of Kamehameha and the *hānai* (adopted) mother of Liholiho) and his biological mother Keōpūolani lured the young chief back to Kona and the *kapu* system was symbolically abolished when Liholiho ate in the presence of his mothers. While Liholiho, his mothers and other chiefs favored the complete abolishment of the *kapu* system, others including Kekuaokalani and his followers prepared to wage war, determined to have the ancient laws reinstated. After several failed attempts at negotiation, Liloliho’s army led by Kalaimoku went head-to-head against the forces of Kekuaokalani in the Battle of Kuamo‘o (Fornander 1918–1919). Western weaponry had already permeated traditional Hawaiian warfare and Kekuaokalani, who stood behind the ancient laws of the land was killed by gunfire on the battlefield alongside his wife Manono, thereby extinguishing the last public display of resistance. The abolishment of the *kapu* system in 1819, began to undermine the very foundations upon which traditional Hawaiian culture was formed. Adding to an already socio-politically fractured society was the arrival of Protestant missionaries who sought to fill the spiritual void of the Hawaiian people.

In October of 1819, just five months after the death of Kamehameha, the first American Protestant missionaries aboard the Brig. *Thaddeus* left Boston, Massachusetts and by March 30th, 1820, sailed to Kawaihae on the northwest coast of Hawai‘i Island (Hawaiian Mission Children’s Society 1901). Having heard of the overturning of the ancient *kapu* system, these early missionaries formed close alliances with some of Hawai‘i’s royalty, including Ka‘ahumanu who held a tremendous amount of political power. Starting in 1823, these early missionaries, one of which included William Ellis (1917) set out into the remote parts of the islands in search of suitable locations for future mission stations and within a few short years, mission stations were being constructed outside of the main town centers. Christian beliefs quickly spread and soon established a firm foothold in the islands. The missionaries quickly discovered that many Hawaiians were selective about what aspects of Christianity they were willing to adopt. In striving for complete conversion, the missionaries with the help of the *ali‘i* implemented laws that enforced Euro-American beliefs on the Hawaiian people. To an extent, this furthered the efforts of the missionaries. Despite these massive cultural changes, many Hawaiians continued to hold to their ancient beliefs, especially those associated with their relationship to the land. Throughout the remainder of the 19th century, introduced diseases and global economic forces continued to degrade the traditional life-ways of the Hawaiian people.

Private Property and Its Effects on Traditional Concepts of Land and Land Use Practices

By the mid-19th century, the ever-growing population of Westerners in the Hawaiian Islands forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership. By 1840, the first Hawaiian constitution had been drafted and the Hawaiian Kingdom shifted from an absolute monarchy into a

constitutional government. Convinced that the feudal system of land tenure previously practiced was not compatible with a constitutional government, the *Mōʻī* Kauikeaouli and his high-ranking chiefs decided to separate and define the ownership of all lands in the Kingdom (King n.d.). The change in land tenure was further endorsed by missionaries and Western businessmen in the islands who were generally hesitant to enter business deals on leasehold lands that could be revoked from them at any time. The push for exclusive private property rights culminated in the *Māhele ʻĀina* of 1848 and the subsequent *Kuleana* Act or Enabling Act of 1850.

While the formalization of private property rights was a success for many Westerners, this ultimately led to the displacement of many Hawaiians from their ancestral lands—lands that they had come to know so intimately. In general, although many Hawaiians were awarded lands during this period, it was realized that the parcels they were awarded were insufficient to sustain their traditional subsistence lifestyles. Additionally, access to resources that were once a part of the now fragmented *ahupuaʻa* system further curtailed traditional subsistence activities. As many Hawaiian continued to migrate to the populated centers around the islands and even elsewhere, large tracts of land that were once dotted with small communities and extensive traditional agricultural fields were being prospected for large scale commercial agriculture and ranching. Although these industries added to the cultural tapestry of the islands, such operations required vast amounts of land and water. The mass acquisition of land and the diversion of water from their natural courses during the 19th and 20th centuries resulted in numerous court battles between Western businessmen competing to increase their operations and native Hawaiians who willfully held to their traditional lifeways. Such issues continue to be vetted in Hawaiʻi courtrooms.

Formerly forested lands were being grazed down and, in some places, planted with introduced species of grass and various shrubs to form natural fencing and to be used as livestock feed (Henke 1929). In the drier leeward area of Hawaiʻi, the planting of *kiawe* or algaroba (*Prosopis robusto*) proved to be useful for the cattle and apiary industry (ibid.). By the mid-19th century, the apparent destruction of native forest habitat had severely diminished the water supply of islands, ultimately prompting action by the Hawaiian Kingdom government. In 1876, the Kingdom legislature under the administration of King David Kalākaua passed "An Act for the Protection and Preservation of Woods and Forests" (Planters' Labor and Supply Company 1887:438)." Between 1876-1910, uncoordinated efforts between the government and various agricultural sectors were undertaken to remedy the loss of native forests and to increase water supply (Cannarella 2010). Wild ungulates were removed from some native forests habitats—an effort that began in the 1830s—and efforts to fence off sections of intact forests set the foundation for Hawaiʻi's forest reserves. To replenish severely degraded forests, a large number of non-native species were experimentally planted, including, *paina* or ironwood (*Casuarina equisitifolia*), silver oak (*Grevillea robusto*), wind acacia, sour plum, and a number of other species (Henke 1929). Efforts to diversify the Kingdom's economy and the long-standing trend of introducing exotic plant and animal species to the islands continued to mount.

The introduction of large-scale planting of sugar cane during the mid- to late-19th century resulted in massive land clearing efforts around the islands. The success and growth of the sugar industry within the more arid parts of the islands was highly dependent upon an ample supply of irrigation water (Wilcox 1996). Occasional wildfires and pests such as the leafhopper threatened the burgeoning sugar industry (Campbell and Ogburn 1990). To ensure economic prosperity, these sugar companies invested in experimental agriculture. New varieties of cane collected from various parts of the world were introduced without restraint and tested to meet the climatic challenges of growing cane in Hawaiʻi. By the 1890s, under the administration of King David Kalākaua, efforts to regulate plant and animal imports, many of which carried pests that were unknown to the islands, had become a priority for the Hawaiian Kingdom government.

HISTORY OF BIOCONTROL IN THE HAWAIIAN ISLANDS

The use of classical biocontrol, "the suppression of pest populations by introduction and liberation of natural enemies," has been actively undertaken in the Hawaiian Islands for roughly 130 years with varying degrees of success (Funasaki et al. 1988:105; Lai 1988). Throughout the latter half of the 19th century, as the Hawaiian Islands became an agricultural hotspot for sugarcane and other crops, many new plant species, some carrying insect pests, were introduced without restraint. In 1890, the Hawaiian Kingdom Government, under the administration of King David Kalākaua established the Commissioners of Agriculture to prevent unwanted immigrant pests from entering the islands, and to control those that had already been introduced. The duties of the Commissioners were detailed in Chapter II of *Session Laws of 1890*. Chapter II titled "An Act Relating to the Suppression of Plant Disease, Blight, and Insect Pests" reads:

> SECTION 2. It shall be the duty of such Commissioners to seek to prevent the introduction into this Kingdom of any plant disease, blight, or insect pests injurious to any tree or trees, plant or plants,

> or vegetation; and to seek to exterminate any such diseases, blight or insect pests now existing or hereafter introduced.
>
> They shall have the power to enter upon any premises where they have reason to believe there is any tree, plant, or vegetation affected with any disease, blight, or insect pest; and to take all reasonable and proper steps to prevent the spread of any such disease, blight or insect pest, and if after due trial (such trial to be not longer than ten days) it is found by said Commissioners, or one of them, that the trees, plants or vegetation cannot be cured, or the blight destroyed, that then an in such case he or they may order the same destroyed. (Kalakaua 1890:4–5)

The initiation of the 1890 laws was in response to unregulated efforts to control pests—an act that prior to 1890 was being initiated by private citizens. The earliest accounts of the unregulated use of biocontrol can be traced back to 1865, when Dr. William Hillebrand, a physician, and naturalist brought the mynah bird (*Acridotheres tristis*) from India to Hawai‘i to control armyworms that were infesting Hawai‘i’s pastures (Funasaki et al. 1988). Because of the mynah bird’s appetite for rotting and decomposed things, and for its use of garbage as nesting material, the bird was given the Hawaiians name of “*manu-‘ai-pilau,*” which can be translated as the bird that consumes rotten things (Pukui and Elbert 1986:486). The mynah bird is also known in Hawaiian as “*piha‘ekelo*”, literally translated as “full of ‘ekelo sound,” a name given because of its raucous nature (ibid.:326). The debate over whether the introduction of the mynah bird was successful in controlling army worms spilled over into local newspapers. Proponents of the mynah bird emphasized its success, however, others alleged that such comments poorly represented the birds’ impacts to agriculture and to the people. An article published in *The Pacific Commercial Advertiser* in 1876 challenged some of the alleged successes:

> THOSE CATERPILLARS.—The *Gazette* says that owing to the large increase of *mynah birds*, “not a caterpillar is to be seen in this regions,” (Honolulu) while at points outside of this favored range of the birds the grass has been destroyed. This would be a very pretty and pleasing statement in favor of the usefulness of the *mynahs*, if it were true, as unfortunately it is not. Right here and now, in the immediate neighborhood of the city, on the plains and elsewhere the birds abound, caterpillars do much more abound,—in such immense quantities that it would be simply impossible for the former to make any perceptible impressions on the mass. No doubt the *mynah* would not refuse a fat caterpillar now and again; but we don’t believe they prefer them as a regular diet, for the bird is something of an epicure and delights to range from stolen beefsteak to a nest of pigeon’s or dove’s eggs. Chickens are very good at destroying the vermin, so far as their capacities go; and turkeys are better. But the plague is usually of but brief duration. (The Pacific Commercial Advertiser 1876:3)

Complaints of the mynah bird attacking people and livestock filled the local newspapers throughout the late 19th century. The noisy mynah bird had become such a nuisance to the residents of Honolulu that some people took to the city with guns to exterminate the birds. The mynah bird proponents fired back and proposed a law that would prevent the killing of the birds. An article written in the November 9th, 1894, issue of *The Hawaiian Star* blamed the mynah bird and the dove for aiding in the spread of another noxious introduction, *Lantana camara*, which was brought to the islands from “tropical America in the year 1858” (The Hawaiian Star 1894:3).

During Hawai‘i’s sugar plantation era, rats had become a serious pestilence to sugar plantation owners and considerable attempts to bring Hawai‘i’s rat population under control were being actualized. An article published in the March 31, 1883, edition of *The Pacific Commercial Advertiser* details the proposed introduction of the infamous mongoose (*Herpestes javanicus*), a native of India to Hawai‘i’s cane fields:

> THE Planters’ Monthly has lately been proposing the introduction of a little animal from India called the mongoose, as a destroyer of rats. He is a famous ratter, surpassing the cat or the ferret. He is described as a lively little urchin, about the size of a weasel, as having a snaky body, vicious looking claws, a sharp nose, a villainous eye and looks like “murder incarnate.” In speaking of his action in capturing rats, it is said that he crawls sinuously up to his victim until within easy distance for a rush, and then strikes with unerring aim, snapping rats just at the base of the brain. The rat has not time even to squeak, so sudden and deadly is the onslaught. Wherever the rat can enter the mongoose can follow. Thus as a ratter this lively little Indian is incomparable, but the trouble is he will not confine his operations to what is deemed his legitimate business. Some writers have endeavored to save his credit as a poultry destroyer, but a naturalist, who has carefully observed his characteristics, says that he is a general destroyer, not only of everything under, but of many creatures over his size. When in a cage the sight of a small living creature made him frantic and whenever he escaped, as he sometimes did, he made a sensation in the poultry house. The mongoose is not content with marauding forays in the yard, but he seems to pervade the house when domesticated…The rat is

> unquestionably a great pest of the cane and rice planter and grain cultivator in all parts of the world. The rat pest was deemed so serious here some fifty years ago that an enlightened and enterprising Commissioner of the Hawaiian Government, sent inquest of Chinese…to procure a species of snake famed as a destroyer of rats; but the Hawaiian people, whose sacred soil had been kept free from snakes and toads by some patron saint equal in influence to St. Patrick, conceived a holy terror of the snake, notwithstanding his possible utilities, and passed a decree that Hawaii would have no snake in her plantations. The destruction of rats in the cane-fields was hardly deemed a sufficient compensation to the Hawaiian mind for the probable presence every now and then of his snakeship in the thatch of the Hawaiian *hale pili*…(The Pacific Commercial Advertiser 1883:2)

By September of 1883, Mr. William H. Purvis, a plant collector and investor in the Pacific Sugar Mill at Kukuihaele on Hawai‘i Island, imported seven mongooses, fowls, and exotic plants from Australian colonies (Daily Honolulu Press 1883). The imported mongooses were "…intended for the damp lands of the Kukuihaele plantation at Hamakua…" (ibid.:4). A number of *‘iole manakuke* or mongooses, were liberated in the cane fields of both Hilo and Hāmākua (Funasaki et al. 1988; Pukui and Elbert 1986). Subsequently, in 1885, mongooses were released on Maui, Moloka‘i, O‘ahu, and Kaua‘i. While mongoose populations had quickly established themselves on Maui, Moloka‘i, and O‘ahu, to date, the mongoose has not established itself on Kaua‘i. Both introductions rapidly multiplied and spread beyond their intended target species. While the introduction of the mongoose appears to have some success in combatting the rodents, their impacts were highlighted in newspaper editorials as early as 1886, from writers complaining that the mongooses were becoming a pest in their own. One such article read:

> The mongoose is a useful little creature for the destruction of rats. He was brought here for that purpose, and, we believe, had done his work thoroughly well on several plantations. But the mongoose does not confine himself to rats, and complaints come from some quarters that ducks and chickens are being destroyed by wholesale. The mongoose may ultimately prove to be a greater nuisance than a benefit. (The Daily Bulletin 1886:2)

By the late 19th-century, the mongoose had become a sort of cultural symbol. A review of newspaper articles published in Hawai‘i during this period reveals that the mongoose was often used metaphorically to refer to people or things that exhibited wild behavior and for people who came to the islands without having any intent to leave. However useful these introductions were in controlling its intended target, over time, their unintended impacts had become obvious. In its wake, the mongoose destroyed livestock, the eggs of native bird species, and the noisy mynah bird is associated with aiding in the proliferation of the noxious weed, *Lantana camara* (Funasaki et al. 1988). These early and poorly thought out introductions are what Funasaki et al. (1988:106) described as a classic example of "biological control gone astray." Funasaki et al. (ibid.) emphasize that:

> However, it must be realized that prior to 1890, planning and evaluation before the introduction of any organism were nonexistent simply because they were not required. There were no laws or regulations restricting or prohibiting the importation of any plant or animal from other geographical areas into Hawaii.

While these early introductions appear to have been a practical solution to a growing problem, ultimately, the lack of regulation, adequate pre-release testing protocols, and post-release monitoring created even more problems for Hawai‘i's environment and people. In response to these ill-fated early and unregulated releases, Hawai‘i's government leaders began to formalize a plan that would limit the introduction of unwanted pest species and control those that had already been introduced.

Regulated Efforts to Control Unwanted Pest in Hawai‘i

By the late 19th century, efforts to study the natural enemies of unwanted pests that were impacting Hawai‘i's agricultural industry were being formalized. In 1893, the year of the unlawful overthrow of Queen Lydia Lili‘uokalani, the provisional government of the Republic of Hawai‘i appointed Albert Koebele as the entomologist to biologically control the many species of immigrant pests (Funasaki et al. 1988). Koebele is credited with being "one of the first, if not the very first entomologist, to engage in the introduction of natural enemies as a method of combating insect pests" (Giffard et al. 1925:340). Between 1893 and 1910, Koebele spent much of his time traveling to places like Australia, Fiji, Japan, China, Ceylon (modern-day Sri Lanka), Mexico, and California where he studied various insects that he thought would be beneficial to combat pests that were introduced to the islands. In 1893, Koebele successfully used biocontrol to combat the cottony cushion scale (*Icerya purchasi*) . In summarizing Koebele's biological introductions to the Hawaiian Islands, Giffard et al. (1925:342) remarked:

> He made the beginning in this line of work, and much of the time was working alone, yet seventeen species of lady beetles were successfully introduced by him and have become valuable factors in

> keeping reduced such pests as scale insects, mealybugs, plant lice and leaf mites. At least six other lady beetles were introduced and became established, but after a few years disappeared. The eight lantana insects were introduced by him, and about the same number of miscellaneous parasites of Diptera and Lepidoptera, etc. Following Mr. Koebele in this line of work, the other entomologists have introduced a larger number of beneficial insects, and some of them have produced more spectacular and valuable results, but this should not in any way lessen the credit to be given to him who was the pioneer in Hawaii in this important branch of entomological work.

Encouraged by Koebele's successes, in 1903, the Territorial Government (formalized in 1898), enacted laws to create the Board of Commissioners of Agriculture and Forestry (the precursor to the Hawaii Department of Agriculture (HDOA)). These early laws provided for facilities and materials "to obtain, propagate, study, and distribute beneficial species of insects to control pest species of insects and weeds" (Funasaki et al. 1988:107). Additionally, a quarantine system to prevent new immigrant pests from entering the islands was also created. Another early organization responsible for the release of a number of biological control agents was the Hawaiian Sugar Planters' Association (HSPA), founded in 1895. In 1904, HSPA instituted an Entomology branch and from its founding to about 1942, this branch aided in combatting a variety of pests that were plaguing Hawai'i's cane fields and threatening the economic promise of the sugar industry (ibid.). Throughout the early to mid-20th century, as Hawai'i's agricultural interest grew to include pineapple and other tropical fruit, additional institutions were organized to study and combat its share of pests. Such organizations included the United States Bureau of Entomology and Plant Quarantine's Fruit Fly Laboratory (now U.S. Department of Agriculture's Tropical Fruit and Vegetable Research Laboratory), Experiment Station of the Pineapple Producers Cooperative Associations, HSPA's Experiment Station, Hawaii Agricultural Experiment Station of the University of Hawaii's College of Tropical Agriculture, the California Agricultural Experiment Station of the University of California, and the Hawaii Department of Health (ibid.). By the 1940s and 1950s, the creation and introduction of chemical pest control had become the favored alternative (Howarth 1983). While chemical pest control still maintains its place in managing unwanted pests, the environmental and health risks associated with its use has led to the adoption of stricter regulations and a push towards finding more natural and low-cost alternatives (ibid.).

Collectively, the laws passed in 1890 to regulate unwanted immigrant pests set the foundation for what is known today as Hawai'i Revised Statutes (HRS) Chapter 141, which governs the State of Hawai'i, Department of Agriculture (HDOA)—the state agency responsible for protecting and diversifying Hawai'i's agricultural industry. HDOA's Plant Industry Division maintains three branches: Pesticides Branch, Plant Pest Control Branch, and the Plant Quarantine Branch that collectively work "to protect Hawaii's agricultural industries, environment, and [the] general public by preventing the introduction and establishment of harmful insects, diseases, illegal non-domestic animals, and other pests…" (Department of Agriculture 2016). In 2003, under Hawai'i Revised Statutes (HRS), Chapter 194, the State of Hawai'i legislature authorized the creation of the Hawai'i Invasive Species Council (HISC), the agency responsible for coordinating efforts between various local, state, federal, and international agencies and organizations to stop the introduction and spread of invasive species in the islands (State of Hawai'i 2005). Since the creation of the HISC, millions of dollars have been allocated to various local councils and government departments and programs to combat invasive species. Efforts have been directed at prevention, response and control, research and technology, and outreach (ibid.). There are four invasive species committees that represent each of the four counties (Kaua'i, O'ahu, Maui, and Hawai'i Island) in addition to an aquatic invasive species team (ibid.).

Historically, Hawai'i's biological control programs were aimed at controlling weeds and pests that were adversely impacting the agricultural industry. During the 1970s and 1980s, the heightened interest in native and endemic taxa, fueled by the passing of federal legislation to protect endangered plants coupled with the growth of native-plant organizations has led to greater consideration of the potential risk of introduced biological control agents on endemic taxa (Pemberton 2004). Hawai'i as a "hub for tourism, trade, and military transport" and the state's continued reliance on globally imported goods perpetuates the ongoing assault of introduced foreign species (Messing and Wright 2006). Funasaki et al. (1988:108) report that "more biological control projects against immigrant species of insect pests have been conducted in Hawaii than anywhere else in the world" and nearly a third of the introduced species (roughly 200 pest species) are known to be established. Reimer (2002:86) reports that "many of these introductions appear to have been successful in that the pest populations eventually did drop to acceptable levels, although scientific evaluations of the effectiveness of these introductions have been virtually non-existent." The lack of natural enemies to combat such pests has propelled state agencies, namely HDOA to continue to identify the pests' natural enemies and to develop stringent host-range testing protocols for the study and release of such agents. Although the application of classical biocontrol in Hawai'i has, at times proven to be economically successful, it is recognized that environmental risks are inherent in biological control programs (Holland et al. 2008; Howarth 1983; Pemberton 2004).

Historically, several individuals and agencies have participated in the study and release of biocontrol agents in the Hawaiian Islands. Today, the U.S. Department of Agriculture-Animal Plant Health Inspection Service-Plant Pest Quarantine (USDA-APHIS-PPQ) and the HDOA regulates the importation of biocontrol agents (Reimer 2002). While these agencies have distinct mandates and jurisdictions, there is some overlap with respect to the regulated use of biocontrol. Efforts to improve pre-release testing has resulted in a federal and state permitting process which includes an environmental review. In summarizing this process, Reimer (ibid.:87) writes:

> All biocontrol agents imported for weed control attack plants and are by definition plant pests. They are, therefore, regulated by USDA.
>
> The USDA requires separate permits for
>
> 1) Importation of a plant pest into the U.S.;
>
> 2) Movement of a plant pest between States; and
>
> 3) Release of a plant pest into the environment.
>
> The federal permitting process requires the submission of PPQ Form 526 (Application for Release) that is forwarded to the HDOA for review and recommendations. All applications to date, for which HDOA has recommended rejection, have also been denied by the USDA. If approval is recommended by HDOA, USDA then reviews the application. This process usually involves review by the Technical Advisory Group; however, Hawai‘i applications are exempt from TAG review due to the thoroughness of the HDOA review process. A draft environmental assessment (EA) is requested from the applicant for any requests for the release of weed biocontrol agents. The USDA prepares the final EA. If endangered or threatened species potentially are affected by the release of a biocontrol agent then the application is sent to the U.S. Fish and Wildlife Service for review. A release permit is issued if the evaluation of the EA produces a finding of no significant impact (FONSI).

While there are some similarities between the federal and state process, Chapter 150A of the Hawai‘i Revised Statutes (HRS) regulates the importation of any plant or animal into the State of Hawai‘i whether or not it is a plant pest (Reimer 2002). HRS 150A strictly prohibits the importation of all non-domestic animals and microorganisms unless approval is obtained by the Board of Agriculture. The review process for a state importation permit application involves six steps. Reimer (ibid.:88-89) provides a synthesis of the six-step process:

> First, the application is submitted to the HDOA with all of the required and pertinent information, including information on host specificity, distribution, preferred habitat, temperature requirements, etc. Host specificity studies may be carried out either in the country of origin or in one of the three approved containment facilities in Hawai‘i. The Advisory Subcommittee then reviews the application. The recommendations from this subcommittee are passed on to the Plants and Animals Committee for their recommendations to the BOA. The BOA either approves or disapproves the application. If approved, the application is submitted to a public hearing process. Comments from the public are brought back to the BOA for discussion, followed by final approval or disapproval of the application. If approved, a State permit is issued. The organism may be imported and released if both State and Federal permits have been issued and permit conditions are met by the importers.
>
> The HDOA review process for the introduction of biocontrol agents has evolved into an effective system that screens agents for host specificity and potential negative impacts on other species. None of the agents introduced since the review process was initiated in 1975 have attacked any native or beneficial plant or animal species. This was not the case before 1975.

Additionally, efforts to improve public transparency following the decision rendered by the Hawai‘i Intermediate Court of Appeals (*Ohana Pale Ke Ao v. Board of Agriculture, State of Hawaii*, 118 Hawaii 247, 249-50, 188 P.3d 761, 763-64 [Hawaii Ct. App. 2008]) has made the HDOA recognize that such biocontrol activities are subject to Chapter 343, Hawai‘i Revised Statutes (Hawai‘i Environmental Policy Act, HEPA) (Holland et al. 2008). Between 1890 and 1999, a total of 708 natural enemies have been released in Hawai‘i, of which 286 have become established and the majority (237) of the introduced agents have contributed to the control of the target pest species (Reimer 2002). Prior to 1944 (before the formalization of the BOA), only 54% of the introduced agents were host-specific. This percentage has increased over the years with 77% host specificity being reported between the years 1944-1975. Since 1975, host specificity for all released biocontrol agents increased to 100% (ibid.). While stricter regulations have been adopted and modified over the years to reduce the environmental risk associated with the use of biological control agents, continued field research and open dialogue remains as a critical component to improving our understanding and mitigating the environmental, economic, and cultural risks associated with such actions.

INTRODUCTION OF *TIBOUCHINA HERBACEA* TO THE HAWAIIAN ISLANDS

While it is not known whether *T. herbacea* was intentionally or accidentally introduced to the islands, it was recorded first in 1977, growing on Saddle Road on Hawai‘i Island—an important route connecting east and west Hawai‘i. In 1982, the first specimens were collected at Lanilili in West Maui and at the Ko‘olau Forest Reserve in East Maui (Almasi 2000). Infestations of *T. herbacea* were also found in Kīpahulu Valley between the 600-5,500 foot elevation. Nearly ten years later, populations of *T. herbacea* were reported on Lāna‘i Island, and in 2003, this plant was observed at Hīpuapua Falls in Hālawa Valley on the east end of the island of Moloka‘i. In 2008, a few plants were discovered by the O‘ahu Army Natural Resources Program at Poamoho in the Waialua District along the leeward side of the Ko‘olau Mountain Range on the island of O‘ahu (Frohlic and Lau 2007). Several plants were also found growing above the H-3 tunnel in Hālawa Valley, “which was apparently landscaped after construction of the tunnels” (ibid.:10). It is believed that seeds of *T. herbacea* arrived on infested *hāpu‘u* (*Cibotium spp.*) ferns that were transported from an off-island area, which were used to landscape the tunnel entrance (ibid.). These plants were removed after their discovery. Of the five islands in which this plant is known, it has become naturalized on the islands of Hawai‘i and Maui where it forms dense thickets and is now beyond the scope of eradication (O‘ahu Invasive Species Committee 2016).

Ecological and Cultural Impacts of *T. herbacea*

T. herbacea is known to threaten critical watershed habitat where numerous endemic and highly vulnerable plants and animals are found. On the islands of Maui and Hawai‘i, this highly invasive plant is known to form dense thickets that crowd out and suppress native plant growth, including the *‘ōhi‘a* (*Metrosideros polymorpha*) (O‘ahu Invasive Species Committee 2016). On the island of Maui, *T. herbacea* is scattered through some 50,000 acres of ecologically important watershed land in West Maui (Strohecker 2018). It can be found from sea level to the summit of Pu‘u Kukui and thrives in the wet windward regions between 2,000-4,000 feet elevation (ibid.). The steep and treacherous terrain has made control of this plant nearly impossible on Maui (ibid.). At Poamoho in the northern Ko‘olau Mountains Range of O‘ahu, where populations of *T. herbacea* remain somewhat manageable, this plant continues to threaten many animals and plants many of which have a federal protection status. In their 2016 report, the O‘ahu Invasive Species Committee (OISC) informed that *T. herbacea*:

> …poses a major threat to Ko‘olau forests, especially the near-pristine summit regions, as it thrives in wet forest conditions, produced hundreds of tiny seeds and is spread by broken stems or via wind, birds, and pigs. We suspect that the population at Poamoho was accidentally introduced by hikers that had recently been hiking on Maui or Hawai‘i Island. Plant material capable of reproducing can be carried on shoes, clothes, and backpacks. (O‘ahu Invasive Species Committee 2016:1)

Since its discovery near the summit area of Poamoho, continued monitoring led to the discovery of this plant’s spread downstream from its known historical point. In 2015, with additional funds, OISC was able to increase its control efforts at Poamoho. With the increased manpower to survey and control populations of *T. herbacea* at Poamoho, the OISC field crew has discovered more plants in the Punalu‘u watershed area. The steep terrain of this area, however, makes access and control of this plant very difficult. The OISC attributes the continued spread of this plant to hikers who may be inadvertently spreading seeds. OISC has more recently begun to undertake aerial surveys using helicopters to identify naturalized populations of *T. herbacea*. Although a significant amount of land can be surveyed using helicopters in comparison to pedestrian surveys, the cost associated with renting a helicopter means fewer surveys can be undertaken in a year (ibid.). The OISC continues to rely on ground surveys to monitor and control populations of *T. herbacea*.

Aerial and ground-level monitoring continue to play an important role in helping to manage existing infestations and detecting new populations of *T. herbacea*. However, despite these long-standing efforts, concerted attempts to educate the public about limiting the spread of invasive species has been a critical component in managing Hawai‘i’s invasive species problem. As part of the public outreach efforts, the four invasive species councils emphasize the importance of thoroughly washing and cleaning hiking boots and gear between hikes. Efforts to increase public knowledge in the identification of invasive species have also been ramped up in recent decades and access to this information has been streamlined through virtual media. The invasive species councils on Kaua‘i, O‘ahu, Maui, and Hawai‘i all depend on the public to report new infestations. Hiking and trails groups across the state have also contributed to these management efforts by leading organized hikes focused on the removal of invasive species.

The spread of *T. herbacea* throughout the native wet forest habitat in the Hawaiian Islands is both an ecological and cultural concern. Hawai‘i’s wet forest habitat, which is a culturally valued resource has maintained a significant role in perpetuating the life-ways and traditions of the Hawaiian people. Continued encroachment upon this habitat

by highly invasive species such as *T. herbacea* and other Melastomes poses an ecological threat that has significant cultural ramifications.

Cultural Uses of Native Wet Forest Habitat in Hawai‘i

The use of native wet forest plants in traditional Hawaiian culture is both extensive and well-documented (see Abbott 1992; Buck 1957; Krauss 1993). The flowers, fruits, woods, roots, and bark of many native plants found in the wet forests of the Hawaiian Islands have been and continue to be extensively used in many Hawaiian cultural practices. Although plants were held in high esteem and celebrated in traditional lore, plants were also valued as a collective whole for its ability to attract diverse wildlife, such as birds and insects. Endemic Hawaiian birds were highly valued for their colorful plumages which were extensively used in creating spectacular feathered garbs, headdresses, *lei*, and other insignia that were worn or displayed traditionally by Hawaiian nobility. The task of collecting birds was undertaken by the *po‘e kia manu* (bird catchers), who held a profound understanding of avian behavior and the forest resources, including what plants to use to attract and capture the birds.

The plethora of plants found in Hawai‘i’s wet forest was and remains an integral component of many traditional Hawaiian cultural practices. Large trees provided a variety of hardwoods from which canoes, houses, *ki‘i* (carved images), fishing accessories, and various utilitarian and recreational implements were made. Aerial roots of the climbing *‘ie‘ie* (*Freycinetia arborea*) were harvested and plaited together to form tightly stitched *‘ie* (baskets). Ferns were collected from the forest floor and woven into *lei* or tucked into *kapa* (bark cloth) as a scenting agent. Flowers and fruits were collected for *lei*, natural dyes, and sometimes mixed together with other plants to make medicinal concoctions. Additionally, plots in the wet forests were cleared to cultivate *olonā* (*Touchardia latifolia*), an endemic plant that was purposefully grown and from which cordage of the finest quality was made. Hawaiian ethnobotanist, Beatrice Krauss notes:

> The finest cordage made by the ancient Hawaiian—in fact, the finest cordage made in the Pacific basin—was made from *olonā*. *Olonā* was cultivated in patches of two or three acres primarily in wet, upland areas. Young shoots or layered cuttings were used for planting material; the latter were obtained by bending down a branch and covering the portion touching the ground with soil so that roots emerged from it. The rooted section, with its terminal leaves, was severed and this became a rooted cutting. Planting was close to prevent side branches from growing. *Olonā* patches were kept free of weeds, especially fom [*sic*] creeping vines, which were abundant in surrounding areas; these would otherwise have choked the *olonā* plants. The stalks were ready for harvest at the end of a year or eighteen months. (Krauss 1993:27–28)

The forest itself also holds profound spiritual implications as various plants found in the wet forest were considered *kinolau* (embodiments) of named deities, many of whom took specific plant forms of the deity Kū. Such examples include but are not limited to Kūka‘ōhi‘alaka, Kūpulupulu, Kūmokuhāli‘i, and Kūalanawao (Fornander 1919–1920; Handy and Handy 1991; Kamakau 1976). While Kū is considered the activating energy associated with the forest, other deities are also recognized including Kāne, who is embodied in the sun and in freshwater; Lono who is connected to winds, storms, and fertility; and Laka who is associated with transpiration (Edith Kanaka‘ole Foundation n.d.). Therefore, the Hawaiian forest, at a minimum, represents the dynamic interplay between Hawaiian deities.

These forested spaces also filled an important spiritual and utilitarian need for Hawaiian *hula* dancers, healing practitioners, and artisans, all of whom rely heavily on Hawai‘i’s forest resources (Stewart 2003). *Hula* practitioners have long valued Hawai‘i’s rich forest, which continues to be extensively used in making adornments, implements, and in furnishing the *kuahu* (altars). In describing the *kuahu*’s association with the forest, Emerson (1909:19) explained that “the wildwoods of Hawaii furnished in great abundance and variety small poles for the framework of the kuahu, the altar, that holy place of the halau, and sweet-scented leaves and flowers suitable for its decoration.” In detailing the thoughtful process of greening a *kuahu*, Emerson adds:

> It was necessary to bear in mind that when one deflowered the woods of their fronds of *ie-ie* and fern or tore the trailings lengths of *maile*—albeit in honor of Laka herself—the body of the goddess was being despoiled, and the despoiling must be done with all tactful grace and etiquette.
>
> It must not be gathered from this that the occasion was made solemn and oppressive with weight of ceremony, as when a temple was erected or as when a tabu chief walked abroad, and all men lay with their mouths in the dust. On the contrary, it was a time of joy and decorous exultation, a time when in prayer-song and ascriptions of praise the poet ransacked all nature for figures and allusions to be used in caressing the deity. (Emerson 1909:16)

Other plants utilized in greening a *kuahu* included *ʻieʻie* (*Freycinetia arborea*), *halapepe* (*Pleomele sp.*), *ʻōhiʻa lehua* (*Metrosideros polymorpha*), *ʻekaha* (*Asplenium nidus*), *maʻo hau hele* (*Hibiscus brackenridgei*), *hau* (*Hibiscus tiliaceus*), *kī* (*Cordyline fruticosa*), *ʻilima* (*Sida fallax*), and *lama* (*Diospyros sandwicensis*) (Emerson 1909).

While historical literature enumerates many different types of *kahuna* (esteemed and highly specialized experts), the *kahuna* whose practice involved the extensive use of both cultivated and wild plants was the *kahuna lāʻau lapaʻau*. These *kahuna* treated the sick using highly tailored plant-based recipes that were accompanied by rituals and ceremonies. With the change in landscape and the arrival of non-native plants to the islands, Krauss (ibid) notes that many "Precontact prescriptions have been altered by addition or substitution of postcontact-introduced plants." Krauss provides a succinct summary of the meticulous preparation of traditional plant-based medicines:

> Different parts of a plant were used for medicine: roots, stems, leaves, flowers, bark, fruits, and seeds. These were prepared for use by brewing, pounding and extracting the juice or sap, pounding and making an infusion, or the part to be used was chewed and swallowed without any preparation. Plant material was pounded in special stone mortars with stone pestles made for this purpose only. In cases where leaves were used, dosages consisted of a specific number of leaves; specific handfuls of leaves; or the quantity of leaves that, when rolled together, fitted within the circle formed when the tips of the thumb and forefinger were joined. When bark was used, a strip of a designated width and length was prescribed. For berries, flowers, flower buds, and the like specific numbers determined the dosage. The "magic" numbers in prescribing dosages, times and, duration of treatment were one, three, and five; four and five; five and six; or five only, according to different sources. Pounded material was strained through or squeezed out with cleaned fabriclike sheath at the base of coconut fronds (*ʻaʻa niu*) or with the fibers of the native sedge *makaloa.* Medicinal herbs were usually administered in formulations that almost always included salt and red clay, *ʻalaea*. (Krauss 1993:101)

The adaption of cultural traditions is an important aspect of any living culture. While many artisans continue to utilize Hawaiʻi's forest plants in a more traditional manner, it is common today to see many Native Hawaiian (and non-Hawaiian) artisans incorporate or draw inspiration from native plants to create contemporary clothing, home furnishings, musical implements, accessories, art, and many other utilitarian and decorative items. The restoration and revitalization of native plant habitat is crucial to sustaining Hawaiian traditions, beliefs, cultural practices well into the future whether that be in a traditional or more contemporary manner.

3. CONSULTATION

Gathering input from community members with genealogical ties and long-standing residency or relationships to the study area is vital to the process of assessing potential cultural impacts to resources, practices, and beliefs. It is precisely these individuals that ascribe meaning and value to traditional resources and practices. Community members often possess traditional knowledge and in-depth understanding that are unavailable elsewhere in the historical or cultural record of a place. As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of the oral interview process is to identify potential cultural resources, practices, and beliefs associated with the affected project area. It is the present authors' further contention that the oral interviews should also be used to augment the process of assessing the significance of any identified traditional cultural properties. Thus, it is the researcher's responsibility to use the gathered information to identify and describe potential cultural impacts and propose appropriate mitigation as necessary.

INTERVIEW METHODOLOGY

In an effort to identify individuals knowledgeable about traditional cultural practices and/or uses associated with *T. herbacea* or the habitat in which this plant is found, a public notice was submitted to the Office of Hawaiian Affairs (OHA) for publication in their monthly newspaper, *Ka Wai Ola*. The notice was submitted via email on April 9th and was subsequently published in the May 2019 issue of *Ka Wai Ola* (2019:21) (Appendix A). As of the date of the current report, no responses have been received from the public notice. Although no responses were received as a result of the *Ka Wai Ola* publication, ASM staff contacted forty-five individuals/organizations via email and/or telephone regarding the preparation of the current CIA. These individuals/organizations were selected because they were either recognized cultural practitioners, plant experts, or Native Hawaiian organizations who utilize Hawaiʻi's forest resources for cultural purposes or were believed to have cultural knowledge about the target species or other plants found within the target species habitat. Of the forty-five individuals contacted, twenty individuals responded to our request with either brief comments, referrals, or accepted the interview request. The names and affiliation of these twenty individuals are listed in Table 1 below. Of the twenty respondents, ASM staff successfully conducted

interviews with nine individuals (see summaries below). A complete list of all persons contacted for consultation is available upon request.

The interviewees were asked a series of questions regarding their background, and their experience and knowledge of the target species. Additional questions focused on any known cultural uses, traditions, or beliefs associated with any of the target species. The interviewees were then asked about their thoughts on the cultural appropriateness of using biocontrol control agents and whether they were aware of any potential cultural impacts that could result from the use of biocontrol control. The interviewees were then asked whether they had any recommendations to mitigate any identified cultural impacts as well as share any additional thoughts about the proposed action.

As part of the interview process and with the consent of the interviewees, some of the interviews were audio-recorded for note-taking purposes only (audio files not available). Where audio recordings were not permitted, ASM staff recorded notes throughout the interview process. Upon completion of the interview, ASM staff prepared an interview summary, which was emailed to the interviewees for review. The interviewees were given the opportunity to review the summary for accuracy and allowed to make any necessary edits. With the approval of the interviewees, the finalized version of the summaries is presented below.

Table 1. Persons contacted for consultation.

Name	*Affiliation, Island*	*Initial Contact Date*	*Comments*
Shalan Crysdale	The Nature Conservancy, Kaʻū Preserve, Hawaiʻi	3/6/2019	See summary below
John Repogle	Retired from The Nature Conservancy, Kaʻū Preserve, Hawaiʻi	3/6/2019	See summary below
Nohealani Kaʻawa	The Nature Conservancy, Kaʻū Preserve, Hawaiʻi	3/6/2019	See summary below
Arthur Medeiros	Auwahi Forest Restoration Project, Maui	3/7/2019	Responded via email on March 11, 2019, stating "Thank you for your valuable work supporting this essential action to attempt to slow the loss of Hawaiian biota."
Jen Lawson	Waikōloa Dry Forest Initiative, Hawaiʻi	4/3/2019	See summary below
Robert Yagi	Waikōloa Dry Forest Initiative, Hawaiʻi	4/3/2019	See summary below
Wilds Brawner	Hoʻola Ka Manakaʻā at Kaʻūpūlehu, Hawaiʻi	4/9/2019	See summary below
Sam ʻOhu Gon III	The Nature Conservancy, Oʻahu	4/22/2019	Responded to interview request but was unable to provide input on this project.
Mike DeMotta	National Tropical Botanical Gardens, Kauaʻi	4/22/2019	See summary below
Wili Garnett	Cultural practitioner, Molokaʻi	5/7/2019	Responded via email stating "I have mostly been involved with Erythrina gall wasp parasite release and monitoring, but experience watching *Tibouchina* and *Schinus* degrade watershed on many islands, including Molokai and even cultural resources at Kalaupapa."

Table 1 continues on next page

Table 2. continued.

Name	*Affiliation, Island*	*Initial Contact Date*	*Comments*
Emily Grave	Laukahi Network, Oʻahu	5/7/2019	Responded via email stating that she was not aware of cultural uses of this plant.
Kim Starr	Starr Environmental, Maui	5/9/2019	See summary below
Forest Starr	Starr Environmental, Maui	5/9/2019	See summary below
Manaiakalani Kalua	Cultural practitioner, Hawaiʻi	5/30/2019	See summary below
Talia Porter	Honolulu Botanical Gardens, Oʻahu	6/3/2019	Responded to interview request but was unable to secure an interview.
Robert Keano Kaʻupu	Cultural practitioner, Oʻahu	6/16/2019	Responded via phone that he has been interested in learning about the cultural uses of *wiliwili* but was not aware of any uses or of anyone else who used this wood for cultural purposes.
Hinaleimoana Wong-Kalu	Cultural practitioner, Oʻahu	7/16/2019	Responded to interview request but was unable to secure an interview.
Pelehonuamea Harman	Cultural practitioner, Hawaiʻi	7/31/2019	Referred ASM staff to Dennis Kanaʻe Keawe
Dennis Kanaʻe Keawe	Cultural practitioner, Hawaiʻi	8/12/2019	See summary below
Iliahi Anthony	Cultural practitioner, Hawaiʻi	8/30/2019	See summary below

End of Table 1

SHALAN CRYSDALE, JOHN REPLOGLE, AND NOHEA LANI KAʻAWA

On March 6th, 2019, Lokelani Brandt and Matt Clark interviewed Shalan Crysdale, John Replogle (retired from the Nature Conservancy), and Nohea Kaʻawa of The Nature Conservancy (TNC) Kaʻū Preserve regarding DOFAW's proposed action and to gather any known cultural knowledge of *T. herbacea*. The crew from TNC indicated that they were not aware of any known cultural uses of *T. herbacea*, but commented that this plant is widespread in portions of the TNC Kaʻū preserve. Shalan described past efforts to control *T. herbacea* but noted that the manpower and chemicals needed were costly, time-consuming, and not entirely effective at managing this highly invasive plant. Shalan explained that *T. herbacea* is effective at shading out native understory species. Both Shalan and John have observed an abundance of *T. herbacea* growing along the forest preserve fence lines. Based on their observations, Shalan and John firmly believe that birds have aided in the widespread dispersal of this plant, especially along the length of the fence lines where the canopy cover is less abundant and where birds frequent. Shalan believes that if *T. herbacea* is removed, it may lend to the recovery of many native understory species.

While Shalan and John were not entirely against the use of biological control agents, they did share some of their concerns. Shalan, John, and Nohea stressed the importance of trial testing to ensure that the release of any proposed biological control agent does not adversely impact other native species as well as other valued crops. They spoke about the limitations of laboratory trial testing that may not account for all the variables that are present in the natural habitat. They strongly recommended that extensive trial testing be conducted prior to any proposed field release and they hope to see more post-release field monitoring to safeguard against the spread beyond the intended target species.

WILDS PIHANUI BRAWNER

Wilds Brawner, Site Manager of the non-profit organization, Hoʻōla Ka Makanaʻa at Kaʻūpūlehu Dryland Forest, was interviewed by Lokelani Brandt on April 18th, 2019. Since 2008, Wilds has worked at the 70-acre Kaʻūpūlehu Dryland Forest preserve performing a variety of duties including management and education.

When asked about his knowledge of *T. herbacea*, Wilds indicated that in his years of work, he has not encountered *T. herbacea* populations in the leeward side of Hawai‘i Island, but was aware of its impacts to the wet forest of Hawai‘i Island and elsewhere. Wilds indicated that he was not aware of any known past cultural uses of this plant.

When asked about any potential cultural impacts that could result from the use of biocontrol, Wilds emphasized that utilizing biocontrol has “great potential” and that it may be a solution to help manage unwanted pests under the condition that there has been extensive research, lab and field testing, and controlled releases. He emphasized that extensive research should consider every possible factor that could potentially result in negative impacts, especially to other endemic taxa. He also stressed that public education should be a key component in this process, as it will create opportunities for the public to learn and provide input. He believes that public input can help assess the possible risks and identify steps to manage those risks. Wilds strongly recommended that all future biological control efforts integrate public input and that it should move towards a community-based resource management structure. Wilds suggested that ways to promote biocontrol are through responsible action, extensive and evidence-based testing and research, and if these pre-release efforts are successful, biocontrol “can be the silver bullet” to managing pests. He concluded that although the process has the potential to control invasive species, the idea and use of the word “control,” as opposed to “management,” is very loaded and attaches unrealistic expectations to the effort. As with any forest, Wilds believes that with proper “management”, the results will net a positive cultural impact. New forest growth produces more flowers and seed and ultimately creates more opportunities for people to interact with these forests through place-based learning. He emphasized that when people interact and participate in caring for our “beloved” resources and when the *mo‘olelo* of these resources are shared, it can then become a living cultural resource for the people.

MIKE DEMOTTA

On April 24th, 2019, Lokelani Brandt conducted an interview with Mike DeMotta, the Head Curator of the living collections for the National Tropical Botanical Gardens (NTBG) on Kaua‘i. Mike manages the center’s plant inventory database, which includes a large collection of native plants. He has also been tasked with developing ways to improve their native plant populations by creating spaces for a thriving living collection. Through his work, Mike has been heavily involved with native plant restoration from the coastal dry areas on Lehua Island to the pristine native forests in Limahuli Valley on Kaua‘i’s north shore.

When asked about any traditional cultural uses of *T. herbacea*, Mike stated that he was unaware of any cultural importance or uses for any part of this plant. While no specific information about any known past or current cultural uses of this plant was shared he did offer insights into the proposed use of biological control to aid in conservation efforts. Mike believes that with proper research, biocontrol could preserve or rescue native forests. With his strong involvement with restoration, Mike strongly believes biocontrol will assist in opening up spaces for the regeneration of native forests and proposed that drastic measures are imperative to control or eradicate the aggressive nature of invasive species. Although he is genuinely concerned about the possibility of a collateral loss of one or two native species, Mike reasoned that the overwhelming threat to native forests from invasive species had lent to his advocacy for biocontrol. He argued that the manpower needed to control these threats are not feasible and are unrealistic. He is particularly pleased that the focus has shifted to conservation and that there is a growing awareness that we are losing pristine forests to these invasive species.

JEN LAWSON AND ROBERT YAGI

On April 26, 2019, Lokelani Brandt and Aoloa Santos met with Executive Director, Jen Lawson and Preserve Manager, Robert Yagi of the Waikoloa Dry Forest Initiative. The Waikoloa Dry Forest Initiative manages 275 acres of dryland forest located near the Waikoloa community. When asked about any known cultural uses of *T. herbacea,* Jen and Robert were not aware of any known past or current uses of this plant. While no specific information about *T. herbacea* was obtained, they did offer their insights into the proposed use of biological control to aid in management strategies.

Although Jen is a proponent of biocontrol, she explained that the proper research must be conducted, and that dissemination of that research should be provided to the affected communities. She expressed that one of the main challenges will be garnering public support for the proposed action because of preconceived notions that are heavily influenced by the historical and unsuccessful application of biocontrol. Although Jen was aware of the extensive research that is conducted prior to the release of any biocontrol agent, she remarked that such research is not always effectively shared with the communities. She added that the lack of public information and transparency only exacerbates misconceptions thereby making community support difficult to establish. In light of this, Jen recommended that DOFAW and other associated agencies restructure informational public meetings to be engaging

and inclusive of community input as she believes this may improve trust between the affected communities and the agencies. Additionally, she strongly advocates for a more collaborative partnership between the DOFAW and its agencies as a way to promote a more open dialogue between the agencies and community groups who work closely with some of these invasive species. Jen and Robert also recommended that more consistent post-release monitoring be conducted and that such efforts should be done in conjunction with established community groups.

FOREST AND KIM STARR

On May 31st, 2019, Lokelani Brandt and Aoloa Santos met with Forest and Kim Starr at their home in Olinda, Maui. Born and raised on Maui, Forest always enjoyed nature. He later moved to New York to attend Cornell University and in 1992 met his now wife and business partner, Kim, who is of Hawaiian descent but was *hānai* (adopted and raised) by a Japanese-Italian family. Since then they have done numerous volunteer and contract work in the conservation field. They currently co-own Starr Environmental and serve as biologists and environmental consultants for developers and federal and state agencies. Forest and Kim have extensive experience in botanical and environmental restoration work in the Hawaiian Islands. Forest shared that they have assisted in prior biocontrol releases but they primarily focus on the early detection of introduced species.

When asked about any known cultural uses for *T. herbacea*, Forest and Kim stated they are not aware of any cultural uses of this plant. They both expressed that this plant is considered rare in its homeland because of its numerous threats but is highly invasive in Hawai‘i because it has no natural predators. Forest stated that in West Maui, specifically at Kapilau ridge and Waikapū, *T. herbacea* is widespread.

Forest described much of the vegetation that dominates the islands as a “rag-tag assemblage of pantropical invasive species” and opined that this sort of global homogenization of the islands’ plant life is exacerbating the spread of really aggressive species. Adding to this, Forest expressed that changes in the environment are inevitable and noted that these changes are difficult for many to accept. Forest and Kim believe that biocontrol is a method that can help mitigate or slow the growth of species but “it never eradicates, it just reduces the numbers” and cited the example of the Erythrina Gall Wasp and the panini cactus (*Opuntia ficus-indica*) which have had biocontrol agents released against them. Both Forest and Kim explained that over the course of many years they have seen limited success where biocontrol has resulted in complete eradication.

When asked about their thoughts on the cultural appropriateness of biocontrol, Forest and Kim shared that they have witnessed the culture and traditions of these islands evolve within an inevitable changing environment. Forest emphasized that the mixed-culture of Hawai‘i has been able to co-exist with the changing environment and they have seen various cultures including Hawaiian culture utilize introduced plants in place of rare or extinct native plants in order to perpetuate their traditional cultural practices. In spite of these cultural adaptations, they feel that biocontrol can be useful in protecting native plant habitats which are both ecologically and culturally important and remain open-minded to these types of undertakings.

Based on their knowledge of the efficacy of former biocontrol efforts, Forest and Kim shared that generally, the way a biocontrol agent is introduced is not very effective and that for the most part, in order for the biocontrol to be entirely successful a large number of biocontrol agents must be introduced. Kim stated that although the purpose of biocontrol is to introduce an organism that is specific to a target plant, the efficacy is oftentimes underwhelming and as a result, there have been a few unintentional consequences. Kim shared that although biocontrol agents are introduced with good intentions, “the unknown,” meaning its potential to cause unforeseen impacts to a non-target species is the main factor that contributes to the general resistance to implement biocontrol. Additionally, Forest and Kim both stated that once a biocontrol agent is released there is very limited and often times no follow-up by the agencies that have invested in the pre-release studies. In light of this, Forest and Kim recommended that post-release monitoring should be held to the same standard as the pre-release of a biocontrol agent. Forest described that “mother nature is so crafty” and that changes are often muted or other factors become more significant than the release, therefore on-going post-release monitoring is a crucial component to this process. Forest also stated that misinformation has been detrimental to these biocontrol efforts and believes that more should be done to effectively communicate these types of undertakings to the public.

MANAIAKALANI KALUA

On June 6th, 2019, Lokelani Brandt conducted an interview with Manaiakalani “Manai” Kalua, a *kumu hula* and life-long Hawaiian cultural practitioner. Born and raised in the Hawaiian homestead community of Keaukaha, Manai has dedicated his life to *hula* and because of this, he has had extensive interactions with Hawai‘i’s native plant life, which is a fundamental element to traditional *hula* practices.

When asked about any known cultural uses for *T. herbacea*, Manai was not aware of any known traditional cultural uses of this plant but recalled seeing it when gathering foliage for *hula* and for other ceremonies. Manai, however, spoke at length about the ways in which invasive species are changing traditional cultural practices specific to *hula*. He explained that within his *hula hālau* he teaches about the proper way to harvest plants in addition to practices that will help limit the spread of invasive species. He now stresses the importance of cleaning all clothing, equipment, and cars after every visit to the forest. He stated that invasive species are a serious problem that has major environmental and cultural implications and cited the example of Rapid ʻŌhiʻa Death (ROD), which has significantly impacted *hula* practices. He noted that culturally, *ʻōhiʻa* is an important part of *hula* adornments and rituals, since becoming aware of ROD, he no longer gathers *ʻōhiʻa* nor does he condone the gathering of this plant. He explained that not being able to utilize *ʻōhiʻa* has required him to be more creative with his cultural practices.

When asked about his thoughts on the cultural appropriateness of utilizing biocontrol, Manai explained that historically we have a long history of unsuccessfully utilizing biocontrol and cited examples including the introduction of the mongoose to control rats and the scale insect to control strawberry guava. Manai expressed concern for the idea of introducing other foreign insects which may adversely impact its intended target but whose impacts are somewhat unknown to the many other species that grow in the same habitat as the target species. He questioned, what will happen to the introduced biocontrol once the target species is eliminated, and what are the long-term impacts of utilizing biocontrol? He noted that we are still living with the repercussion of previous biocontrol choices that we still cannot manage. Although Manai is not a proponent of utilizing biocontrol, he understands that the shift to use biocontrol suggests that all other methods for controlling these invasive species have been exhausted. He was aware that utilizing biocontrol is a much slower process and stated that the government does not have the means to manually eradicate Hawaiʻi's invasive species. He stated that there are also risks associated with the manual removal of invasive species.

While Manai remains skeptical of the effectiveness of biocontrol, he believes that the government must develop stricter laws and policies to stop the introduction of invasive species. He noted that in his travels to other parts of the world, including Japan and New Zealand, their customs process is far more thorough and intensive. He believes that these countries and exemplary models where the emphasis is placed on stopping the introduction instead of trying to combat its spread. He also advocates for a more rapid response to known invasive species and cited the example of the coqui frog, which on Hawaiʻi Island is now so widespread and nearly unmanageable. He believes that rapidly responding to invasive species, especially when populations are far more contained, could be far more effective.

DENNIS KANAʻE KEAWE

On August 13, 2019, Aoloa Santos conducted an interview with Dennis "Kanaʻe" Keawe, a retired Commercial Services Consultant for Hawaiian Electric Light Company (HELCO) and former lecturer at the University of Hawaiʻi at Hilo (UH Hilo). Born and raised on Oʻahu, Kanaʻe moved to Hawaiʻi Island in November of 1974, to help his father with his coffee farm in Hōnaunau, Kona. Following his retirement from HELCO at age 55, he was asked to teach a Hawaiian studies ethnobotany course at the UH Hilo. Kanaʻe stated that when he was asked to teach the course, his botanical vocabulary and knowledge was appropriate for teaching young children and therefore acknowledged that in order to instruct at the university level, he needed to expand and develop his botanical nomenclature. Through this process, Kanaʻe learned that many varieties of Hawaiʻi's native plants "exists within the tropical belt around the world" and by having in-depth knowledge of scientific names and identifiers allowed him to effectively communicate with people well-versed in similar plants of those regions. Additionally, Kanaʻe is a renowned Hawaiian artisan and cultural practitioner endearingly referred to by many as "the all-around guy." He has been recognized for his expert-crafted oeuvres, such as *hula pahu* (drum), *kapa* (bark cloth), *iʻe kuku* (*kapa* beater), and feather crafts. As a result of his artisanship, he has been afforded opportunities and invitations to visit communities and institutions around the world, notably the Smithsonian Museum, an institution that houses a large collection of Hawaiian antiquities.

When asked about any traditional cultural uses of the *T. herbacea*, Kanaʻe stated that he was unaware of any cultural importance or uses for any part of this plant but suggests that it perhaps may have medicinal properties and noted that this claim would have to be substantiated with proper research. While no specific information about any known past or current cultural uses of this plant was shared, he did offer thoughts on the use of biocontrol. Kanaʻe expressed his support of its use and did not foresee any major cultural impacts if extensive study and testing is done prior to its release. He added that although there are unknown variables to this method, humans can only do so much, especially in the current state of our environment and the rapid growth of invasive species.

ILIAHI ANTHONY

On September 3rd, 2019, Lokelani Brandt interviewed Iliahi "Ili" Anthony, a *hula* dancer, *lauhala* weaver, *lei* maker, and natural dye expert. Ili is also an art teacher at Ka ʻUmeke Kāʻeo Hawaiian Immersion Public Charter School and

has a background in designing furniture and exhibit spaces. Ili grew up in the community of Keaukaha and has been dancing *hula* since the age of four. As a life-long *hula* dancer for Hālau O Kekuhi, Ili explained that her knowledge of Hawai‘i plant life comes from years of gathering foliage (primarily indigenous and endemic species) and other natural resources for their *‘a‘ahu* (costume), *lei*, and *hula* implements. Ili recalled as a child being accompanied by her *kumu hula* and family members into their gathering areas where they taught her about the Hawaiian cultural significance of the plants, gathering protocols, how to identify them in the forest, and how to sustainably gather and prepare them to be used in the context of *hula*. She emphasized that as a small kid, she learned about these practices by watching and listening to her *kumu* and relatives and stated that when you are that young, you're not keenly aware of what it is they are teaching you, but as an adult, those teachings remain and are better understood. Ili openly stated that although she is not of Hawaiian ancestry, she has been raised by native Hawaiians and has learned about many of the traditional practices and customs. She expressed that although she chooses to remain respectful when it comes to Hawaiian issues and matters, she is willing to share her knowledge when asked and feels that she has something to offer.

Ili explained that as a *hula* dancer, she has learned to depend on other cultural practices to help her with gathering certain natural resources needed in *hula*. She described going on expeditions with her brother, who is a hunter, to gather *maile*. Ili explained that her brother knows the trails very well and is very particular about how they cut *maile*, and how much they take from any one plant. She added that although her brother is not necessarily a *lei* maker, he knows this plant and forest resources very well. She explained that she also relies on her father who is a woodcarver to help her make certain *hula* implements. Ili also described gathering with other *hula* dancers, some of whom have a background in native plants and botany, and shared that when she gathers with them, they often teach her about the names and can point out the subtleties that are not obvious to her. Ili believes that this demonstrates the interconnectedness of cultural practices and stated that even people who we think may not use plants, such as hunters and fishers, do often know a lot about native plant life. She stressed that as a *hula* practitioner and in terms of plant resources, she relies greatly on other practices that are not necessarily defined as *hula*.

With respect to learning about and identifying plants, whether native or non-native, Ili shared that unless someone shares that knowledge with her, then she would most likely not know about it. She expressed that when she has gone to get gathering permits from DLNR, she recalled seeing various informational posters in their office which she finds useful for learning about Hawai‘i's plant life and invasive pests.

When asked about her knowledge regarding any cultural uses for *T. herbacea*, Ili stated that she was not aware of this plant nor of any cultural uses. While Ili supports the removal of invasive species, especially if they are directly impacting native plants or native plant habitat, she cautioned that some plants that have been dubbed "invasive" are utilized for various traditional and contemporary cultural purposes. Ili opined that today, people utilize various "rubbish plants" to make adornments such as *lei* and that such plants if properly arranged can be turned into something beautiful and wearable. She also noted that weedy plants such as *laukahi* (*Plantago major*) and the introduced guava (*Psidium guajava*) have become incorporated into Hawaiian *lā‘au lapa‘au* (plant healing) practices. While she believes that finding a cultural purpose for an invasive plant is not a strong reason to halt invasive species management efforts, she cautioned that people have come to rely on certain invasive species to perpetuate select cultural practices because they are easily accessible and abundant. Adding to this, Ili expressed that people have and will continue to adapt to living with invasive species. Ili also worries that if invasive species, particularly those that are used for cultural purposes become less abundant and available, then people will likely have to find a more readily available substitute, which could result in people gathering indigenous or endemic species. She stated that people tend to use invasive species because they are abundant and easily accessible.

Ili shared that over the years she has observed an increasing number of pests on native plants and made specific reference to *‘a‘ali‘i* (*Dodonaea viscosa*), which now seems to be infested with spiders. She shared that as a *lei* maker, she often brings these plants into her home and disposes of her *hakina* (scrap pieces) in her yard. Although she has not seen those spiders move onto the plants at her home, Ili expressed a sense of uncertainty with gathering and possibly transporting unknown pest.

Ili also spoke about the need to improve our understanding of the ecological relationships that may exist between native and non-native species. She shared that some native plants such as *‘iliahi* (sandalwood; *Santalum ellipticum*) is semi-parasitic and relies on a host plant to thrive. She added that we know that native plants have adapted to each other and wonders if native species may have adapted or are adapting to living amongst non-native species as well. She pondered on the idea of removing invasive species and the possibility of causing indirect impacts to native species that have come to rely on them for some life-giving element.

When asked about her thoughts on the cultural appropriateness of using biocontrol, Ili opined that this is a difficult question to answer and lightheartedly stated that "basically, you're introducing another culture into the culture." She

asked, what things have we introduced in the past that actually worked? Ili added that she feels there have been more things in the past that have been introduced that haven't worked in comparison to those that have actually worked. Ili stated that introducing more foreign species to the islands is a scary thought and wondered what the future would look like. She asked, will we have to continually introduce more foreign species to combat those we previously introduced? Additionally, she wondered what would take the place of these invasives once they are removed?

When asked about her thoughts and recommendations about the proposed action, Ili believes the state could do more in terms of educating the public about identifying invasive species and the ways in which everyone can help limit the spread. She stated that there is a general lack of awareness and believes that providing more information to those who are obtaining gathering permits may be one way to improve awareness. She stressed that the information needs to be presented in a reasonable manner that would not deter people from obtaining a gathering permit. Ili shared that since the events taking place on Mauna Kea, she believes there is growing alertness amongst the people about land and culture-related issues. She has noticed an increasing awareness in schools where teachers are working with students to better understand and to seek solutions to these issues. She believes that the state should improve support to the schools so that the information is more accessible to students and teachers. Ili explained that many teachers want to do more of these kinds of projects with their students but there are many challenges that hinder their ability to execute such projects, including accessibility, funding, time, and finding a good resource person that can connect them to specific places and resources. She expressed that teachers can only guide and facilitate these kinds of projects, but they are not plant experts. She believes that education can be a key component in improving public awareness. She also added that while there may be a robust amount of scientific information about the potentially positive aspects of biocontrol, it needs to be condensed and expressed in layman's terms to that the general population can actually understand and connect to what scientists are discovering. She lamented that otherwise, people won't listen or hear what is being said because they can't connect to or understand what the scientists are saying. Ili made reference to the tremendous educational efforts that were put into improving public awareness about Rapid ʻŌhiʻa Death and noted that their outreach team was doing big and small things such as community talks, stickers, hats, and being present at various local community events. She believes that more of these kinds of efforts could be undertaken for other invasive species.

Ili also shared that many scientists are not practitioners and opined that these two groups, although they may share an affinity for preserving plants, both have two completely different relationships with the resource. She believes that the relationship between scientists and practitioners should also be improved because both groups can help to elevate and improve each other's practices if they are willing to work collaboratively. While she feels that this dynamic has been changing, she thinks its especially important as we move towards the possibility of using biocontrol in native plant habitats.

4. IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS

The OEQC guidelines for assessing cultural impacts identify several possible types of cultural practices and beliefs that are subject to assessment. These include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The guidelines also identify the types of potential cultural resources associated with cultural practices and beliefs that are subject to assessment, which "may include traditional cultural properties or other types of historic sites, both man made and natural, including submerged cultural resources"(Office of Environmental Quality Control (OEQC) 1997:1). The origin of the concept of traditional cultural property is found in National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service (Parker and King 1998). A traditional cultural property can be generally defined as:

> …one that is eligible for inclusion in the National Register because of its association with cultural practices and beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. (Parker and King 1998:1)

This definition also implies that any identified traditional practices and beliefs of an ethnic community, or members of that community, exceeds fifty years. "Traditional" as defined in the National Register Bulletin 38 "refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practices (ibid.). Whereas, "Culture" refers to "a system of behaviors, values, ideologies, and social arrangements" in addition to "tools and expressive elements such as graphic arts" (ibid.). The

use of the term "Property" defines this category of resource as an identifiable place. Traditional cultural properties are not intangible, they must have some kind of boundary; and are subject to the same kind of evaluation as any other historic resource, with one very important exception. By definition, the significance of traditional cultural properties should be determined by the community that values them.

It is however with the definition of "Property" wherein there lies an inherent contradiction and corresponding difficulty in the process of identification and evaluation of potential Hawaiian traditional cultural properties because it is precisely the concept of boundaries that runs counter to the traditional Hawaiian belief system. The sacredness of a particular landscape feature is often cosmologically tied to the rest of the landscape as well as to other features on it. To limit a property to a specifically defined area may actually partition it from what makes it significant in the first place. However offensive the concept of boundaries may be, it is nonetheless the regulatory benchmark for defining and assessing traditional cultural properties. As the OEQC guidelines do not contain criteria for assessing the significance for traditional cultural properties, this study will adopt the state criteria for evaluating the significance of historic properties, of which traditional cultural properties are a subset. To be significant the potential historic property or traditional cultural property must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

a Be associated with events that have made an important contribution to the broad patterns of our history;

b Be associated with the lives of persons important in our past;

c Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

d Have yielded, or is likely to yield, information important for research on prehistory or history;

e Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

While it is the practice of the DLNR-SHPD to consider most historic properties significant under Criterion d at a minimum, it is clear that traditional cultural properties by definition would also be significant under Criterion e. A further analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities resulted from the *Ka Paʻakai O Ka ʻĀina* v Land Use Commission court case. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired; and third, specify any mitigative actions to be taken to reasonably protect native Hawaiian rights if they are found to exist.

Summary of Findings, Identification of Cultural Impacts, and Proposed Mitigative Measures

A review of the culture-historical background information reveals that *T. herbacea* was first discovered in 1977, growing along the Saddle Road on Hawaiʻi Island and by 1982, specimens were found at locations in both east and west Maui. By the 1990s, *T. herbacea* was discovered on the island of Lānaʻi and in the 2000s, it was found growing in Hālawa Valley in east Molokaʻi and at several locations on the island of Oʻahu. It is now naturalized on both the islands of Maui and Hawaiʻi. A review of the culture-historical background in addition to the consultation efforts has yielded no reported cultural use for this plant nor is there any historical evidence to suggest that *T. herbacea* is crucial to any particular ethnic groups' cultural history, identity, practices, or beliefs, nor does it meet any of the significance criteria outlined above. Although *T. herbacea* does not meet any of the significance criteria, what is culturally significant is the wet forest habitat in which it thrives. Hawaiʻi's wet forest habitat could be considered significant as a traditional cultural property under Criterion e, as it contains many culturally important indigenous and endemic taxa, which are still utilized in certain Hawaiian cultural practices. Some of these wet forest resources are also associated with certain Hawaiian cultural beliefs.

Based on the information presented in the culture-historical background and from the insights shared by the consulted parties, it is the assessment of this study that the release of the proposed biological control agent, *Syphraea uberabensis* will not result in impacts to any valued cultural, historical, or natural resources. Conversely, if no action is taken to further reduce remaining populations of *T. herbacea* and other highly invasive Melastomes from claiming more of Hawaiʻi's wet forest habitat, then impacts to this valued resource would be anticipated.

While no specific cultural impacts have been identified, the consulted parties shared valuable insight, concerns, and recommendations that could reduce the potential for any future impacts and improve public transparency regarding the effectiveness of biocontrol as a conservation management strategy. Several key themes emerged from the consultation efforts, all of which are further described below:

1) maintain stringent pre and post-release testing and monitoring;
2) improved community transparency and input;
3) active and ongoing public outreach and education;
4) improve efforts to limit the introduction of potentially harmful invasive species.

While the consulted parties did not explicitly oppose the use of biocontrol, especially to aid in the recovery of Hawai‘i’s native forest habitat, they all shared a sense of concern and spoke about the risks inherent in biocontrol activities. While they were all aware of the extensive studies that are conducted prior to the release of any biocontrol agent, they all spoke about the uncertainty of introducing another foreign insect to Hawai‘i’s fragile ecosystems. Several of the consulted parties noted that although pre-release host specificity test helps with the screening process, they shared that laboratory testing cannot account for all the variables found in nature. The generally held belief is that field release is merely another screening and testing procedure. Despite this element of uncertainty, all of the consulted parties agreed that some sort of action is necessary to limit the growth and spread of *T. herbacea* and other weedy Melastomes. Nearly all of the consulted parties stressed the importance of thorough controlled pre-release studies to safeguard against the potential for the collateral loss of other endemic taxa or economically valuable crops. Several of the consulted parties also stressed the importance of conducting on-going and consistent post-release monitoring to ensure that the biocontrol agent does not spread beyond its intended target. These individuals noted that consistent post-release monitoring will help with early detection if it is found that the proposed biocontrol agent has unintentionally spread beyond the host plant. Wild Brawner suggested the concept of integrated pest management, particularly for native plants, where natural and cultural management practices are employed concurrently. Examples of this include, timing weed removal and planting companion plants to attract active pollinators or insects that may combat other invasive insects.

In looking to future biocontrol efforts, nearly all of the consulted parties expressed the need to integrate more public input and stressed the importance of moving towards a community-based resource management structure. Based on the past public meetings held by HDOA for biocontrol, Jen Lawson felt that the public meetings held by the HDOA should be restructured so that they are engaging and inclusive of community input as she believes this may improve trust between the affected communities and the agencies. Jen Lawson and Iliahi Anthony believe that supporting biocontrol research must be clearly and effectively communicated to the public using various media forms. Iliahi Anthony noted that education and outreach are key components to improve the public’s understanding of biocontrol and empowering them with the knowledge and tools to help limit the spread of invasive species. Both Jen Lawson and Iliahi Anthony expressed that improving the public’s understanding of the risk and benefits of biocontrol may help to build public transparency and hopefully resolve some of the misconceptions associated with biocontrol. Jen Lawson encourages the responsible agencies to consider partnering with conservation-focused non-profit organizations and community groups, especially during the field release monitoring phase as these groups are working directly with these target species daily. As noted by Kim and Forest Starr, the conventional biocontrol release methods that have been used in the past typically yields results that are underwhelming. Perhaps, the additional support from non-profit organizations could potentially improve the efficacy of biocontrol.

All of the consulted parties spoke about the many misconceptions associated with biocontrol, many of which are based on failed historical examples. While testing and screening procedures have improved significantly since the late 19th century, many people today remain resistant and skeptical to implement biocontrol. It is the author’s contention and as described by some of the consulted parties that this widely held belief stems from the agencies’ lack of public outreach and education. In light of this, it is imperative that DLNR, DOFAW, and HDOA make serious efforts to participate in public outreach events and to educate the public so that these misconceptions, some of which are rooted in a historical context, can be better understood. Public outreach and education efforts should also demonstrate the potential effectiveness of biocontrol as a conservation management strategy. Iliahi Anthony spoke about the effectiveness of the Rapid ‘Ōhi‘a Death (ROD) community outreach efforts and believes that this could be an exemplary model. Iliahi Anthony noted that the ROD outreach team has been actively disseminating information using various media forms.

While combatting existing populations of invasive species is a critical step in managing Hawai‘i’s natural resources, it was noted by Manaiakalani Kalua that the State of Hawai‘i must also ramp up their efforts to prevent the arrival and introduction of unwanted pest species. Manaiakalani Kalua believes that current policies and laws must be revised and strengthened. Both Manaiakalani Kalua and Iliahi Anthony noted that in their travels to other countries

their customs entry process is far more rigorous and thorough. Manaiakalani Kalua believes that the State should look to other countries such as New Zealand and Japan as models to prevent the arrival of unwanted pests.

In summary, the recommendations provided above are intended to ensure that the release of *S. uberabensis* as a biocontrol agent for *T. herbacea* and other Melastomes considers the culture-historical context and the concerns and thoughts shared by the consulted parties. While none of the consulted parties explicitly opposed the use of biocontrol, the concerns, and recommendations offered above are intended to support the State of Hawai‘i, specifically DLNR, DOFAW, and HDOA in being mindful of the cultural, social, and environmental uniqueness of Hawai‘i. Conducting background research, consulting with community members, and taking steps towards mitigating any potential cultural impacts is done so in the spirit and practice of *Aloha ‘Āina*, a contemporary movement founded on traditional practices and beliefs that emphasize the intimate relationship that exists between Native Hawaiians and the *‘āina* (land). If DLNR, DOFAW, and HDOA assume ownership of their right and responsibility to release a biocontrol agent, we recommend it be done so in that same spirit and practice. Attention to and implementation of the above-described issues and measures will help to ensure that no such resources, practices, or beliefs will be adversely affected by the proposed release of *S. uberabensis*.

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APPENDIX A.
KA WAI OLA PUBLIC NOTICE

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PUBLIC NOTICE

ASM Affiliates is preparing a Cultural Impact Assessment (CIA) in advance of a proposed statewide release of four (4) biological control (biocontrol) agents for four target invasive species. In brief, DOFAW is seeking to conduct a statewide field release of four (4) separate biocontrol agents on four target species:

- introduction of a wasp parasitoid *(Aprostocetus nitens)* to further control the erythrina gall wasp (*Quadradstichus erythrinae)*, which has been impacting the native *wiliwili (Erythrina sandwicensis)*;
- introduction of a small beetle *(Syphraea uberabensis)* to control weedy melastomes *(Tibouchina spp.)*;
- introduction of a thrips insect *(Pseudophilothrips ichini)* to control Christmas berry *(Schinus terebinthifolia)*;
- introduction of a butterfly *(Euselasia chrysippe)* to control miconia *(Miconia calvescens)*.

We are seeking consultation with any community members that might have knowledge of traditional cultural uses or who are involved in any ongoing cultural practices associated with the target species (i.e. *wiliwili*, melastones, Christmas berry, and miconia). If you have and can share any such information please contact Lokelani Brandt lbrandt@asmaffiliates.com, or Aoloa Santos asantos@asmaffiliates.com, phone (808) 969-6066, mailing address ASM Affiliates 507A E. Lanikaula Street, Hilo, HI 96720.

(Ka Wai Ola 2019:21)

ATTACHMENT 3

Host specificity of *Syphraea uberabensis* (Coleoptera: Chrysomelidae), a proposed biological control agent for invasive melastomes in Hawaii

Summary

The South American flea beetle, *Syphraea uberabensis* (Coleoptera: Chrysomelidae), was evaluated as a potential biological control agent for the invasive weed, *Tibouchina herbacea* and its relatives (Melastomataceae), in Hawaii. Adult beetles, 3-4 mm in length, feed and lay eggs on leaves and soft stems of their host plants. Larvae feed externally on leaves as well. Specificity tests indicated the host range of *Syphraea uberabensis* is restricted to a few melastome species, all non-native and considered invasive in Hawaii. The results of no-choice starvation tests and multi-choice testing consistently identified the potential Hawaiian hosts as: *Tibouchina herbacea, Tibouchina longifolia, Pterolepis glomerata, Melastoma septemnervium* and *Melastoma sanguineum*.

In no-choice tests, substantial feeding by *Syphraea* beetles was observed on no more than seven melastome species, and egg laying was further restricted to the five mentioned species, all in the tribe Melastomeae, which includes American and Asian species. In no-choice tests with larvae, these same melastomes supported high rates of survival, while a few other melastomes supported lower rates of survival, and other plants did not support survival beyond the second instar.

Multi-choice testing with adult beetles revealed strong preferences for feeding and oviposition in the same species identified as probable hosts during no-choice trials. Feeding within tribe Melastomeae occurred at significantly higher levels than in other tribes ($p < 0.01$). When the preferred hosts were excluded in reduced multi-choice tests, adult insect feeding decreased dramatically. In the absence of the preferred hosts, oviposition increased slightly on other species within family Melastomataceae, with the greatest increase in oviposition occurring on *Tibouchina urvilleana*. Although closely related to preferred host plants, this weedy shrub was rarely accepted by *Syphraea* for feeding or egg laying. It appears to be an unlikely host because its leaves are well protected by dense hairs.

The Hawaiian ranges of *T. herbacea, T. longifolia, P. glomerata, M. septemnervium* and *M. sanguineum* overlap considerably. Although *Syphraea* showed a clear preference for *T. longifolia* in laboratory tests, it is unlikely that this preference will have a significant impact in

the Hawaiian environment because *T. longifolia* is so scarce compared to *T. herbacea* and other potential hosts. A more likely scenario is that *Syphraea* will negatively impact widespread *T. herbacea*, while perhaps helping prevent *T. longifolia* from spreading.

Syphraea is tolerant of cool and moderate temperatures, and is not expected to be restricted in range by temperatures in Hawaii, except perhaps in exceptionally warm habitats (Souder 2008). However, the potential of *Syphraea* as a biological control could be limited by humidity at the microhabitat level. In Brazil, *Syphraea* is found with its melastome hosts in boggy soils, similar to the areas where *Tibouchina* and *Pterolepis* thrive in Hawaii, so these hosts should be highly susceptible. On the other hand, *Melastoma* in Hawaii can grow in relatively drier areas – such as young lava flows. *Syphraea* could be less effective against *Melastoma* in drier habitats, because its eggs and larvae appear to be susceptible to drying when humidity is not high.

Feeding damage by adults and larvae of *Syphraea uberabensis* on the host plant *Tibouchina herbacea*.

Testing Methods

Insect rearing: *Syphraea uberabensis* eggs and larvae on *T. herbacea* cuttings were shipped in July 2005 from Universidade Estadual Centro-Oeste in Irati, Parana State, Brazil to the Hawaii Volcanoes National Park Quarantine Facility (HVNPQF). The shipment resulted in an initial colony of approximately 50 adult flea beetles. Abnormal growth of potted *Tibouchina*

plants in HVNPQF limited rearing the flea beetle on live plants. Therefore, *T. herbacea* cuttings collected around Glenwood and Volcano, Hawaii (700-1200 m) were used to maintain colony insects. In HVNPQF, the environmental conditions ranged from 18-24º C, 20-95% relative humidity (RH), with a natural photoperiod (approximately12-12h light:dark). Flea beetles were reared on fresh leaf cuttings of *T. herbacea* over moistened paper towel in 150mm x 25mm circular petri dishes. The moistened towel maintained a level of humidity inside the petri dish that kept plant material turgid. Each dish was filled with 30-40 newly emerged adults (roughly 1:1 sex ratio). Deteriorating and heavily damaged leaves were removed and replaced with new cuttings every other day, and each petri dish was changed completely approximately twice per week. When adults began to lay eggs, the egg bearing leaves were removed and recombined in equal proportions from different source dishes to maintain a diverse genetic pool. Larvae were reared on fresh leaf cuttings in large petri dishes, similar to adults. Large third instars were transferred to petri dishes with moistened vermiculite to simulate soil for pupation. Beetles completed a full generation cycle in approximately two months.

Test Plants: Potential host preferences were evaluated on a total of 58 plant species in 30 families. Test plants were selected based on the centrifugal phylogenetic method proposed by Wapshere (1974). The test list included six plant species requested by the U.S. Fish and Wildlife Service because of their ecological importance, as well as a variety of species with economic significance in Hawaii (Table 1). Potted plants were grown with a standard medium of half potting soil and half cinder under automated irrigation and either direct sunlight (1200 m elevation at HVNPQF) or 73% shade cloth (300 m elevation at Waiakea Experiment Station, University of Hawaii College of Tropical Agriculture and Human Resources, Hilo). Cuttings were made from wild plants growing in the vicinities of Volcano and Hilo, Hawaii. Two common forms of Hawaii's dominant forest tree, *Metrosideros polymorpha*, were tested: with glabrous and pubescent leaves. All plants and cuttings were maintained without pesticides and were inspected and cleaned to remove pests and previous damage before testing.

Table 1. Plant species used for *Syphraea uberabensis* host specificity testing, listed in order of phylogenetic relation to the target weed, *Tibouchina herbacea*.

Order	Family	Tribe	Species	Common name
Myrtales	Melastomataceae	Melastomeae	*Tibouchina herbacea*	cane tibouchina
			Tibouchina longifolia	
			Tibouchina urvilleana	glorybush
			Pterolepis glomerata	
			Heterocentron subtriplinervium	pearl flower
			Melastoma septemnervium	
			Melastoma sanguineum	
			Dissotis rotundifolia	
		Microlicieae	*Arthrostemma ciliatum*	
		Dissochaeteae	*Medinilla cumingii*	
		Miconieae	*Clidemia hirta*	Koster's curse
			Miconia calvescens	miconia
			Tetrazygia bicolor	
	Myrtaceae		*Metrosideros polymorpha* *	ohia lehua
			Syzygium cumini	Java plum
			Syzygium malaccense	mountain apple
			Syzygium jambos	rose apple
			Psidium cattleianum	strawberry guava
			Eugenia uniflora	surinam cherry

Table 1 (continued).

Order	Family	Tribe	Species	Common name
Myrtales	Lythraceae		*Lythrum maritimum*	
			Cuphea carthagenensis	
			Cuphea ignea	cigar flower
			Cuphea hyssopifolia	false heather
	Onagraceae		*Fuchsia magellanica*	fuchsia
			Epilobium ciliatum	
			Oenothera laciniata	evening primrose
	Combretaceae		*Terminalia catappa*	tropical almond, false kamani
Sapindales	Anacardiaceae		*Mangifera indica*	mango
	Rutaceae		*Citrus limon*	lemon
	Sapindaceae		*Dodonaea viscosa* *	‘a’ali’i
Malvales	Malvaceae		*Hibiscus arnottianus*	hibiscus
	Thymelaeaceae		*Wikstroemia sandwicensis*	akia
Brassicales	Caricaceae		*Carica papaya*	papaya
Fabales	Fabaceae		*Acacia koa* *	koa
			Erythrina sandwicensis	wiliwili
			Pisum sativum	pea
			Sophora chrysophylla *	mamane
Rosales	Rosaceae		*Rubus ellipticus*	Himalayan raspberry
			Rubus hawaiensis	akala
			Fragaria vesca	strawberry
	Urticaceae		*Pipturus albidus*	mamaki
Malpighiales	Passifloraceae		*Passiflora* spp.	passion flower
Ericales	Ericaceae		*Vaccinium calycinum*	ohelo
	Theaceae		*Camellia sinensis*	tea
Gentianales	Apocynaceae		*Alyxia stellata*	maile
	Rubiaceae		*Coffea arabica*	coffee
Solanales	Solanaceae		*Physalis peruviana*	poha
Lamiales	Myoporaceae		*Myoporum sandwicense* *	naio
Asterales	Goodeniaceae		*Scaevola chamissoniana*	naupaka
Proteales	Proteaceae		*Macadamia integrifolia*	macadamia
Alismatales	Araceae		*Anthurium* sp.	anthurium
Asparagales	Asparagaceae		*Cordyline fruticosa*	ki
	Orchidaceae		*Arundina graminifolia*	bamboo orchid
			Cymbidium sp.	cymbidium
Zingiberales	Zingiberaceae		*Hedychium gardnerianum*	kahili ginger
Laurales	Lauraceae		*Persea americana*	avocado
Gleicheniales	Gleicheniaceae		*Dicranopteris linearis*	uluhe
Polypodiales	Dicksoniaceae		*Cibotium glaucum* *	hapuu pulu

*Ecologically significant native species tested on request of U.S. Fish and Wildlife Service

Results: Larval Feeding and Survival

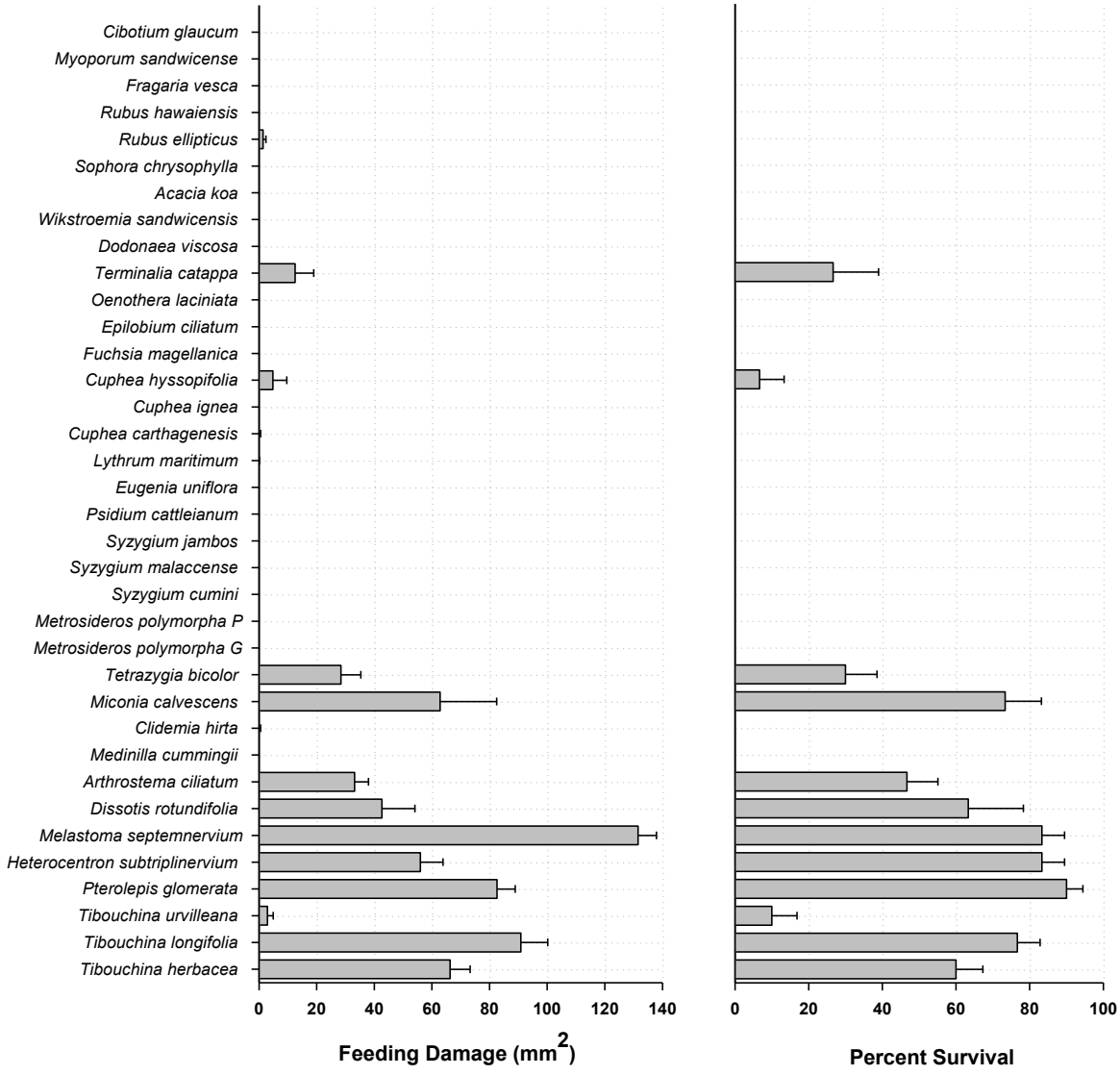

Figure 1. Feeding and survival of newly hatched *S. uberabensis* larvae after 7 days on potted plants under no-choice conditions (means ± standard errors; 6 replicates, 5 larvae per replicate). Genetic relationship to *Tibouchina herbacea* increases from top to bottom. Two leaf forms of *Metrosideros polymorpha* were tested: glabrous (G), and pubescent (P).

Results: Larval Survival and Development

Table 2. Survival of *S. uberabensis* from newly hatched first instars to successive developmental stages on fresh plant cuttings under no-choice conditions (mean percentage ± standard error; 4 replicates 10 larvae per replicate). Plant species were selected based on occurrence of at least minor levels of larval feeding in 7 day tests.

Test Plant	**2nd Instar**	**3rd Instar**	**Pupa**	**Adult**
Tibouchina herbacea	80.0 ± 4.1	70.0 ± 4.1	67.5 ± 4.8	62.5 ± 4.8
Tibouchina longifolia	82.5 ± 2.5	77.5 ± 4.8	75.0 ± 2.9	62.5 ± 2.5
Tibouchina urvilleana	0	-	-	-
Pterolepis glomerata	90.0 ± 4.1	85.0 ± 2.9	80.0 ± 4.1	67.5 ± 2.5
Heterocentron subtriplinervium	50.0 ± 4.1	30.0 ± 7.1	25.0 ± 6.5	15.0 ± 6.5
Melastoma septemnervium	82.5 ± 8.5	75.0 ± 5.0	67.5 ± 2.5	62.5 ± 2.5
Dissotis rotundifolia	42.5 ± 11.1	27.5 ± 4.8	17.5 ± 7.5	12.5 ± 4.8
Arthrostema ciliatum	0	-	-	-
Medinilla cummingii	0	-	-	-
Clidemia hirta	0	-	-	-
Miconia calvescens	37.5 ± 8.5	22.5 ± 9.5	0	-
Tetrazygia bicolor	32.5 ± 8.5	17.5 ± 2.5	10.0 ± 4.1	0
Cuphea carthagenensis	0	-	-	-
Cuphea hyssopifolia	5.0 ± 2.9	0	-	-
Terminalia catappa	15.0 ± 6.5	0	-	-

Results: Young Adult Feeding and Survival

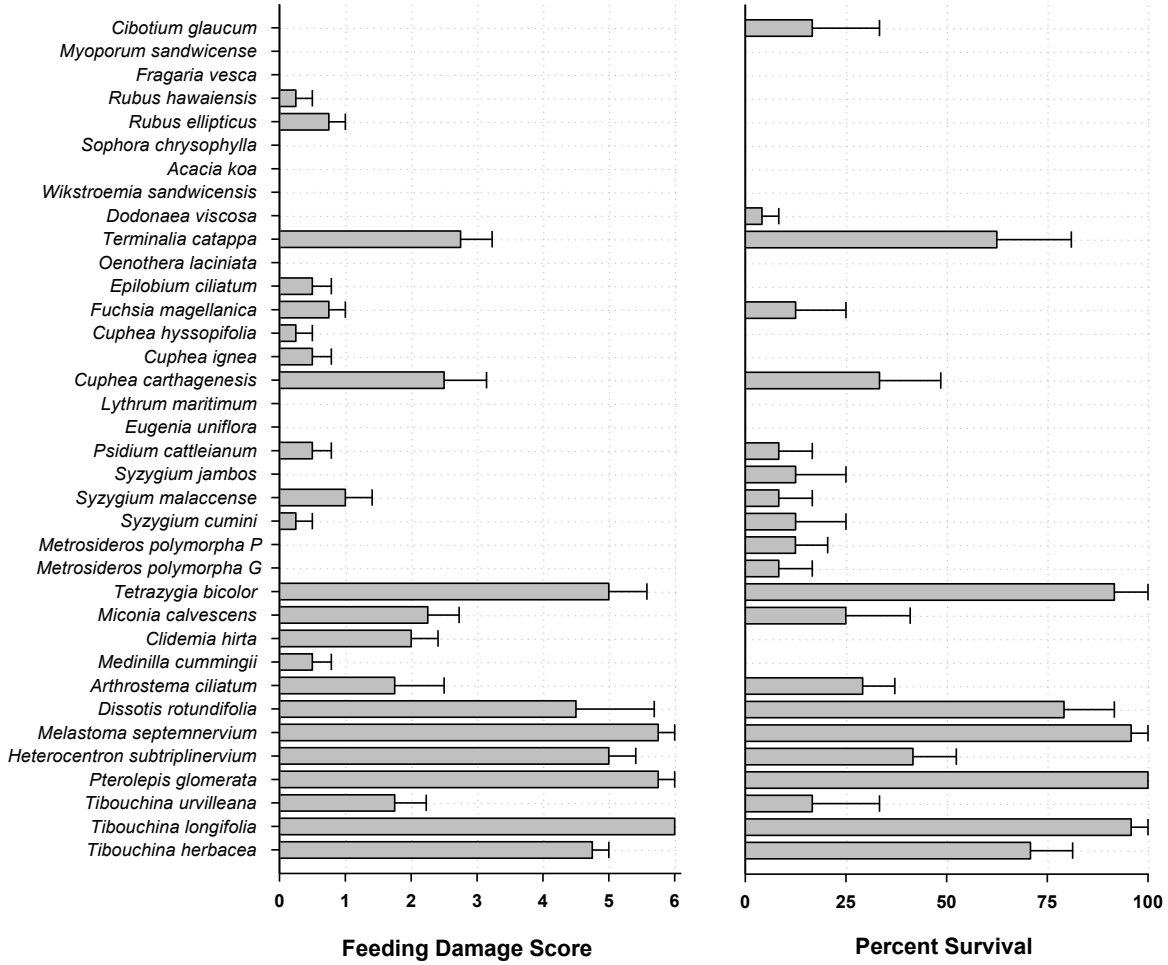

Figure 2. Feeding and survival of naïve adult *S. uberabensis* after 7 days on potted plants under no-choice conditions (means ± standard errors; 4 replicates). Naïve adults (3 male and 3 female per replicate) were newly emerged from pupation in vermiculite (<12 hours old) and had not been exposed to any plant material prior to testing. Feeding score: 0 = no damage, 1 = fewer than 10 pinholes, 2 = less than 1 cm^2 damaged, 3 = 1-2 cm^2, 4 = 2-3 cm^2, 5 = 3-4 cm^2, 6 = greater than 4 cm^2 damaged.

Results: Mature Adult Feeding and Survival

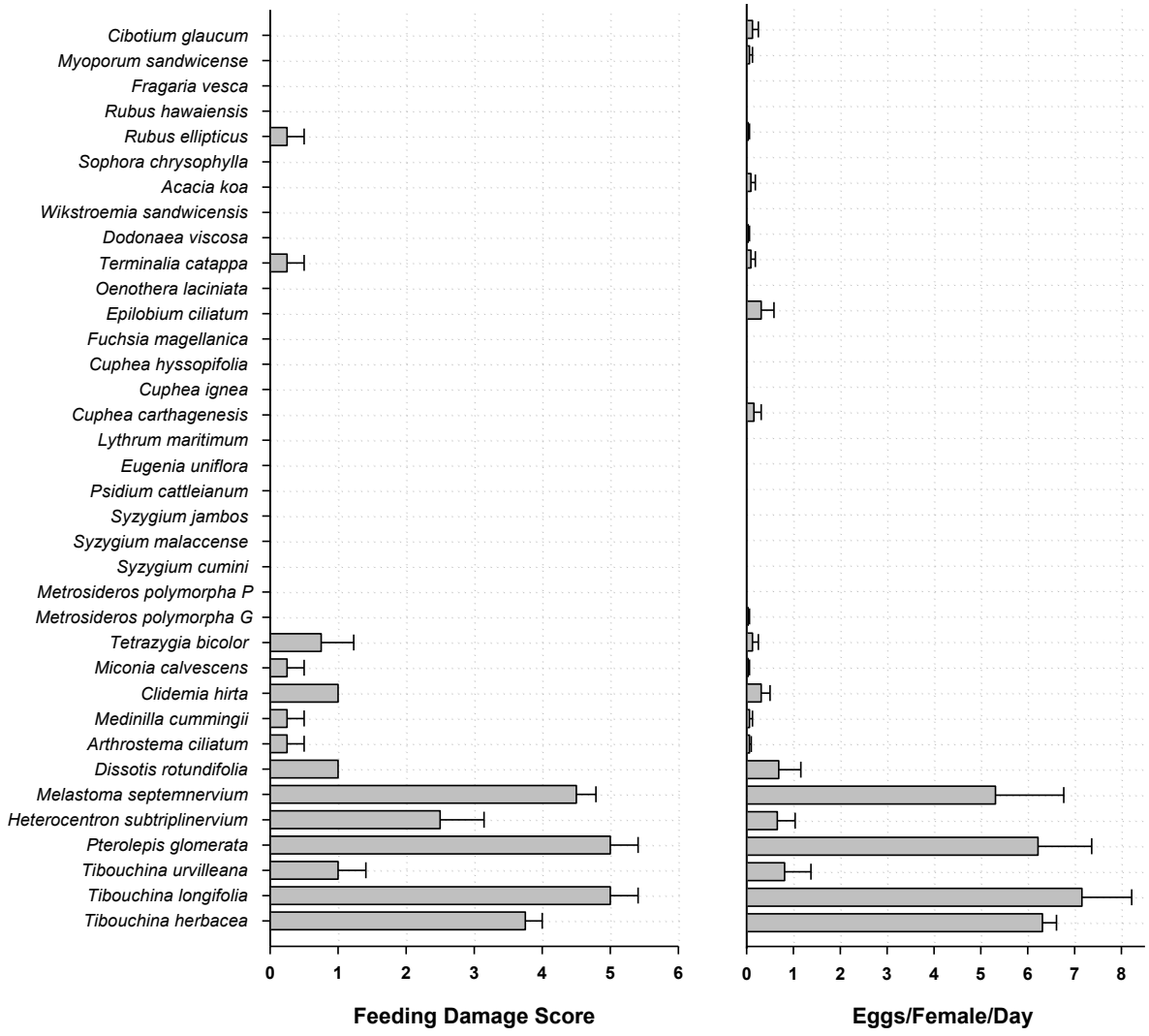

Figure 3. Feeding and oviposition by mature adult *S. uberabensis* after 4 days on potted plants under no-choice conditions (means ± standard errors; 4 replicates). Before testing, adults were reared in petri dishes on *T. herbacea* cuttings for 30 days, removed from food for 24 hours, and then transferred as mating pairs into enclosures on potted plants (2 males and 2 females per replicate). Mature beetles fed more selectively than naïve adults which had no prior feeding experience on *T. herbacea* (Fig. 2). However, testing naïve adults for longer periods showed that only a few melastome species support survival to maturity and oviposition (Table 3).

Results: Fecundity and Development

Table 3. Female lifespan, pre-oviposition period, and total fecundity (means ± standard errors), and survival of offspring for *S. uberabensis* male-female pairs fed fresh plant cuttings under no-choice conditions.

Test Plant	Number females	Life Span (d)	Pre-oviposition (d)	Eggs per female	F1 Survival egg to adult (n=eggs collected)	F2 Survival egg to 3rd instar (n=eggs collected)
Tibouchina herbacea	12	50.3 ± 3.4	23.4 ± 0.5	173 ± 38	38% (94)	67% (100)
Tibouchina longifolia	10	70.1 ± 8.0	40.3 ± 3.3	175 ± 36	43% (90)	72% (100)
Tibouchina urvilleana	7	51.4 ± 4.9	31.6 ± 1.5	36 ± 13	0% (50*)	-
Pterolepis glomerata	14	98.8 ± 7.4	58.6 ± 6.5	220 ± 31	51% (93)	79% (100)
Heterocentron subtriplinervium	10	25.8 ± 3.8	23.0 ± 0	6 ± 6	0% (11*)	-
Melastoma septemnervium	11	63.6 ± 7.5	29.6 ± 2.5	207 ± 37	42% (91)	71% (100)
Tetrazygia bicolor	11	52.9 ± 5.6	45.3 ± 6.9	17 ± 12	0% (40*)	-

* Collected every egg laid by females on this test plant

This test was initiated with naïve adults caged on foliage of a potted plants of 13 species (30 beetles per plant). After 14 days surviving individuals were separated into single male-female pairs and placed in petri dishes with plant cuttings. Only four plants of 13 species tested sustained naïve adults to maturation, oviposition, and development of F1 generation adult beetles: *T. herbacea*, *T. longifolia*, *P. glomerata*, and *M. septemnervium*. F1 progeny were reared on each of these four plant species, producing viable F2 eggs and larvae that development to third instars before testing was terminated. Plant species *T. urvilleana, H. subtriplinervium,* and *T. bicolor* supported survival of beetles to maturation and egg-laying, but larvae did not survive. No beetles survived beyond 14 days on plants species *A. ciliatum*, *C. hirta*, *M. calvescens*, *C. carthagenesis*, and *T. catappa*; some beetles survived on *D. rotundifolia* but did not produce any eggs. (For these reasons, results for these six plant species are not shown above).

There were significant differences between *T. herbacea*, *T. longifolia*, *P. glomerata*, and *M. septemnervium* in female lifespan ($H = 17.90$, $df = 3$, $P \geq 0.001$) and pre-oviposition time ($H = 17.74$, $df = 3$, $P \geq 0.001$), but no significant differences in the total number of eggs laid ($H = 1.46$, $df = 3$, $P = 0.691$) or in daily oviposition rates ($H = 1.73$, $df = 3$, $P = 0.631$).

Results: Additional Tests with Mature Adults

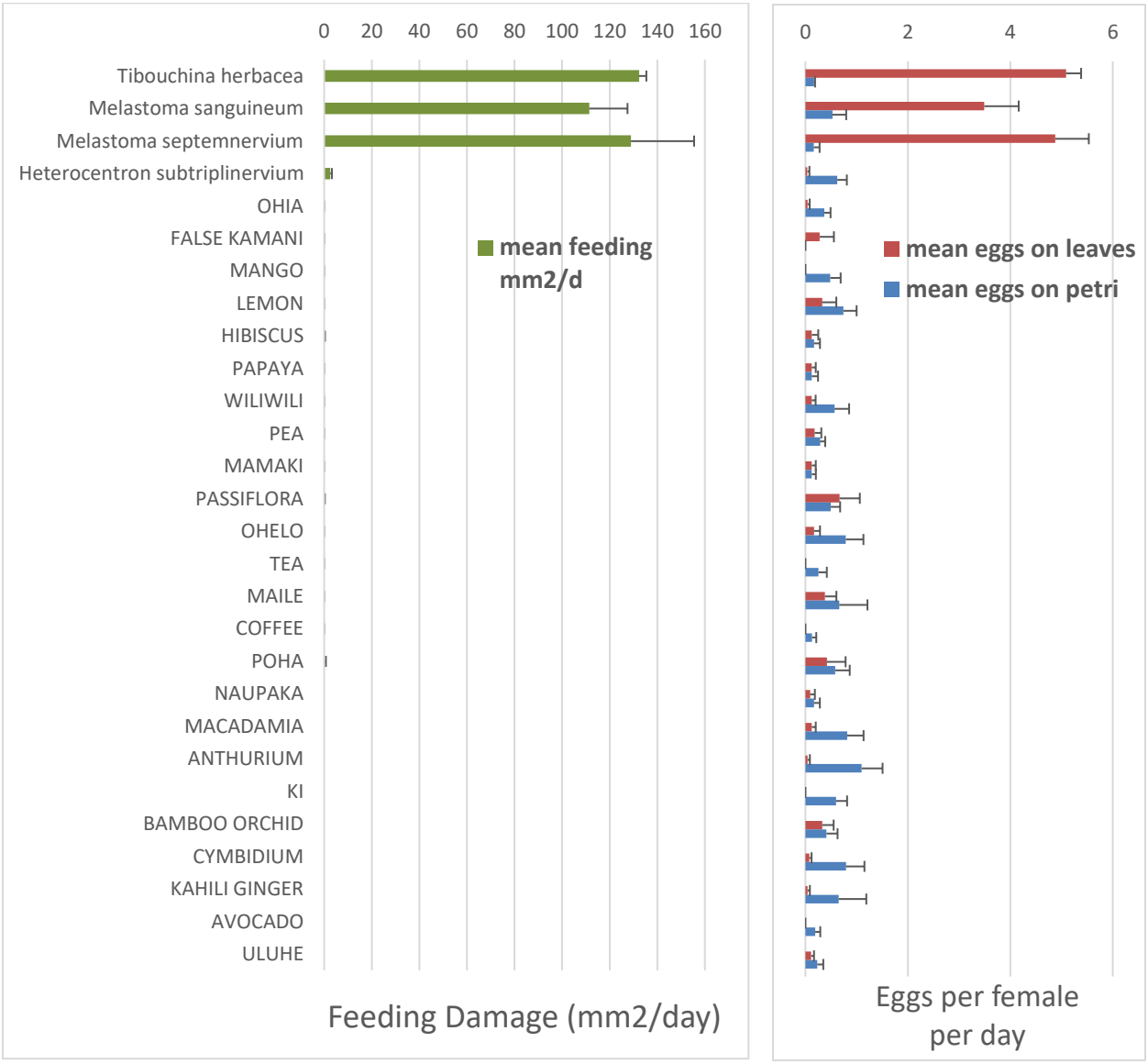

Figure 4. Feeding and egg-laying by mature adults exposed to plant leaves in petri dishes (10cm x 1cm) for 2 days under no-choice conditions; 3 females and 3 males per test (means ± standard errors; 4 replicates). This test utilzed a variety of plants not closely related to the family Melastomataceae. It was common for females to occasionally lay a few eggs in petris with non-host plants, typically on a paper towel rather than on a leaf. “Egg dumping” is not unusual in this kind of confined testing (Heard 2002, Papaj 2000, Wang & Horng 2004).

Results: Adult Choice Tests

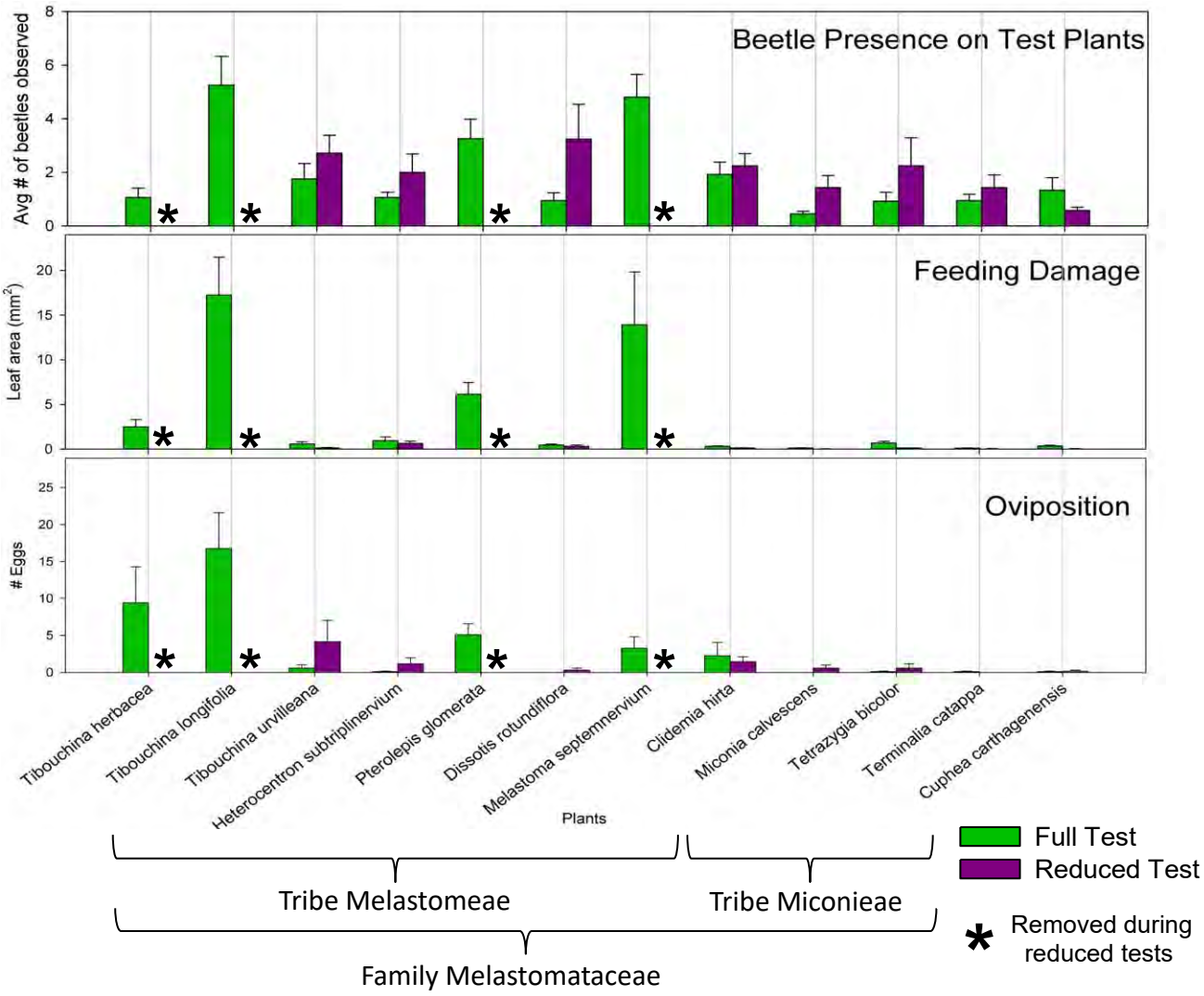

Figure 5. Location, feeding, and oviposition of *Syphraea uberabensis* in multi-choice testing over 3 days in an arena (40x40x40 cm) with cut stems of several plant species (means ± standard errors). Plant species are listed from left to right in order of decreasing genetic relationship to *Tibouchina herbacea*. Green bars represent Full tests (12 replicates, 12 test plants), and purple bars represent Reduced tests, for which the highly preferred host plants were removed (7 replicates, 8 test plants). Feeding and egg laying decreased greatly overall when preferred host plants were removed, and egg laying increased only slightly on the non-preferred melastomes, mainly *Tibouchina urvilleana*.

Conclusions

Testing revealed *Syphraea uberabensis* to be narrowly host-specific within the family Melastomataceae and able to complete development on only five plant species in Hawaii. Larvae and naïve adults showed a somewhat broader range of feeding compared to mature adults in tests lasting a few days, however low levels of feeding outside the normal host range is a common result of no-choice tests, in which insects are unable to seek out preferred hosts (Heard 2002). Longer test periods demonstrated that only a few melastome species support survival to maturity and oviposition. Choice tests demonstrated the same few melastome species to be highly preferred over other related plants.

Egg laying was negligible on all plants tested except *Tibouchina herbacea*, *Tibouchina longifolia*, *Pterolepis glomerata*, *Melastoma septemnervium* and *Melastoma sanguineum*. Furthermore, these species were the only plants that supported the complete life cycle of *S. uberabensis*. Eggs laid in very low numbers on other species may have been a result of egg dumping, which occurs with some insects when a female's egg load exceeds a maximum threshold (Papaj 2000, Wang & Horng 2004). Feeding and minor egg laying suggested that a few Melastomataceae (*T. urvilleana*, *T. bicolor*, *H. subtriplinervium* and *D. rotundifolia*) might be marginal hosts, however longer development tests showed that these plants are unlikely to sustain populations of *S. uberabensis.* If introduced to Hawaii, it is possible that *S. uberabensis* could be found in association with these plants where they grow in proximity to hosts that support complete development. Additional association could be observed on the non-melastome *Terminalia catappa*, which experienced minor feeding damage in host specificity tests. However, no sustained development occurred during long-term larval and adult tests on this plant, and in Hawaii *T. catappa* typically occurs at coastal sites where the preferred melastome hosts are not common. Feeding observed in no-choice testing on plants like *T. catappa* is less likely to occur when flea beetles can move to a preferred host (Heard 2002). Choice tests confirmed this, showing negligible feeding and egg laying by *S. uberabensis* on *T. catappa*, regardless of presence or absence of highly preferred hosts.

It is interesting to note that two suitable hosts of *S. uberabensis*, *Melastoma septemnervium* and *Melastoma sanguineum*, originate from Asia, and that ancestors of this plant genus likely diverged from neotropical ancestral hosts of *Syphraea* an estimated 11-12 million

years ago (Renner and Meyer 2001). Molecular analyses place the three genera, *Melastoma*, *Pterolepis* and *Tibouchina*, all in the same clade (Clausing & Renner 2001). Thus our host range results are consistent with a long coevolutionary relationship between *Syphraea* and members of these taxa. Plant secondary chemistry of melastomes has received limited study (Yoshida et al 2005), but would likely shed additional light on relationships between these three genera and host preference of *S. uberabensis*.

The preferred melastome hosts of *S. uberabensis* are all considered serious weeds in Hawaii (HDOA 1992, Jacobi and Warshauer 1992, Almasi 2000, Motooka et al. 2003). Of these plants, *T. longifolia* has the most limited distribution and appears least likely to have significant ecological interaction with the potential biocontrol agent. If *T. herbacea* and *M. septemnervium* can maintain substantial populations of *S. uberabensis*, these might help suppress *T. longifolia* and prevent it from spreading. The species *T. herbacea* and *M. septemnervium* overlap geographically across large areas, which could facilitate establishment and impacts of *S. uberabensis* generally. *M. sanguineum* is ecologically similar to *M. sanguineum* but less widely distributed. Impacts of biocontrol by *S. uberabensis* would likely be swifter and more severe on *T. herbacea* than *M. septemnervium* and *M. sanguineum*, which grow to large woody shrubs. Increased herbivory of *M. septemnervium*, which has been targeted but not adequately impacted by past introductions of other biocontrols (Conant et al. 2013), would have potential benefit to extensive forest watersheds in Hawaii (Jacobi and Warshauer 1992). The final host, *P. glomerata*, is a less prominent invader but broadly distributed in wet forests and pastures, including mountain areas on the island of Oahu where it has limited overlap with the other melastome hosts. Although *P. glomerata* appears to be equally suitable as a host for *S. uberabensis*, longer development times on this plant might delay the impacts of biocontrol (Souder 2008).

Syphraea is tolerant of cool and moderate temperatures, and it is not expected to be restricted in range by temperatures in Hawaii, except perhaps in exceptionally warm habitats (Souder 2008). However, its potential as a biological control could be limited by humidity at the microhabitat level. In Brazil, *S. uberabensis* is found with its melastome hosts in boggy soils, similar to the areas where *T. herbacea* and *P. glomerata* thrive in Hawaii, so these hosts should be highly susceptible. On the other hand, *Melastoma* spp. can grow in drier areas – such as

young lava flows. *Syphraea* could be less effective against *Melastoma* in dry habitats, because its eggs and larvae appear to be susceptible to drying when humidity is not high.

In conclusion, our testing indicates that *S. uberabensis* is narrowly host specific and will not feed or survive on any native or otherwise important plants in Hawaii. Given that Melastomataceae are entirely alien to Hawaii, and the host range of *S. uberabensis* includes only five weedy melastome species here, this flea beetle appears to hold great potential benefit and minimal environmental risk as a future biological control agent.

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United States Department of Agriculture

ATTACHMENT 4

United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection & Quarantine
4700 River Road
Riverdale, MD 20737

Permit to Move Live Plant Pests, Noxious Weeds, and Soil

Importation
Regulated by 7 CFR 330

This permit was generated electronically via the ePermits system

PERMITTEE NAME:	Matthew Johnson	**PERMIT NUMBER:**	P526P-20-02009
ORGANIZATION:	USDA Forest Service	**APPLICATION NUMBER:**	P526-190826-015
ADDRESS:	Hawaii Volcanoes National Park Quarantine Facility Kilauea Research Station, Building 34 Volcano, HI 96718	**FACILITY NUMBER:**	22
MAILING ADDRESS:	P.O. Box 236 Volcano, HI 96785	**HAND CARRY:**	No
		DATE ISSUED:	04/21/2020
PHONE:	808-967-7122		
FAX:	808-967-7158	**EXPIRES:**	**04/21/2023**
DESTINATION:	HI		
DESIGNATED PORTS:	HI, Honolulu		

Under the conditions specified, this permit authorizes the following:

Regulated Article	Life Stage(s)	Intended Use	Shipment Origins	Originally Collected	Culture Designation
Allorhogas clidemiae	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	
Allorhogas granivorus	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	
Anthonomus monostigma	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	
Diclidophlebia lucens	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	
Euselasia bettina	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	
Euselasia chrysippe	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	
Syphraea uberabensis	Any	Research - Lab	Central America, South America	Originally Collected from Outside the U.S. and Territories	

SPECIAL INSTRUCTIONS TO INSPECTORS

See permit conditions below

Permit Number P526P-20-02009

THIS PERMIT HAS BEEN APPROVED ELECTRONICALLY BY THE FOLLOWING PPQ HEADQUARTER OFFICIAL VIA EPERMITS. Robert Pfannenstiel	DATE 04/21/2020

WARNING: Any alteration, forgery or unauthorized use of this Federal Form is subject to civil penalties of up to $250,000 (7 U.S.C.s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C.s 1001)

DHS CBP INSPECTORS - SHIPMENT BY BONDED CARRIER
1) Confirm that the carrier of the shipment imported under this USDA PPQ 526 permit is commercially bonded.
2) Confirm that the imported shipment has a valid USDA PPQ Form 599 Red/White label attached to the exterior for routing to a USDA APHIS PPQ Inspection Station or other "Designated Port" as stated on the Permit. A valid label will have the permit number, expiration date, label number, and address of a USDA APHIS PPQ Plant Inspection Station/Designated Port. PLEASE NOTE: In the event of a shipment of bulk container with discrete units, a single PPQ Form 599 Red/White label may be used.
3) Validate the permit in ePermits using the CBP search feature.
4) If a valid PPQ Form 599 Red/White label is not attached to the exterior of the package or the label has been covered or is otherwise not legible, then forward to the nearest USDA APHIS PPQ Plant Inspection Station.
5) If the address on the airway bill does not match the address on the PPQ Form 599 Red/White label then forward the package to the nearest USDA APHIS PPQ Plant Inspection Station/designated port shown on the PPQ Form 599 label. All costs associated with rerouting misaddressed packages will be assumed by the permit holder.

APHIS PPQ INSPECTORS at PIS -High-Risk Invertebrates
Follow the instructions in the Plant Inspection Station Manual for High-Risk Invertebrates Red and White Labeled Packages (must be opened in a sleeved cage; see procedures for handling on page 3-7-39). For questions or concerns, contact the USDA APHIS PPQ Pest Permit Branch in Riverdale, MD, at 301-851-2046, toll free 866-524-5421.

PERMIT GUIDANCE

1) Receipt or use of foreign isolates or samples from countries under sanctions requires specific permission from the U.S. Department of Treasury; please refer to https://www.treasury.gov/resource-center/sanctions/Programs/Pages/Programs.aspx
2) This permit does not authorize movement or release into the environment of genetically engineered organisms produced with the regulated organisms described in this permit. Importation, interstate movement, and environmental release of genetically engineered plant pests require a different permit issued under regulations at 7 CFR part 340. Any unauthorized interstate movement or environmental release, including accidental release, of a regulated GE organism would be a violation of those regulations. Additional guidance and contact information for APHIS Biotechnology Regulatory Services, can be found at: https://www.aphis.usda.gov/aphis/ourfocus/biotechnology.
3) If an animal pathogen is identified in your shipment, to ensure appropriate safeguarding, please refer to http://www.aphis.usda.gov/import_export/animals/animal_import/animal_imports_anproducts.shtml
4) If a human pathogen is identified, please refer to the CDC Etiologic Agent Import Permit Program at http://www.cdc.gov/od/eaipp/
5) This permit does not fulfill the requirements of other federal or state regulatory authorities. Please contact the appropriate agencies, such as the U.S. Environmental Protection Agency, the U.S. Fish and

THIS PERMIT HAS BEEN APPROVED ELECTRONICALLY BY THE FOLLOWING PPQ HEADQUARTER OFFICIAL VIA EPERMITS.	DATE
Robert Pfannenstiel	04/21/2020

Wildlife Service, the U.S. Food and Drug Administration, the Centers for Disease Control and Prevention, the APHIS Veterinary Services unit, the APHIS Biotechnology Regulatory Services, or your State's Department of Agriculture to ensure proper permitting.
6) If you are considering renewal of this permit, an application should be submitted at least 90 days prior to the expiration date of this permit to ensure continued coverage. Permits requiring containment facilities may take a longer period of time to process.

PERMIT CONDITIONS

USDA-APHIS issues this permit to Matthew Johnson, USDA Forest Service, Hawaii Valcanoes National Park, Quarantine Facility, Kilauea Research Station, Volcano, HI 96718. This permit authorizes the importation of any life stages of the various taxa shown under Regulated Article above, collected in/from Central and South American countries, and observed to feed on or be associated with Miconia calvescens,(the target/host plant), to the permit holder Dr. Matthew Johnson, USDA Forest Service, Hawaii Volcanoes National Park, to be received into the USDA APHIS approved containment facility at that address (CF #22).

The imported material may contain various host plant parts of Miconia calvescens, including roots, leaves and stems.

This permit authorizes the possession and rearing of any species imported under this permit for research in the USDA APHIS inspected containment facility (Facility #22) at USDA Forest Service, Hawaii Volcanoes National Park, Kilauea Research Station, Quarantine Facility, Building 34, Volcano, HI 96718, subject to the conditions below.

1.
- This permit is issued by the United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). It conveys APHIS regulations and requirements for the material(s) listed on this permit. It does not reduce or eliminate your legal duty and responsibility to comply with all other applicable Federal and State regulatory requirements.
- The permit number or a copy of the permit must accompany the shipment.
- You must be an individual at least 18 years old, or legal entity such as partnership, corporation, association, or joint venture.
- You are legally responsible for complying with all permit requirements and permit conditions.
- The regulated material and shipping container(s) are subject to inspection by officials of Custom and Border Protection (CBP) and APHIS. CBP or APHIS officials may require the shipment to be treated, seized, re-exported, or destroyed (in part or whole). You will be responsible for expenses.

Permit Number P526P-20-02009

THIS PERMIT HAS BEEN APPROVED ELECTRONICALLY BY THE FOLLOWING PPQ HEADQUARTER OFFICIAL VIA EPERMITS.	DATE
Robert Pfannenstiel	04/21/2020

- If you violate any applicable laws associated with this permit, you may face substantial civil or criminal penalties. We may cancel all current permits and deny future permit applications.
- Without prior notice and during reasonable hours, authorized Federal and State Regulators must be allowed to inspect the conditions associated with the regulated materials/organisms authorized under this permit.

2. The permit holder must:

- maintain a valid PPQ526 permit so long as the regulated materials/organisms are alive or viable,
- not assign or transfer this permit to other persons without APHIS PPQ authorization,
- maintain an official permanent work assignment, residence, or affiliation at the address on this permit,
- notify the Pest Permit Staff as soon as possible of any change in the permit holder's work assignment, residence, or affiliation,
- notify the Pest Permit Staff of the receipt of unauthorized and/or misdirected shipments of regulated materials/organisms,
- adequately mitigate environmental impacts resulting from unauthorized release of regulated materials/organisms and notify the Pest Permit staff immediately if one occurs,
- notify the Pest Permit Staff if the facility is damaged/destroyed or if you wish to decommission the facility,
- destroy all regulated materials/organisms prior to departure from the organization unless other arrangements are confirmed by the Pest Permit Staff.

Notifications to the Pest Permit Staff must be made via 866-524-5421 or pest.permits@usda.gov within one business day of the event triggering a notification.

Permit Number P526P-20-02009

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3. All packages for transport must minimally consist of both inner/primary and outer/secondary packages securely sealed so that both are effective barriers to escape or unauthorized dissemination of the listed materials/organisms. The inner/primary package(s) will contain all regulated materials/organisms and must be cushioned and sealed in such a way that it remains sealed during shock, impact, and pressure changes that may occur. The outer/secondary shipping container must be rigid and strong enough to withstand typical shipping conditions (dropping, stacking, impact from other freight, etc.) without opening.
4. After PPQ issues this 526 permit, you will need to request Red/White labels (PPQ Form 599) at least 5 days in advance of your shipping date. If you applied for your permit online using ePermits, you may request the labels using the My Shipments/Labels feature. Otherwise, send your request to Redandwhitelabelrequest@usda.gov. All email requests must come from the permit holder or designee. If requested by the designee, the permit holder must be copied on all requests. Specify the approved port as listed on the permit and the total number of labels needed. You may request additional labels the same way.
   Packages without labels on the exterior may be refused entry.

   Review label instructions at:
   https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/plant-pests/or ganisms-shipping-requirements

   You are responsible for instructing your shipper to carefully follow these instructions. You are responsible for each import shipping label issued under this permit.
5. Upon receipt, open the package only in the approved containment facility identified above. Depending on the organism(s) or developmental stage, it may be necessary to open the package inside a cage (glove box or sleeve cage) or use other appropriate means that must prevent the organisms from escaping.
6. After separation of organisms regulated under this permit, along with any necessary host organisms and host plant parts, all other foreign biological material and substrate, including soil, and foreign plant material, if any, must be properly disposed of or destroyed immediately.

   Only authorized/permitted organisms may be retained as live organisms, plus any hosts and plant parts as needed for continued rearing and culture of the regulated organisms until transfer to lab-sourced material. Upon completion of isolations/transfers from imported material (i.e., soil, hosts) these imported materials must likewise be properly disposed of or destroyed immediately, as described above.

   Only secondary containers and packing materials suitable for re-use (such as coolers and icepacks) may be reused, and only after sterilization by autoclave, or with bleach or alcohol, etc., as per protocols established in the SOP's for this facility.

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Robert Pfannenstiel	04/21/2020

7. This permit authorizes the importation and possession of live organisms of only those taxa/species listed under "Regulated Article" above, and not authorized under this permit are live cultures of other taxonomic groups from other hosts, or are from other source countries/continents, or received by way of any other permit, except as described below.

   In addition, this permit authorizes continued possession/continued curation of only the live organisms (identified and unidentified) cultured or stored by the permit holder which were imported as authorized on previous permits, of which this is a "renewal". All other such live regulated organisms must be kept under separate USDA APHIS permit, or devitalized.

8. The regulated organisms authorized for import under this permit are to be maintained only in the laboratory area approved for containment at the address indicated under the "Authorizations" above on this permit (CF 22). Any distribution or other removal of live organisms regulated under this permit from the designated area of Containment Facility Forest Service requires a separate prior authorization from APHIS PPQ.

   This permit does not authorize field release, interstate transport, field research, greenhouse work, or any other activities with the regulated organisms authorized for import under this permit outside of the containment facility.

9. All operations must be consistent with information submitted in association with this Containment Facility (CF #22) including the most recent Standard Operating Procedures (SOP's) submitted for the Facility, and any information submitted in association with the inspection of this Containment Facility. This includes, minimally, maintenance of restricted access to unauthorized persons of building and or approved containment areas (key, key card or code), and/or restricted access to unauthorized persons of growth chambers and other equipment (for example by lock) where organisms will be kept, as well as proper/prescribed maintenance of the Autoclave and/or other equipment used to devitalize or sterilize waste.

   The permit holder must insure that all persons working with these regulated organisms
   a) are trained in the importance of approved containment practices;
   b) follow the Standard Operating Procedures (SOP) established for the facility and filed with the USDA APHIS Pest Permit Evaluation Unit at the time of facility inspection; and
   c) are informed of these permit conditions and understand the requirement to adhere to these conditions and the SOP.

   The permit holder shall document such training or familiarization with these permit conditions and the SOP's for the facility, by having copies of both dated and signed/initialed by all persons handing the regulated articles, and have such documentation made available to USDA APHIS upon request.

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Robert Pfannenstiel	04/21/2020

10. A separate authorization from USDA APHIS (a new PPQ 526 permit) is required for possession/maintenance of live regulated organisms received under this permit beyond the expiration of this permit. Otherwise, all regulated organisms received under this permit must be devitalized prior to expiration of this permit.

END OF PERMIT CONDITIONS

Permit Number P526P-20-02009

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M. TRACY JOHNSON

Institute of Pacific Islands Forestry
Pacific Southwest Research Station
USDA Forest Service

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Education

Ph.D., 1995, Entomology, North Carolina State University
Thesis: The role of natural enemies in ecology and evolution of *Heliothis virescens* on transgenic plants.
M.S., 1990, Entomology, North Carolina State University
Thesis: Combined effects of genetically engineered host plant resistance and natural enemies on *Heliothis* populations in tobacco.
A.B., 1984, Biology, University of California - Berkeley

Work Experience

Research Entomologist, Aug 2000-Present, USDA Forest Service, PSW, Institute of Pacific Islands Forestry
Biological control of weeds in Hawaiian forests, Insect ecology, Post-release monitoring of biocontrol, Non-target impacts of biocontrol, Plant-herbivore-enemy interactions
Junior Researcher, Mar-Aug 2000, Department of Zoology, University of Hawaii – Manoa
Examining population dynamics of the agricultural pest *Nezara viridula* under sublethal biological control by an introduced parasitoid.
Junior Researcher, Dec 1997-Feb 2000, Dept. Entomology, University of Hawaii - Manoa
Quantifying the off-target effects of biological control on the native Hawaiian koa bug, and surveying parasitism of an alien leafhopper invading native forests.
Fulbright Fellow, Oct 1996-Sep 1997, Internatl Centre of Insect Physiology and Ecology, Kenya
Assessing risk of African maize stemborers evolving resistance to transgenic maize expressing toxins of *Bacillus thuringiensis*.
Technician, May 1984 – Dec 1986, Biological Control of Weeds Lab, USDA-ARS, Albany CA
Field studies of native thistles and insects to measure nontarget impact of weevil introduced for biocontrol of weedy thistles; quarantine study of insects shipped from Greece in search for biocontrol agents against thistles.

Recent Publications

Alfaro-Alpízar MA, Koster SJC, Johnson MT, and Badenes-Pérez FR. 2020. Description, biology, and impact of the fruit-feeding moth, *Mompha luteofascia* sp. n. (Lepidoptera: Momphidae), on *Miconia calvescens* (Melastomataceae) in Costa Rica. *Annals of the Entomological Society of America* 113: 30-39.

Pejchar L, Lepczyk CA, Lepczyk- Fantle J, Hess SC, Johnson MT, Leopold CR, Marchetti M, McClure KM, Shiels AB. 2020. Hawaii as a microcosm: advancing the science and practice of managing introduced and invasive species. *BioScience*

Mayfield AE, Seybold SJ, Haag WR, Johnson MT, Kerns BK, Kilgo JC, Larkin DJ, Lucardi RD, Moltzan BD, Pearson DE, Rothlisberger JD, Schardt JD, Schwartz MK, and Young MK. CHAPTER 2: Impacts of Invasive Species in Terrestrial and Aquatic Systems in the USA, *In* Poland, T.M., Patel-Weynand, T., Finch, D., Miniat, C. F., and Lopez, V. (eds). 2019. Invasive Species in Forests and Grasslands of the United States: A Comprehensive Science Synthesis for the United States Forest Sector. Springer Verlag.

Horvitz CC, Denslow JS, Johnson T, Gaoue O, Uowolo A. 2018. Unexplained variability among spatial replicates in transient elasticity: implications for evolutionary ecology and management of invasive species. *Population Ecology* 60: 61-75.

Barbosa, J. M.; Asner, G. P.; Hughes, R. F.; Johnson, M. T. 2017. Landscape-scale GPP and carbon density inform patterns and impacts of an invasive tree across wet forests of Hawaii. *Ecological Applications* 1-13

Barbosa, J.M.; Asner, G.P.; Martin, R.E.; Baldeck, C.A.; Hughes, F.; Johnson, T. 2016. Determining subcanopy *Psidium cattleianum* invasion in Hawaiian forests using imaging spectroscopy. *Remote Sensing* 8, 33

Johnson, M.T. 2016. Managing conflict over biological control: the case of strawberry guava in Hawaii, pp. 264-276. *In*: Integrating Biological Control into Conservation Practice; Van Driesche, R.G.; Simberloff, D.; Blossey, B.; Causton, C.; Hoddle, M.S.; Wagner, D.L.; Marks, C.O.; Heinz, K.M.; Warner, K.D. (eds). Wiley.

Castillo, A., Johnson, M.T., and Badenes-Perez, F.R. 2014. Biology, behavior, and larval morphology of *Salbia lotanalis*, a potential biological control agent of *Miconia calvescens* from Costa Rica. *Annals of the Entomological Society of America* 107: 1094-1101.

Badenes-Perez, F.R., Castillo, A., and Johnson, M.T. 2014. Damage to *Miconia calvescens* and Seasonal Abundance of *Salbia lotanalis* (Lepidoptera: Crambidae) in Costa Rica. *Environmental Entomology* 43: 877-882.

Hughes, R.F., M.T. Johnson and A. Uowolo. 2013. The invasive alien tree *Falcataria moluccana*: Its impacts and management. Pp 218-223 *in* Wu, Y., T. Johnson, S. Sing, S. Raghu, G. Wheeler, P. Pratt, K. Warner, T. Center, J. Goolsby and R. Reardon (eds), Proceedings of the XIII International Symposium on Biological Control of Weeds.

Conant, P., J.N. Garcia, M.T. Johnson, W.T. Nagamine, C.K. Hirayama, G.P. Markin and R.L. Hill. 2013. Releases of natural enemies in Hawaii since 1980 for classical biological control of weeds. Pp. 230-242 *in* Wu, Y., T. Johnson, S. Sing, S. Raghu, G. Wheeler, P. Pratt, K. Warner, T. Center, J. Goolsby and R. Reardon (eds), Proceedings of the XIII International Symposium on Biological Control of Weeds.

Chacón-Madrigal, E., M.T. Johnson, and P. Hanson. 2012. The life history and immature stages of the weevil *Anthonomus monostigma* Champion (Coleoptera: Curculionidae) on *Miconia calvescens* DC (Melastomataceae). *Proceedings of the Entomological Society of Washington* 114: 173-185.

Ramadan, M.M., K.T. Murai, T. Johnson. 2011. Host range of *Secusio extensa* (Lepidoptera: Arctiidae), and potential for biological control of *Senecio madagascariensis* (Asteraceae). *Journal of Applied Entomology* 135: 269-284.

Badenes-Pérez, F.R., M.A. Alfaro-Alpízar, and M.T. Johnson. 2010. Diversity, ecology and herbivory of hairstreak butterflies (Theclinae) associated with the velvet tree, *Miconia calvescens* in Costa Rica. *Journal of Insect Science* 10, 209

Reichert, E., M.T. Johnson, E. Chacón, R.S. Anderson, and T.A. Wheeler. 2010. Biology and host preferences of *Cryptorhynchus melastomae* (Coleoptera: Curculionidae), a possible biocontrol agent for *Miconia calvescens* (Melastomataceae) in Hawaii. *Environmental Entomology* 39: 1848-1857.

Hanson, P., K. Nishida, P. Allen, E. Chacón, B. Reichert, A. Castillo, M. Alfaro, L. Madrigal, E. Rojas, F. Badenes-Perez, and T. Johnson. 2010. Insects that feed on *Miconia calvescens* in Costa Rica. *In*: Loope, L.L., J.-Y. Meyer, B.D. Hardesty and C.W. Smith (eds.), Proceedings of the International Miconia Conference, Keanae, Maui, Hawaii, May 4-7, 2009, Maui Invasive Species Committee and Pacific Cooperative Studies Unit, University of Hawaii at Manoa. www.hear.org/conferences/miconia2009/proceedings/

Johnson, M.T. 2010. Miconia biocontrol: Where are we going and when will we get there? *In*: Loope, L.L., J.-Y. Meyer, B.D. Hardesty and C.W. Smith (eds.), Proceedings of the International Miconia Conference, Keanae, Maui, Hawaii, May 4-7, 2009, Maui Invasive Species Committee and Pacific Cooperative Studies Unit, University of Hawaii at Manoa. www.hear.org/conferences/miconia2009/proceedings/

Badenes-Perez, F.R., M.A. Alfaro-Alpizar, A. Castillo-Castillo, and M.T. Johnson. 2008. Biological control of *Miconia calvescens* with a suite of insect herbivores from Costa Rica and Brazil. *In* Proceedings of the XII International Symposium on Biological Control of Weeds. Julien MH, Sforza R, Bon MC, Evans HC, Hatcher PE, Hinz HL, Rector BG, editors. CAB International, Wallingford, UK., Montpellier, France. 129-132.

Badenes-Perez, F.R., and M.T. Johnson. 2008. Biology, herbivory, and host specificity of *Antiblemma leucocyma* (Lepidoptera: Noctuidae) on *Miconia calvescens* DC. (Melastomataceae) in Brazil. *Biocontrol Science and Technology* 18: 183-192.

Badenes-Perez, F.R., and M.T. Johnson. 2007. Ecology and impact of *Allorhogas* sp. (Hymenoptera: Braconidae) and *Apion* sp. (Coleoptera: Curculionoidea) on fruits of *Miconia calvescens* DC (Melastomataceae) in Brazil. *Biological Control* 43: 317-322.

RESTRICTED ANIMAL LIST (Part A) §4-71-6.5

SCIENTIFIC NAME	COMMON NAME
CLASS Insecta	
ORDER Coleoptera	
FAMILY Apionidae	
Apion scutellare	biocontrol agent, gorse
FAMILY Buprestidae	
Lius poseidon	biocontrol agent, clidemia
FAMILY Chrysomelidae	
Chlamisus gibbosa	biocontrol agent, blackberry
Syphraea uberabensis	biocontrol agent, Tibouchina herbacea
FAMILY Coccinellidae	
Delphastus pusillus	predator, spiraling whitefly
Hippodamia convergens	beetle, convergent lady
Nephaspis oculatus	predator, spiraling whitefly
Nephaspis bicolor	predator, spiraling whitefly
Stethorus nigripes	predator, spider mites
Stethorus picipes	predator, spider mites
FAMILY Curculionidae	
Acythopeus sp. 1	biocontrol agent, ivy gourd
Acythopeus sp. 2	biocontrol agent, ivy gourd
Acythopeus sp. 3	biocontrol agent, ivy gourd
Auletobius convexifrons	biocontrol agent, firetree
Gymnaetron tetrum	biocontrol agent, common mullein
FAMILY Scarabaeidae	
Euoniticellus intermedius	predator, hornfly
Onitis vanderkelleni	predator, horn fly
ORDER Diptera	
FAMILY Chamaemyiidae	
Leucopis (all species in subgenus)	predator
FAMILY Drosophilidae	
Drosophila (all species in genus)	flies, pomace
Zapriothrica sp.	biocontrol agent, banana poka