Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE

Field Release of the Golden Sombermark Butterfly (*Euselasia chrysippe* (Lepidoptera: Riodinidae)) for the Biological Control of Miconia, *Miconia calvescens,* (Melastomataceae), in Hawaii

Final Environmental Assessment, April 2023

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Agency Contact:

Robert Pfannenstiel, Acting Assistant Director
Pests, Pathogens, and Biocontrol Permits
Plant Protection and Quarantine
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
4700 River Road, Unit 133
Riverdale, MD 20737–1236

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I. Purpose and Need for the Proposed Action

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), Pests, Pathogens, and Biocontrol Permits (PPBP) is proposing to issue permits for release of the golden sombermark butterfly *Euselasia chrysippe* (Lepidoptera: Riodinidae). This butterfly would be used by a permit applicant for classical biological control (biocontrol) of miconia, *Miconia calvescens* (Melastomataceae) in the State of Hawaii.

Classical biological control of weeds is a control method where natural enemies from a foreign country are used to reduce exotic weeds that have become established in the United States. Several different kinds of organisms have been used as biological control agents of weeds: insects, mites, nematodes, and plant pathogens. Efforts to study and release an organism for classical biological control of weeds consist of the following steps (TAG, 2021):

1. Foreign exploration in the weed's area of origin.
2. Host specificity studies.
3. Approval of the exotic agent by PPBP.
4. Release and establishment in areas of the United States invaded by the target weed.
5. Post-release monitoring.

APHIS has the authority to regulate biological control organisms under the Plant Protection Act of 2000 (Title IV of Pub. L. 106–224). Applicants who wish to study and release biological control organisms into the United States must receive PPQ Form 526 permits for such activities. The PPBP received a permit application requesting environmental release of the golden somberback butterfly, *E. chrysippe*, from Costa Rica, and the PPBP is proposing to issue permits for this action. Before permits are issued, the PPBP must analyze the potential impacts of the release of this agent into the State of Hawaii.

This environmental assessment (EA) has been prepared, consistent with USDA, APHIS' National Environmental Policy Act of 1969 (NEPA) implementing procedures (Title 7 of the Code of Federal Regulations (CFR), part 372). It examines the potential effects on the quality of the human environment that may be associated with the release of *E. chrysippe* to control infestations of miconia in the State of Hawaii. This EA considers the potential effects of the proposed action and its alternatives, including no action. Notice of this EA was made available in the Honolulu Star-Advertiser on January 23 and January 24, 2023 for a 30-day public comment period. APHIS received three comments on the EA by the close of that comment period. All three comments were in support of the release of *E. chrysippe* in Hawaii.

The following information in this EA regarding miconia, *E. chrysippe*, and the host specificity testing conducted is from information submitted by M.T. Johnson, U.S. Department of Agriculture, Forest Service (USFS), Pacific Southwest Research Station (Johnson, undated), and a draft environmental assessment prepared by SWCA Environmental Consultants (2020) for Hawaii Division of Forestry and Wildlife.

The permit applicant's purpose for releasing *E. chrysippe* is to reduce the severity of damage of miconia in the family Melastomataceae in Hawaii. Miconia is a major threat to forest ecosystems in Hawaii. It was declared a Hawaii state noxious weed in 1992 and continues to be one of Hawaii's most invasive plants (Kaiser, 2006). Miconia trees form dense stands and their large leaves shade out native forest trees. Over time, miconia can come to dominate a forest. Each plant can produce over 20,000 seeds per fruiting season, and each seed may remain viable for more than 16 years. Seeds are dispersed long distances by animals such as birds and rats and can be spread by wind, water, or humans (CABI, 2022; Hawaii Invasive Species Council, 2022).

Control of this plant with herbicides and mechanical methods is expensive and is not effective in the long term. Mechanical and chemical methods of control have been underway to attempt to keep the species from spreading; however, long-term management of miconia will rely on biocontrol as a critical tool. Therefore, there is a need to identify and release an effective, host-specific biological control organism against miconia in Hawaii.

II. Alternatives

This section will explain the two alternatives available to PPBP: no action (no issuance of permits) and issuance of permits for environmental release of *E. chrysippe* into Hawaii. Although APHIS' alternatives are limited to a decision of whether to issue permits for release of *E. chrysippe*, we describe other methods currently used to control miconia in Hawaii. Use of these control methods is not an APHIS decision, and their use is likely to continue whether or not PPBP issues permits for environmental release of *E, chrysippe*.

The PPBP considered a third alternative but will not analyze it further. Under this third alternative, PPBP would issue permits for the field release of *E, chrysippe.* The permits, however, would contain special provisions or requirements concerning release procedures or mitigating measures, such as limited releases of *E, chrysippe* in Hawaii. There are no issues raised indicating that special provisions or requirements are necessary.

A. No Action

Under the no action alternative, the PPBP would not issue permits for the field release of *E. chrysippe* for the control of miconia in Hawaii — the release of this biological control agent would not occur, and current methods to control miconia in Hawaii will continue at current levels. Use of these methods is likely to continue even if PPBP issues permits for release of *E. chrysippe,* depending on the efficacy of the organism to control miconia. Presently, control of miconia in Hawaii is limited to chemical control using herbicides and mechanical control methods. In Hawaii, the Invasive Species Committees have a goal of eradication of miconia on Kauai and Oahu (vs. containment on Hawaii and Maui) (CABI, 2022).

1. Chemical Control

Herbicide is also used by workers on the ground in Hawaii, but spot aerial spraying with triclopyr from helicopters is also an important method, especially on the island of Maui (CABI, 2022). Cut-stump treatment of trees using herbicides (trichlopyr, trichlopyr + 2,4-D, glyphosate) is commonly used in Hawaii. (CABI, 2022).

2. Mechanical Control

Physical pulling of plants from the ground is combined with chemical control in Hawaii. (CABI, 2022).

B. Issue Permits for Environmental Release of Euselasia chrysippe

Under this alternative, PPBP would issue permits for the field release of *E. chrysippe* for the control of miconia in Hawaii. These permits would contain no special provisions or requirements concerning release procedures or mitigating measures. *Euselasia chrysippe* is specific to miconia.

1. *Euselasia chrysippe* Taxonomic Information

Order: Lepidoptera
Family: Riodinidae
Subfamily: Euselasiinae
Genus: *Euselasia*
Species: *Euselasia chrysippe* (Bates, 1866)
Common name: golden sombermark butterfly

Taxonomy: *Euselasia chrysippe* (Bates, 1866) (golden sombermark butterfly) is classified under the family Riodinidae, or metalmark butterflies, in the subfamily Euselasiinae. Euselasiinae is restricted to the subtropics and contains five genera; all except *Euselasia* contain few taxa. *Euselasia*, by contrast, contains around 170 described species. Despite the relative abundance of this genus, little is known about its members outside of a few pest species of *Eucalyptus* (Nishida, 2010).

Description: Adult males of this species have a reddish-orange discal area on the upper surface of wings, whereas females are yellowish-orange. Both sexes have five to seven black spots along the margins on the underside of the hindwings (Nishida, 2010). Nishida (2010) describes the sixth instar larva (immature developmental stage) as greenish-dark-gray to greenish-dull black; the head capsule width is approximately 1.65 millimeters (mm); the color of the head is bright orange, black, or a mixture of these two.

Biology: In captive rearing conditions, the *E. chrysippe* life cycle from egg to emergence of the adult butterfly from the pupa is approximately eight weeks. Both male and female adults have been shown to live for longer than a month (Nishida, 2010). The caterpillars have six larval instars that feed and rest as a group, primarily on the undersides of fully opened leaves of their host, moving from leaf to leaf, ultimately consuming the equivalent of one whole leaf (Johnson, 2010). As with all known members of the tribe Euselasiini, *E. chrysippe* caterpillars hatch, feed, rest, molt, and pupate together in a single sibling cohort of up to 100 individuals (Allen, 2010; Nishida, 2010). This gregarious behavior is thought to assist the species with feeding on tough leaves, which optimizes foraging. In addition, traveling as a large group provides a defense against predation and may contribute to the low parasitism rates on this species observed in their home range (Allen, 2010).

Habitat: The elevational range of *E. chrysippe* starts at sea level and extends up to 1,500 meters (Nishida 2010). In Costa Rica, it is found on the Caribbean and Pacific slopes in both primary and secondary rain forests (Allen, 2012; Nishida, 2010). Caterpillars and eggs of *E. chrysippe* have only been collected from species in the Melastomataceae family, specifically *Miconia calvescens*, *M. impetiolaris*, *M. trinervia*, *M. elata*, *M. appendiculata*, *M. donaena*, *M. longifolia*, and *Conostegia rufescens* (DeVries, 1997; DeVries et al., 1992; Janzen and Hallwachs, 2009; Nishida, 2010).

2. Geographic Range of *E. chrysippe*

The native range of *E. chrysippe* extends from southern Mexico to Colombia (DeVries, 1997). Studies reported in this document involve *E. chrysippe* collected from a few different sites on the Caribbean slope of Costa Rica, from two of its host plants, *Miconia calvescens* and *Miconia impetiolaris*.

3. Potential Range of *E. chrysippe* in Hawaii

The proposed release of *E. chrysippe* will be statewide. The first stage of release will focus on miconia infestations on east Maui and east Hawaii, where the host species is most abundant. Many areas where miconia is known to occur are under some level of active management, and it would be a waste of effort to release biocontrol on plants that will soon be killed with herbicide. Once successfully established, the butterfly may expand its range to other locations or islands both naturally and by additional releases. Actual dispersal rates are not known at this time but will be tracked and monitored following release.

4. Impact of *E. chrysippe* on Miconia

Euselasia chrysippe was selected as a leaf-feeding biocontrol for miconia in Hawaii because its gregariously feeding larvae can cause substantial damage to leaves. When reared on potted plants, a cohort of 60–80 larvae will consume several hundred square centimeters of leaf tissue – equivalent to the area of one average-sized leaf. Damage is typically distributed across several leaves because larvae move to new feeding areas between meals. Damage also includes removal of portions of uneaten leaves, presumably to reduce detection by natural enemies (figure 1) (Puliafico et al., 2015).

Although extensive defoliation by *E. chrysippe* is not observed in Costa Rica, its populations are presumed to be limited by natural enemies there. If introduced to Hawaii, population growth is expected to be less constrained by enemies, allowing numbers of *E. chrysippe* to increase to levels sufficiently high to cause substantial defoliation. Damage is unlikely to be severe enough to kill miconia trees, but repeated partial defoliations may reduce growth and reproduction of trees and enhance light levels for plants competing with miconia.

Figure 1. *Euselasia chrysippe* larvae feeding on miconia.

III. Affected Environment

A. Miconia Description and Taxonomic Information

Taxonomy
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Myrtales
Family: Melastomataceae
Tribe: Miconieae
Genus: *Miconia* Ruiz & Pavón
Species: *Miconia calvescens* DC.

Synonyms: *Cyanophyllum magnificum* Groenland, *Melastoma arborea* Velloso, *Melastoma mandioccana* Raddi, *Miconia arborea* Pav. ex Triana, *Miconia magnifica* Triana, *Miconia velutina* L. Linden & Rodigas

Miconia calvescens belongs to the pantropical Melastomataceae family. The genus *Miconia* is the largest genus of new world plants and contains more than 1,500 species ranging from Mexico to the Caribbean to Uruguay and northern Argentina (Mabberley, 2017). *Miconia calvescens* is the main species in the genus to be popularized as an ornamental; uses for other species in the genus include lumber (*M. longistyla*), edible berries (*M. macrophylla*), dyeing (*M. cinnamomifolia*), and medicine (*M. agrestis* and *M. fothergilla*) (Meyer, 2010).

Description *Miconia calvescens* can grow up to 16 m tall, but usually reaches 4–12 m. Its oblong-elliptical to elliptical-ovate leaves are smooth, 20–80 cm long and 8–30 cm wide. The bicolored form seen in Hawaii has dark green leaves with purple undersides with entire or slightly toothed margins. Flowers are panicles 20–35 centimeters long. Petals are white and smooth on the surfaces but sometimes sparsely glandular around the edges, 2–3 mm long and 1–2 mm wide. Fruits are globose, purplish-black, 3.5–4.5 mm in diameter, containing ovoid to pyramidal seeds around 0.5 mm long (Weber, 2003).

B. Areas Affected by Miconia

1. Native and Worldwide Distribution

Miconia is native to Central and South America, from Mexico to Argentina. Miconia is rarely seen in its native range, which extends from southern Mexico to northern Argentina. The bicolored form with purple undersides to the leaves found in invaded regions is restricted to Central America.

2. Present Distribution in Hawaii

In Hawaii, it was introduced to Wahiawa Botanical Garden in 1961, was subsequently introduced to other botanical gardens on Oahu, and had reached the island of Hawaii by 1964, Maui in the early 1970s, and Kauai by the early 1980s. Large infestations exist on the islands of Hawaii and Maui, and populations can also be found on Kauai and Oahu. Efforts to control miconia were first initiated in 1991 on the island of Maui, near Hana. By that time, it had already spread widely. More than 20,000 plants were removed from Hana between 1991 and 1993 (Thomas, 1997).

3. Habitats Where Miconia is Found in Hawaii

Miconia is found in tropical or wet forests where the mean annual rainfall is greater than 2,000 mm and mean temperature is over 22 degrees Celsius. It has a broad elevational range from the lowlands up to 1,800 meters in elevation and grows in disturbed or second-growth forests, in semi-open areas. Miconia is an early successional species, colonizing small gaps, forest edges, streambanks, and trailsides, and only rarely grows in the understory of dense primary forest. This species' invaded range is very similar to its native range (Meyer, 2010).

C. Plants Related to Miconia in Hawaii

1. Native and Non-Native Relatives

Information regarding plants taxonomically related to miconia is included because closely related plant species have the greatest potential for attack by *E, chrysippe* if it is released in Hawaii. However, no plants in the family Melastomataceae (the plant family to which miconia belongs) are native to Hawaii, and nine of the 15 species naturalized in Hawaii have been declared state noxious weeds (Medeiros et al., 1997). Miconia has no native close relatives in Hawaii.

IV. Environmental Consequences

A. No Action

Under the no action alternative, *E. chrysippe* will not be released for biocontrol of miconia in Hawaii. Control of the target weed will be limited to mechanical and chemical control methods.

1. Impact of Miconia on the Environment

Miconia is a major threat to forest ecosystems in Hawaii. It was declared a Hawaii state noxious weed in 1992 and continues to be one of Hawaii's most invasive plants (Kaiser, 2006). Miconia trees form dense stands (figure 2) and their large leaves shade out native forest trees. Over time, miconia can come to dominate a forest. Each plant can produce over 20,000 seeds per fruiting season, and each seed may remain viable for more than 16 years. Seeds are dispersed long distances by animals such as birds and rats and can be spread by wind, water, or humans (Meyer, 2010; Hawaii Invasive Species Council, 2022).

Figure 2. Miconia infestation in Onomea, Big Island; Photo by Forest and Kim Starr.

2. Impact from the Use of Other Control Methods

The continued use of chemical and mechanical controls at current levels in Hawaii would result if the "no action" alternative is chosen and may continue even if permits are issued for environmental release of *E. chrysippe* in Hawaii.

a) Chemical Control

Chemical methods of control have been underway in Hawaii to attempt to keep the species from spreading, including the use of triclopyr herbicide and the use of Herbicide Ballistic Technology, which targets miconia plants from a helicopter. Despite sustained efforts using chemical control, this species continues to spread, particularly on Maui and Hawaii Islands.

b) Mechanical Control

Similar to chemical control, hand-pulling can be effective for rapid removal of infestations that are small in size and easily accessible. However, for large areas and remote locations, this method is not effective because the sites are too difficult to access. Mechanical methods have been used to keep miconia from spreading but have not been effective.

These impacts from the use of other control methods may have environmental consequences even with the implementation of the biological control alternative, depending on the efficacy of *E. chrysippe* to reduce miconia infestations in Hawaii.

B. Issue Permits for Environmental Release of Euselasia chrysippe

1. Impact of *E. chrysippe* on Non-target Plants

Host specificity of *E. chrysippe* to miconia in Hawaii has been demonstrated through scientific literature and host range testing. If the candidate biological control agent only attacks one or a few plant species closely related to the target weed, it is considered to be very host specific. Host specificity is an essential trait for a biological control organism proposed for environmental release.

a) Scientific literature

Recorded host plants for the genus *Euselasia* include members of the families Euphorbiaceae, Clusiaceae, Myrtaceae, Melastomataceae, Sapotaceae, and Vochysiaceae; however, caterpillars and eggs of *E. chrysippe* have been collected only from Melastomataceae, specifically *Miconia calvescens, M. impetiolaris, M. trinervia, M. elata, M. appendiculata, M. donaena, M. longifolia,* and *Conostegia rufescens* (DeVries, 1997; DeVries et al., 1992; Janzen and Hallwachs, 2009;

Nishida, 2010). No-choice host tests conducted by Nishida (2010) found that larvae collected from *M. impetiolaris* would feed on *Conostegia xalapensis* and *M. calvescens* (Melastomataceae) but exhibited no feeding on two *Eucalyptus* spp., *Eugenia truncata*, and *Psidium guajava* (all belonging to family Myrtaceae), or *Clusia flava* (family Clusiaceae).

b) Host Specificity Testing

Quarantine host range testing was conducted to determine the specificity of *E. chrysippe* to miconia and to determine if nontarget plants in Hawaii could be at risk of attack by *E. chrysippe.* Host specificity of *E. chrysippe* to miconia has been demonstrated through host specificity testing. If the candidate biological control agent only attacks one or a few plant species closely related to the target weed, it is considered to be very host-specific. Host specificity is an essential trait for a biological control organism proposed for environmental release.

(1) Host Specificity Testing Methodology

Test plant lists are developed by researchers for determining the host specificity of biological control agents of weeds. Test plant lists are usually developed on the basis of phylogenetic relationships between the target weed and other plant species (Wapshere, 1974). It is generally assumed that plant species more closely related to the target weed species are at greater risk of attack than more distantly related species.

The host specificity test strategy as described by Wapshere (1974) is "a centrifugal phylogenetic testing method which involves exposing to the organism a sequence of plants from those most closely related to the weed species, progressing to successively more and more distantly related plants until the host range has been adequately circumscribed." Researchers do not pursue release of biological control agents that do not demonstrate high host specificity to the target weed.

Host specificity tests with larvae of *E. chrysippe* were conducted from 2012–2014 in laboratories in Hawaii, at the Hawaii Volcanoes National Park Quarantine Facility, and in Costa Rica, at La Selva Biological Station. Larvae for tests were collected as eggs from several sites in Costa Rica on two of its host plants, *Miconia calvescens* and *Miconia impetiolaris*. An emphasis was placed on testing plants in the order Myrtales, specifically on species within the families Melastomataceae, Myrtaceae, Combretaceae, Lythraceae, and Onagraceae. Relationships within the Melastomataceae were based on Clausing and Renner (2001). In addition, species from more distantly related taxa but with economic, cultural, and/or ecological significance in Hawaii were selected based on input from the U.S. Fish and Wildlife Service, consultations with members of the agricultural community, and expert sources on native Hawaiian plants. In total, 73 species of plants from 19 families were examined for suitability as hosts for *E. chrysippe* (table 1). No-choice tests, with cohorts of 5–10 larvae exposed to leaves of each plant species for three days in 90 mm petri dishes, were replicated four to five times. Further tests of a subset of melastomes were conducted over longer periods, on potted plants and in petri dishes with leaves replaced every few days, to determine if any are suitable for complete development of *E. chrysippe*.

Table 1. Plant species exposed to *Euselasia chrysippe* larvae in no-choice host specificity testing.

Order	Family	Tribe	Species	Native Range*	Common name
Myrtales	Melastomataceae	Miconieae	*Clidemia dentata*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Clidemia discolor*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Clidemia epiphytica*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Clidemia hirta*	SCA	Koster's curse
Myrtales	Melastomataceae	Miconieae	*Conostegia subcrustulata*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Conostegia xalapensis*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Henriettea tuberculosa*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Leandra granatensis*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Leandra longicoma*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia affinis*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia argentea*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia barbinervis*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia calvescens*	SCA	miconia
Myrtales	Melastomataceae	Miconieae	*Miconia cremadena*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia elata*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia gracilis*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia impetiolaris*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia longifolia*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia multispicata*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia nervosa*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia prasina*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Miconia theizans*	SCA	none
Myrtales	Melastomataceae	Miconieae	*Tetrazygia bicolor*	NA/SCA	none
Myrtales	Melastomataceae	Bertolonieae	*Triolena hirsuta*	SCA	none
Myrtales	Melastomataceae	Blakeeae	*Blakea litoralis*	SCA	none
Myrtales	Melastomataceae	Blakeeae	*Topobea maurofernandeziana*	SCA	none
Myrtales	Melastomataceae	Dissochaeteae	*Medinilla cummingii*	IM	none
Myrtales	Melastomataceae	Dissochaeteae	*Medinilla magnifica*	AU/IM	showy medinilla
Myrtales	Melastomataceae	Melastomeae	*Arthrostemma ciliatum*	SCA	pinkfringe
Myrtales	Melastomataceae	Melastomeae	*Dissotis rotundifolia*	AF	pink lady, rockrose
Myrtales	Melastomataceae	Melastomeae	*Heterocentron subtriplinervium*	SCA	pearlflower
Myrtales	Melastomataceae	Melastomeae	*Melastoma sanguineum*	IM	fox-tongued melastome
Myrtales	Melastomataceae	Melastomeae	*Melastoma septemnervium*	IM	Asian melastome
Myrtales	Melastomataceae	Melastomeae	*Pterolepis glomerata*	SCA	false meadowbeauty
Myrtales	Melastomataceae	Melastomeae	*Tibouchina herbacea*	SCA	cane tibouchina

Order	**Family**	**Tribe**	**Species**	**Native Range***	**Common name**
Myrtales	Melastomataceae	Melastomeae	*Tibouchina longifolia*	SCA	long leaf glory tree
Myrtales	Melastomataceae	Melastomeae	*Tibouchina urvilleana*	SCA	princess flower, glorybush
Myrtales	Combretaceae	Not listed	*Terminalia catappa*	AU/IM	false kamani
Myrtales	Lythraceae	Not listed	*Cuphea ignea*	SCA	cigar flower
Myrtales	Lythraceae	Not listed	*Lythrum maritimum*	SCA	pukamole
Myrtales	Myrtaceae	Not listed	*Eucalyptus deglupta*	IM	rainbow eucalyptus
Myrtales	Myrtaceae	Not listed	*Eucalyptus globulus*	AU	blue gum
Myrtales	Myrtaceae	Not listed	*Eugenia uniflora*	SCA	Surinam cherry, pitanga
Myrtales	Myrtaceae	Not listed	*Lophostemon confertus*	AU	brushbox, Brisbane box
Myrtales	Myrtaceae	Not listed	*Melaleuca leucadendra*	AU/IM	weeping paperbark
Myrtales	Myrtaceae	Not listed	*Metrosideros macropus*	HI	lehua mamo
Myrtales	Myrtaceae	Not listed	*Metrosideros polymorpha*	HI	'ohi'a lehua
Myrtales	Myrtaceae	Not listed	*Plinia cauliflora*	SCA	jaboticaba
Myrtales	Myrtaceae	Not listed	*Psidium cattleianum*	SCA	strawberry guava
Myrtales	Myrtaceae	Not listed	*Psidium friedrichsthalianum*	SCA	Costa Rican guava
Myrtales	Myrtaceae	Not listed	*Psidium guajava*	SCA	common guava
Myrtales	Myrtaceae	Not listed	*Rhodomyrtus tomentosa*	IM	downy myrtle, rose myrtle
Myrtales	Myrtaceae	Not listed	*Syzygium cumini*	IM	Java plum
Myrtales	Myrtaceae	Not listed	*Syzygium malaccense*	AU/IM	mountain apple
Myrtales	Onagraceae	Not listed	*Epilobium ciliatum*	NA/SCA/IM	willowherb
Myrtales	Onagraceae	Not listed	*Fuchsia magellanica*	SCA	hardy fuchsia
Myrtales	Onagraceae	Not listed	*Oenothera laciniata*	NA	cutleaf, evening primrose
Geraniales	Geraniaceae	Not listed	*Geranium homeanum*	AU	Australasian geranium
Brassicales	Caricaeae	Not listed	*Carica papaya*	SCA	papaya
Malvales	Malvaceae	Not listed	*Hibiscus rosa-sinensis*	IM	hibiscus
Sapindales	Anacardiaceae	Not listed	*Mangifera indica*	IM	mango
Sapindales	Rutaceae	Not listed	*Citrus x sinensis*	IM	lemon
Sapindales	Sapindaceae	Not listed	*Dodonaea viscosa*	COS/HI	‘a’ali’i
Rosales	Moraceae	Not listed	*Artocarpus altilis*	IM	ulu, breadfruit
Fabales	Fabaceae	Not listed	*Acacia koa*	HI	koa
Fabales	Fabaceae	Not listed	*Sophora chrysophylla*	HI	mamane
Gentianales	Rubiaceae	Not listed	*Coffea arabica*	AF	coffee
Lamiales	Myoporaceae	Not listed	*Myoporum sandwicense*	HI	naio
Proteales	Proteaceae	Not listed	*Macadamia integrifolia*	AU	macadamia
Alismatales	Araceae	Not listed	*Anthurium* sp.	SCA	anthurium
Laurales	Lauraceae	Not listed	*Persea americana*	SCA	avocado
Cyatheales	Dicksoniaceae	Not listed	*Cibotium glaucum*	HI	hapu'u

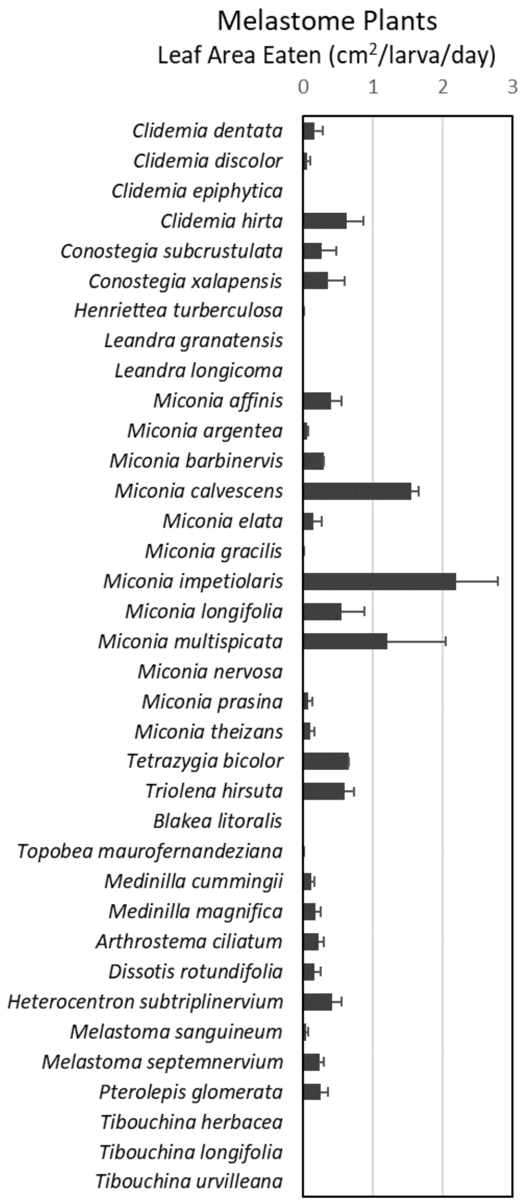
* HI =Hawaii, SCA =South & Central America, NA =North America, AU =Australia, AF =Africa, IM =Indomalayan, COS =Cosmopolitan.

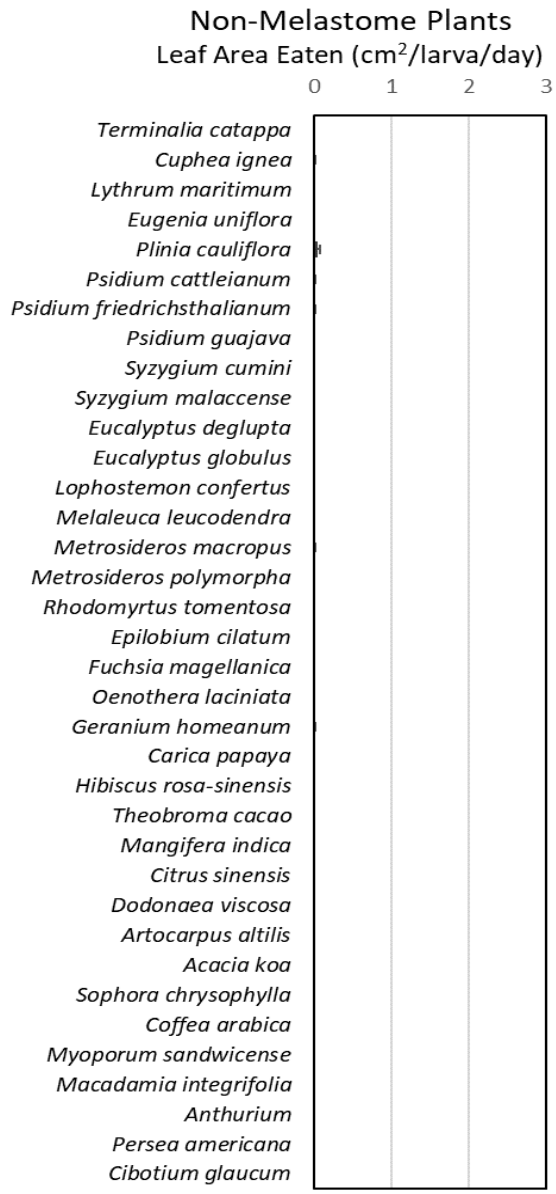
c) Summary of Host Specificity Results

Results of host specificity studies showed that among the 73 species tested, *E. chrysippe* larvae feed and survive primarily on *Miconia calvescens* and a few close relatives within the tribe Miconieae (figure 3). Very low levels of feeding occurred on a few plants in families outside of the family Melastomataceae, but in all cases, survival of the larvae past the 3-day mark on species in these families was extremely low, and none developed into larger larvae. Among plants occurring in Hawaii, only two species other than miconia experienced substantial levels of feeding: the melastomes *Clidemia hirta* and *Tetrazygia bicolor*, which have recently been found through genetic analyses to be better placed within the genus *Miconia* (Michelangeli et al., 2020). No plants in the family Melastomataceae are native to Hawaii, and nine of the 15 species naturalized in Hawaii have been declared state noxious weeds (Medeiros et al., 1997).

Studies have clearly demonstrated that *E. chrysippe* is host-specific to a narrow subset of Melastomataceae. Results of the host specificity studies are summarized below (figures 3 and 4). Laboratory tests are consistent with field observations of *E. chrysippe* in Costa Rica, where eggs and larvae have been collected only from species of *Miconia* and *Conostegia rufescens*, a plant in the same tribe (Nishida, 2010). A similar pattern of specificity holds for other species within the genus *Euselasia*. Across numerous studies in various parts of tropical America, *Euselasia* have been found to be narrowly host-specific, with each species specializing within a family of plants (Nishida, 2010).

Figure 3. Average feeding damage by mid-sized larvae (instars 3–5) of *Euselasia chrysippe* on plant species in Costa Rica and Hawaii exposed as fresh leaves for 3 days in 90 mm petri dishes in 2012–2014, measured from photos before and after exposure (bar = standard error). Species on left, in the family Melastomataceae, are grouped according to genetic relatedness, and non-melastomes on right are listed in order of genetic distance from Melastomataceae.


Melastome Plants
Leaf Area Eaten (cm2/larva/day)
0
1
2
3
Clidemia dentata
Clidemia discolor
Clidemia epiphytica
Clidemia hirta
Conostegia subcrustulata
Conostegia xalapensis
Henriettea turberculosa
Leandra granatensis
Leandra longicoma
Miconia affinis
Miconia argentea
Miconia barbinervis
Miconia calvescens
Miconia elata
Miconia gracilis
Miconia impetiolaris
Miconia longifolia
Miconia multispicata
Miconia nervosa
Miconia prasina
Miconia theizans
Tetrazygia bicolor
Triolena hirsuta
Blakea litoralis
Topobea maurofernandeziana
Medinilla cummingii
Medinilla magnifica
Arthrostema ciliatum
Dissotis rotundifolia
Heterocentron subtriplinervium
Melastoma sanguineum
Melastoma septemnervium
Pterolepis glomerata
Tibouchina herbacea
Tibouchina longifolia
Tibouchina urvilleana


Non-Melastome Plants
Leaf Area Eaten (cm2/larva/day)
0
1
2
3
Terminalia catappa
Cuphea ignea
Lythrum maritimum
Eugenia uniflora
Plinia cauliflora
Psidium cattleianum
Psidium friedrichsthalianum
Psidium guajava
Syzygium cumini
Syzygium malaccense
Eucalyptus deglupta
Eucalyptus globulus
Lophostemon confertus
Melaleuca leucodendra
Metrosideros macropus
Metrosideros polymorpha
Rhodomyrtus tomentosa
Epilobium cilatum
Fuchsia magellanica
Oenothera laciniata
Geranium homeanum
Carica papaya
Hibiscus rosa-sinensis
Theobroma cacao
Mangifera indica
Citrus sinensis
Dodonaea viscosa
Artocarpus altilis
Acacia koa
Sophora chrysophylla
Coffea arabica
Myoporum sandwicense
Macadamia integrifolia
Anthurium
Persea americana
Cibotium glaucum

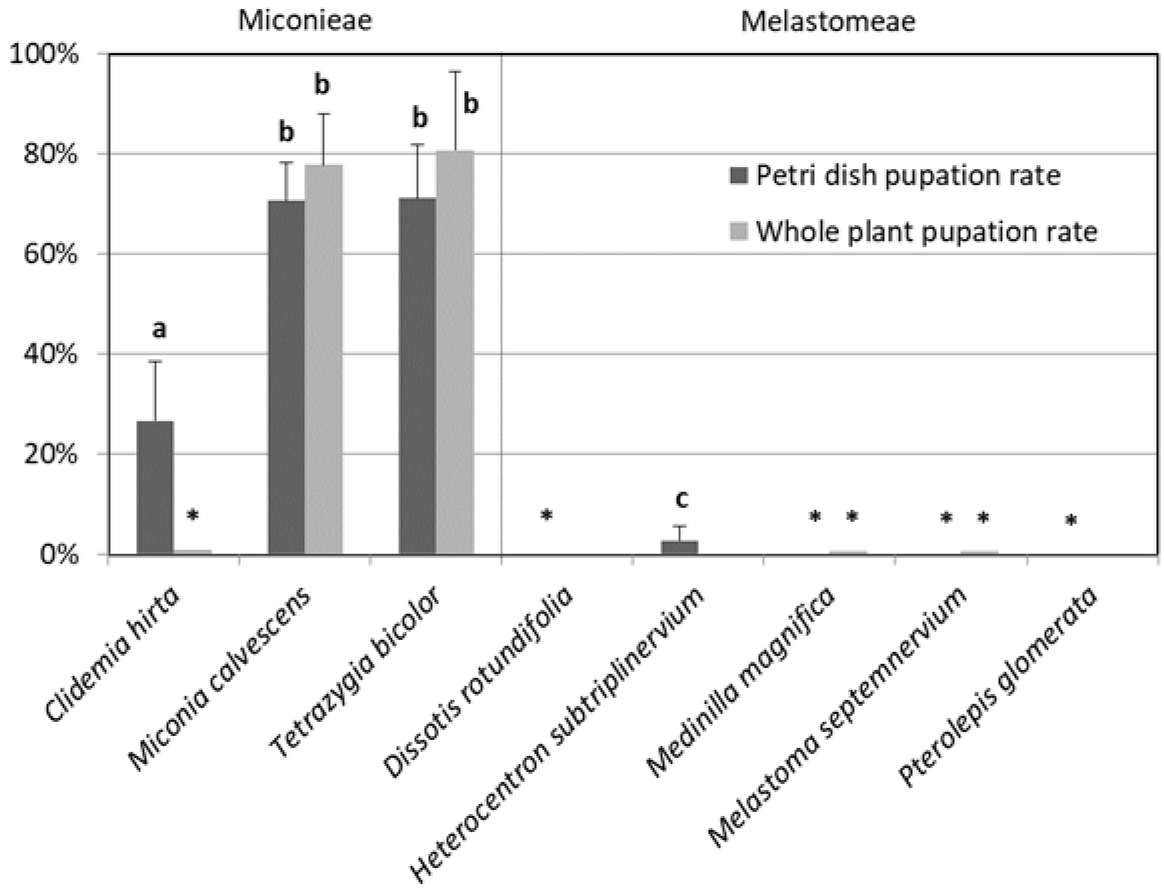


Figure 4. Survival of *E. chrysippe* larvae to pupation (percent average ± standard error) when exposed continuously to leaves in Petri dishes (dark gray) and whole plants (light gray) of test plant species in the tribes Miconieae and Melastomeae (family: Melastomataceae). Results with different letters (a,b,c) are statistically different. Results with an asterisk (*) had negligible survival and were not tested in the statistical model.

2. Impact of E. chrysippe on Miconia

The direct effect on the target species is the reduction in fitness and abundance through herbivory. Feeding by *Euselasia chrysippe* will reduce the fitness of miconia wherever the insect and the plants interact. The degree of control will likely vary by location.

3. Impact on Human and Animal Health

Euselasia chrysippe is a butterfly. This insect poses no risk to humans, livestock, or wildlife. It will not sting or bite, and the larvae feed only on miconia and possibly other invasive, non-native plants in the family Melastomataceae.

4. Impact on Native Fauna

Native animals are expected to benefit from the successful control of miconia, which poses a threat to native forests. Although miconia is a bird-dispersed species, there is no evidence that native birds use this species as a food source. A small number of native animals might be indirectly affected by the proposed action if the target weeds are used for shelter; however, the effect is expected to be insignificant, as native animals that adapted to use the introduced species would be generalists, capable of using alternative plant species once the target species is removed.

5. Socio-economic Impacts

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. However, release of *E. chrysippe* into Hawaii's environment is not expected to have negative socio-economic impacts. Miconia has no economic value and the locations where biocontrol will interact with miconia are mostly uninhabited natural areas. The successful control of miconia will benefit the environment and can release the resources used in chemical and mechanical control efforts for other purposes. The proposed action will not significantly change the land use of areas affected by miconia. 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. Recreational use of the affected area is expected to benefit from the proposed action. The target species is a noxious weed that can degrade the recreational value of natural areas. Therefore, the control of miconia is expected to benefit recreation. *Euselasia chrysippe* is expected to remain localized on and near miconia, which grows mainly in uninhabited forested areas. Because of this, it is unlikely that *E. chrysippe* would become a nuisance to residents and visitors. Biocontrol of miconia 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. Thus, the proposed action will have insignificant effect in scenic value and visual resources.

6. Uncertainties Regarding the Environmental Release of E. chrysippe

Once a biological control agent such as *E. chrysippe* is released into the environment and becomes established, there is a slight possibility that it could move from the target plant (miconia) to attack nontarget plants. Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000). Native species that are closely related to the target species are the most likely to be attacked (Louda et al., 2003). If other plant species were to be attacked by *E. chrysippe*, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents such as *E. chrysippe* generally spread without intervention by man. In principle, therefore, release of this biological control agent at even one site must be considered equivalent to release over the entire area in which potential hosts occur, and in which the climate is suitable for reproduction and survival. However, significant non-target impacts on plant populations from previous releases of weed biological control agents are unusual (Suckling and Sforza, 2014).

In addition, this agent may not be successful in miconia populations in Hawaii. Worldwide, biological weed control programs have had an overall success rate of 33 percent; success rates have been considerably higher for programs in individual countries (Culliney, 2005). Actual impacts on miconia by *E. chrysippe* will not be known until after release occurs and post-release monitoring has been conducted (see appendix A for release protocol and post-release monitoring plan). It is expected that *E. chrysippe* will reduce populations of miconia in Hawaii.

7. Cumulative Impacts

"Cumulative impacts are defined as the impacts on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agencies or person undertakes such other actions" (40 CFR 1508.7).

Control of miconia is carried out by various federal, state, local, and private organizations in Hawaii. For instance, on Kauai, the Kauai Invasive Species Committee (KISC) works with partners to survey for and control all known miconia on Kauai (MISC, 2022). Land owners and tenants can allow KISC to survey their property and eradicate miconia. On Oahu, the Oahu Invasive Species Committee is working to survey all population boundaries to completely eradicate miconia from Oahu (MISC, 2022). On Hawaii Island where miconia is widespread, the Big Island Invasive Species Committee controls miconia in high-value native forest areas, otherwise, control is dependent upon the landowner (MISC, 2022). In 2000, the State of Hawaii spent approximately $1.7 million trying to control the spread of Miconia (Kaiser, 2006; Chan-Halbrendt et al., 2010). However, limited funding is available to control miconia in Hawaii (Chan-Halbrendt et al., 2010).

Release of *E. chrysippe* is not expected to have any negative cumulative impacts in Hawaii because of its host specificity to invasive melastomes. Release of *E. chrysippe* will not preclude other agencies or organizations from working to control these plants and if effective, would assist them with their efforts. Effective biological control from introduced *E. chrysippe* may not only provide safe, effective, and long-term control of miconia, but it may also result in reduced use of herbicides against these plants.

No other agents have been released in Hawaii for biological control miconia; therefore, no competitive interactions between agents are expected. The USFS is proposing to release a beetle for biocontrol of cane tibouchina (*Tibouchina herbacea*) and other invasive plants in the family Melastomataceae in Hawaii. However, that beetle does not feed on miconia, nor does *E. chrysippe* feed on cane tibouchina. Thus, it is not expected that the two insects will interact with one another.

8. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species or result in the destruction or adverse modification of critical habitat.

U.S. Fish and Wildlife Service Assessment: There are currently 474 federally listed species under the jurisdiction of the U.S. Fish and Wildlife Service in the State of Hawaii (FWS, ECOS, 2022), the majority of which are flowering plants.

Mammal assessment: The Hawaiian hoary bat has been found to use diurnal roosts in a variety of tree species and in an assortment of habitat stand types including native and non-native habitats (Montoya-Aiona, 2020). However, miconia was not specifically noted as a tree used for roosting in the study. Even if miconia was used for roosting, biocontrol of miconia would not affect the bat because Hawaiian hoary bat selected roost trees by height and size characteristics rather than by preferred tree species (Montoya-Aiona, 2020) and any tree species could be used. Therefore, release of *E. chrysippe* will have no effect on the Hawaiian hoary bat.

Bird Assessment: Ten birds are federally listed in Hawaii. Only the Hawaii akepa is a forest-inhabiting bird species. This bird uses old growth forest trees and is not reported to use miconia for nesting or foraging (FWS, 2006). No federally listed birds in Hawaii are dependent on or are reported to forage on miconia. Although miconia is a bird-dispersed species, there is no evidence that native birds use this species as a food source. Therefore, APHIS has determined that release of *E. chrysippe* will have no effect on the Hawaii akepa or other listed birds in Hawaii.

Reptile Assessment: Four sea turtles are federally listed in Hawaii (Green (Central North Pacific DPS), hawksbill, leatherback and olive ridley). Miconia is not considered a primary constituent element of the critical habitat of these species; thus, release of *E. chrysippe* will have no effect on their critical habitat. There is no information indicating specific interactions between listed sea turtles and miconia, and sea turtles would not use miconia in any way; thus, removal of the plant from the environment would have no effect on them. Therefore, APHIS has determined that release of *E. chrysippe* will have no effect on listed sea turtles in Hawaii.

Snail Assessment: Three tree snails are federally listed in Hawaii (*Partulina semicarinata*, Lanai tree snail; *Partulina variabilis*, Lanai tree snail; and *Newcombia cumingi*, Newcomb's tree snail). *Erinna newcombi* (Newcomb's snail) is listed but is not a tree snail.

Lanai tree snail (*Partulina semicarinata*) is found on the following native host plants: *Metrosideros polymorpha*, *Broussaisia arguta* (kanawao), *Psychotria* spp. (kopiko), *Coprosma* spp. (pilo), *Melicope* spp. (alani), and dead *Cibotium glaucum* (tree fern, hapuu). Occasionally the snail is found on nonnative plants such as *Psidium guajava* (guava), *Cordyline australis* (New Zealand tea tree), and *Phormium tenax* (New Zealand flax). (Hadfield, 1994).

Lanai tree snail (*Partulina variabilis*) is found on the following native host plants: *Metrosideros polymorpha, Broussaisia arguta, Psychotria* spp., *Coprosma* spp., *Melicope* spp., and dead *Cibotium glaucum*. Occasionally *Partulina variabilis* is found on nonnative plants such as *Psidium guajava* and *Cordyline australis* (Hadfield, 1994). Historically, *Partulina variabilis* was found in wet and mesic *Metrosideros polymorpha* forests on Lanai.

Newcomb's tree snail (*Newcombia cumingi*) has been documented living on small, older *Metrosideros polymorpha* (ohia) primarily in areas with dense cover by *Dicranopterus linearis* (uluhe fern) (Thacker and Hadfield, 1998), though other hosts that support suitable microbes might also be used by the tree snail.

Miconia is not reported as a host plant for these tree snails. Thus, release of *E. chrysippe* will have no effect on these snails. Release of *E. chrysippe* will also have no effect on the designated critical habitat of listed snails in Hawaii. Miconia is not a physical or biological feature essential to the conservation of any listed snail.

Insect assessment: *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 and Magnacca, 2003). Native yellow-faced bees have not been observed to forage on miconia, and any use of the targeted plants would be peripheral to their primary foraging on native species. Thus, release of

E. chrysippe will have no effect on *Hylaeus* species bees or designated critical habitat. Miconia is not a physical or biological feature essential to the conservation of any listed insect.

Blackburn's sphinx moths are found in dry to mesic forest habitats. Larvae can develop on a range of native and non-native plants in the Solanaceae. In addition to using known larval hosts like the native and endangered aiea (*Nothocestrum* spp.) and tree tobacco (*Nicotiana glauca*), it also has the ability to develop fully on the native glossy nightshade (*Solanum americanum*) and *Solanum sandwicense* in a laboratory setting. *Eurelasia chrysippe* would not affect the solanaceous host plants of this moth.

The naiads of damselflies are aquatic and both adults and naiads are predaceous. Eggs are laid on aquatic vegetation. Thus, release of *E. chrysippe* would have no effect on the blackline Hawaiian damselfly, crimson Hawaiian damselfly, flying earwig Hawaiian damselfly, oceanic Hawaiian damselfly, orangeblack Hawaiian damselfly, or Pacific Hawaiian damselfly or designated critical habitat.

Several of the listed *Drosophila* spp. picture wing flies occur in wet to mesic forests, where miconia invades. However, miconia is not a host for these flies. In addition, invasion of wet forests by miconia may adversely affect these fly species and their critical habitat if they outcompete their plant hosts. Release of *E, chrysippe* would have no effect on listed *Drosophila* spp. or their critical habitat in Hawaii. There is a potential that release could be beneficial to these flies if it can reduce the competition between miconia and their primary host plants, but this is dependent on the efficacy of *E, chrysippe* in reducing miconia.

Crustacean Assessment: Two Anchialine pool shrimp (*Procaris hawaiana* and *Vetericaris chaceorum*) are listed in Hawaii. Biological control of miconia is not expected to result in increased runoff or sedimentation of waterbodies. In addition, biological control may reduce the use of herbicides for invasive plant control that could runoff or drift into aquatic habitat and could directly adversely affect listed crustaceans (acute or chronic exposure). There is no information indicating specific interactions between listed crustaceans and miconia. Although invasive plants are listed as a threat to these species, miconia is not mentioned (FWS, 2020a; b).

Miconia is not considered a primary constituent element of the critical habitat of any listed crustacean and is not reported as occurring in the habitat of any listed crustacean. APHIS has determined that release of *E. chrysippe* will have no effect on listed crustaceans or their designated critical habitats.

Potential for attack of federally-listed plants

There are no federally listed plants belonging to the same family as the target weed (Melastomataceae).

In no-choice testing, there was minor larval feeding on a few plants outside of the Melastomataceae family:

- *Cuphea ignea* (Lythraceae) – there are no federally listed plants in this family in Hawaii;
- *Plinia cauliflora, Psidium cattleianum, Psidium friedrichsthalianum,* and *Metrosideros macropus*, (Myrtaceae) – there is only one federally listed plant in the Myrtaceae in Hawaii, *Eugenia koolauensis.* However, another *Eugenia* species was tested in no-choice host specificity tests (*Eugenia uniflora*) and no larval feeding occurred on that plant;
- *Terminalia catappa* (Combretaceae) – there are no federally listed plants in this family in Hawaii.
- *Geranium homeanum* (Geraniaceae) – there are five geraniums listed in Hawaii.
  - *Geranium arboreum* (Nohoanu) Endangered
  - *Geranium hanaense* (Nohoanu) Endangered
  - *Geranium hillebrandii* (Nohoanu) Endangered
  - *Geranium kauaiense* (Nohoanu) Endangered
  - *Geranium multiflorum* (Nohoanu) Endangered

The feeding on *Geranium homeanum* was extremely minor. 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). Thus, under natural conditions, no feeding would occur on listed *Geranium* species. No larvae survived on any plant outside of the Melastomataceae for more than three days.

In addition, release of *E. chrysippe* may be beneficial to native and federally-listed plants if it is effective in reducing miconia. In areas where miconia has invaded, sites formerly dominated by native vegetation become completely transformed as miconia gains dominance, due to the creation of deep shade which few native plant species can tolerate (Meyer, 1994, as cited in CABI (2022)). In Tahiti, 70–100 native plant species, including 35–45 species endemic to French Polynesia, are directly threatened by invasion of miconia into native forests (Meyer and Florence, 1996; Meyer, 2001, as cited in CABI (2022)).

APHIS has determined that the release of *E, chrysippe* will have no effect listed plants or their critical habitats in Hawaii due to non-target attack. It is possible that there could be a beneficial effect to certain listed plants, but this depends on the efficacy of *E. chrysippe* in reducing miconia in Hawaii.

National Oceanic and Atmospheric Administration (NOAA) Fisheries Species Assessment: The proposed release of *E. chrysippe* would have no effect on federally-listed species or critical habitat under the jurisdiction of the National Marine Fisheries Service (table 2) (NOAA Fisheries, 2022). There would be no interaction between *E. chrysippe* and these species.

Table 2. Species in Hawaii under NOAA Fisheries jurisdiction that are protected under the Endangered Species Act (NOAA Fisheries, 2022).

Common Name	Scientific Name	ESA Listing Status
Blue Whale	*Balaenoptera musculus*	Endangered
False Killer Whale - Hawaiian Insular	*Pseudorca crassidens*	Endangered with critical habitat
Fin Whale	*Balaenoptera physalus*	Endangered
North Pacific Right Whale	*Eubalaena japonica*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Hawaiian Monk Seal	*Neomonachus schauinslandi*	Endangered with critical habitat
Central North Pacific Green Turtle	*Chelonia mydas*	Threatened
Hawksbill Turtle	*Eretmochelys imbricata*	Endangered
Leatherback Turtle	*Dermochelys coriacea*	Endangered
North Pacific Loggerhead Turtle	*Caretta caretta*	Endangered
Olive Ridley Turtle	*Lepidochelys olivacea*	Threatened
Giant Manta Ray	*Manta birostris*	Threatened
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened

V. Other Issues

A. Equity and Underserved Communities

In Executive Order (EO) 13985, Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, each agency must assess whether, and to what extent, its programs and policies perpetuate systemic barriers to opportunities and benefits for people of color and other underserved groups. In EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, Federal agencies must identify and address disproportionately high and adverse human health or environmental impacts of proposed activities.

Consistent with these EOs, APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. APHIS did not identify any disproportionately high or adverse environmental or human health effects from the field release of *E. chrysippe.* The preferred action will not have disproportionately high or adverse effects to any minority or low-income populations.

Federal agencies also comply with EO 13045, Protection of Children from Environmental Health Risks and Safety Risks. This EO requires each Federal agency, consistent with its mission, to identify and assess environmental health and safety risks that may disproportionately affect children and to ensure its policies, programs, activities, and standards address the potential for disproportionate risks to children. Consistent with EO 13045, APHIS considered the potential for disproportionately high and adverse environmental health and safety risks to children. No aspects of the proposed field release of *E. chrysippe* could be identified that would have disproportionate effects on children.

B. Cultural Assessment

ASM Affiliates Hawaii, a Heritage and Cultural Resource Management firm, prepared a Cultural Impact Assessment (CIA) for the Hawaii Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), and Hawaii Department of Agriculture (HDOA) for the proposed release of *E. chrysippe* statewide in Hawaii (Brandt, 2019). This assessment is part of the administrative record for this EA and is available upon request. The primary focus of the report was to understand the cultural and historical context of miconia with respect to Hawaii's host culture. The CIA is divided into four main sections, beginning with an introduction of the
proposed action followed by a physical description of miconia and *E. chrysippe*. Part two of this report provided 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 Hawaii was also provided, and this section concluded with a detailed discussion of the introduction of *Miconia* to the South Pacific and into the Hawaiian Islands. The results from the consultation process were presented, along with a discussion of potential impacts as well as appropriate actions and strategies to mitigate any such impacts.

To identify individuals knowledgeable about traditional cultural practices and/or uses associated with the affected environment, a public notice was submitted 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. Twenty people responded to the request with either brief comments, referrals, or acceptance of the interview request. ASM Affiliates conducted a total of eight interviews. The interviewees were asked a series of questions regarding their background, and their experience and knowledge of miconia. 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.

As reported in the CIA (Brandt, 2019), although miconia has existed in the Hawaiian Islands for more than fifty years, there are no recorded cultural uses for miconia, other than its use as an ornamental. While horticulturalist and plant collectors are known to favor this plant for its unique qualities, there is no historical evidence to suggest that miconia is crucial to any particular ethnic groups' cultural history, identity, practices, or beliefs, nor does it meet any of the significance criteria described in the report. Although miconia does not meet any of the significance criteria, what is culturally significant is the wet forest habitat in which it thrives. Hawaii's wet forest habitat could be considered significant as a traditional cultural property as it contains many culturally important native plants and animals, which are still used in certain Hawaiian cultural practices or are 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 was the assessment of the CIA that the release of *E. chrysippe* 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 miconia from claiming more of Hawaii's wet forest habitat, then 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: 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.

C. Climate Change

Climate change will affect Hawaii in many ways as a result of rising air temperatures, changing rainfall patterns, rising sea levels, and increased risk of extreme drought and flooding (Keener et al., 2018).

1) Impact of Climate Change on Proposed Action

Climate change is affecting Hawaii, resulting in sea level rise, coastal and inland flooding, and coastal erosion (State of Hawaii, 2022). These will lead to land becoming unusable, and structures, roads, cultural sites, and other assets at risk (State of Hawaii, 2022). Changing climate, including increased flooding events, could possibly affect the ability of *E. chrysippe* to establish and control miconia.

2) Impact of Proposed Action on Climate Change

Release of *E. chrysippe* will have none to very little effect on long-term or regional climate patterns. Biocontrol of miconia may affect microclimates that are influenced by invasive vegetation. Successful control of miconia is expected to enable native vegetation to recolonize the invaded area, which will reduce the negative effect of miconia on microclimates benefitting native species.

Sources of greenhouse gas emissions as a result of permitting the environmental release of *E. chrysippe* would include (1) vehicle use by the permittee and cooperators during biocontrol agent delivery and monitoring in the field, and greenhouse gas releases associated with heating and cooling the facilities used for the rearing of *E. chrysippe*. It is not possible to predict the number of site visits or distance traveled to those sites. Initially, these visits would be expected to be more frequent as *E. chrysippe* is distributed and monitoring activities are conducted by the permittee and cooperators. Over time, as the agent establishes and spreads on its own, site visits would be expected to decrease. Rearing of *E. chrysippe* occurs in the Hawaii Volcanoes National Park Quarantine Facility (HVNPQF). Rearing of *E. chrysippe* would contribute only a small portion of greenhouse gas produced by the facility. In addition, if *E. chrysippe* is successful in reducing the invasion of miconia into new locations, the greenhouse gas emissions from vehicles used to apply insecticides or physical methods to control it would be reduced.

VI. Agencies, Organizations, and Individuals Consulted

This EA was prepared and reviewed by personnel from APHIS, USFS, and SWCA. The addresses of participating APHIS units and any applicable cooperators are provided below.

SWCA Environmental Consultants
1200 Ala Moana Blvd. #380
Honolulu, HI 96814

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Policy and Program Development
Environmental and Risk Analysis Services
4700 River Road, Unit 149
Riverdale, MD 20737

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Pests, Pathogens, and Biocontrol Permits
4700 River Road, Unit 133
Riverdale, MD 20737–1236

U.S. Department of Agriculture
Forest Service
Pacific Southwest Research Station
Institute of Pacific Island Forestry
60 Nowelo St.
Hilo, Hawaii 96720

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Appendix A. Release and post-release monitoring plan for *E. chrysippe* in Hawaii

1) Process for collection, screening, rearing and field release of *Euselasia chrysippe*

Proposed steps:

1) Egg masses collected from field sites in Costa Rica
2) Larvae reared to adulthood in entomology lab at Univ. of Costa Rica, observing and removing diseased or parasitized individuals at each life stage
3) Adults released in large rearing cage at Univ. of Costa Rica for mating and egg laying
4) Eggs collected at UCR and shipped to Hawaii Volcanoes quarantine
5) Larvae reared to adulthood in containment at Hawaii Volcanoes quarantine, checking for diseased or parasitized individuals at each life stage. In addition to visual screening for natural enemies, we will destructively subsample larvae and adults for genetic analysis to detect potential pathogens.
6) Adults removed from quarantine and released into large rearing cage near Hilo for mating and egg laying
7) Eggs collected from rearing cage and larvae reared to adult in labs or cages at HDOA, Forest Service, or other partner facilities, checking for diseased or parasitized individuals
8) Adults released at field sites of miconia invasion

Protocol:
Immature stages will be inspected twice per week for potential natural enemies. Genetic screening is proposed for pathogens that may be difficult to detect, but are known to affect butterfly larvae, pupae, or adults. These include species of fungi, viruses, and bacteria that commonly infect lepidopterans. If natural enemies are detected at any stage of development, the associated batches of *E. chrysippe* will be isolated and destroyed if there is no other means of insuring an enemy-free colony. This is mainly relevant for pathogens that might escape visual detection and spread easily, rather than parasitoids that tend to be obvious. Parasitoids include tiny wasps that emerge from eggs, or wasps and flies that emerge from larvae and pupae.

Immatures from a single egg batch (approx. 40–80 individuals) will be reared together as a cohort on a potted miconia sapling in isolation from other egg cohorts. This allows for careful screening of natural enemies and separate handling of males and females from the same cohort to minimize in-breeding. Males from a cohort emerge from pupae one day before females, allowing easy separation and handling of sexes. Duration of life stages are approximately four weeks for eggs, three weeks for larvae, two weeks for pupae, and four to eight weeks for adults.

Large rearing cages in both Costa Rica and Hawaii will be situated in environments that are expected to lack specialized enemies of *E. chrysippe*. At the University of Costa Rica, the field cage is situated in a forested area far from natural populations of the insect and its host plants. In Hawaii, there are no known specialized natural enemies of *Euselasia*. The Hilo field cage site will be treated to eliminate little fire ant (*Wasmannia auropunctata*) and other potential predators. A few dozen adult male and female *E. chrysippe* butterflies will be introduced to a cage at a time. Egg masses will be monitored by inspecting undersides of miconia leaves on trees within the cage. Egg masses will be collected by removing all or a portion of each leaf.

The field cage will be constructed of sewn panels of shade cloth suspended by ropes from trees and other structures over several large miconia trees planted in the ground. Edges of shade cloth will be tied together or buried in the ground to close gaps large enough for butterflies to escape. Entry to the cage will be through a shade cloth vestibule to prevent escape by butterflies. The Hilo rearing cage (approx. 30 x 50 x 18 feet) is planned for a location with appropriate conditions for *Euselasia* mating and egg laying, on private property away from public access points. The cage will be monitored at least 3 times per week. Although potentially vulnerable to wind or other natural or human-caused damage, the shade cloth cage is expected to be durable for use for three years or more. Its main function is to allow rearing of large numbers of egg masses, rather than to prevent possible environmental release of small numbers of butterflies. It can be made available for inspection prior to first use or as needed.

These protocols will allow for screening of two generations of *E. chrysippe* prior to environmental release in Hawaii, and one additional generation of screening before field release. All rearing of immatures can be conducted on potted plants in secure environments, where insects are easily inspected for signs of natural enemies. Adult mating and egg laying will occur in rearing cages which can be managed to minimize possible exposure to natural enemies.

2) Post-release monitoring of *Euselasia chrysippe*

Euselasia chrysippe will be released as newly emerged adults at selected field sites on the islands of Hawaii and Maui where *Miconia calvescens* is abundant. Initial release sites on Hawaii Island in the vicinity of Hilo will be selected for accessibility for regular follow-up monitoring by USDA Forest Service and partners. On Maui, monitoring efforts will depend upon on-island partners such as Hawaii Department of Agriculture, Hawaii Dept. of Land and Natural Resources, and Maui Invasive Species Committee. It is likely that detection of *E. chrysippe* populations will be challenging in the early stages of establishment. Surveys for adult *E. chrysippe* and feeding damage by early larval stages will be used to measure population levels at monthly intervals. Survey methods will be developed initially based on observations of adult behavior and larval feeding within a large captive rearing cage. Biological data such as time of day of adult flights and egg-laying, and details and visibility of early larval feeding will inform design of surveys. Dispersal of *E. chrysippe* butterflies away from initial release sites will be quantified as methods become standardized and shared with partners, including via citizen science approaches, if feasible.

As populations establish, USDA Forest Service personnel will focus on assessing impacts of larval feeding by *E. chrysippe* on miconia, at the levels of a stand and individual trees. Impacts will be measured in foliage cover and light penetration, as well as growth and reproduction of individual trees. Methods will likely include quarterly surveys of marked locations using ground-based measures and aerial photography by drone.

As mass-reared *E. chrysippe* butterflies become available for experimental purposes, the permittee will also monitor survival of immature stages marked and revisited frequently at selected sites, to assess vulnerability to natural enemies (levels of predation, disease, or parasitism).