Hylaeus assimulans
(Assimulans yellow-faced bee)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawai‘i

5-YEAR REVIEW

Species reviewed: *Hylaeus assimulans* (Assimulans yellow-faced bee)

TABLE OF CONTENTS

5-YEAR REVIEW
Hylaeus assimulans (Assimulans yellow-faced bee)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Diane Sether, Ph.D., Invertebrate and Wildlife Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

Lead Regional Office:
Interior Region 12, Portland Regional Office, Portland Oregon

Lead Field Office:
Interior Region 12, PIFWO, Honolulu, Hawai‘i

Cooperating Field Office(s):
N/A

Cooperating Regional Office(s):
N/A

1.2 Methodology used to complete the review:

This review was conducted by staff of the U.S. Fish and Wildlife Service (Service) at the Pacific Islands Fish and Wildlife Office, beginning in November 2020. The review was based on the final rule listing this species; the final critical habitat designation; peer reviewed scientific publications; unpublished field observations by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation completed by Diane Sether, Ph.D., Invertebrate and Wildlife Biologist, was reviewed by John Vetter, Animal Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2019. Endangered and threatened wildlife and plants; Initiation of 5-year status reviews for 91 species in Oregon, Washington, Hawaii, and American Samoa. Federal Register 84 27152-27154.

1.3.2 Listing history:

Original Listing
FR notice: [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; Determination of endangered status for 49 species from the Hawaiian Islands. Federal Register 81:67786-67860.
.
Date listed: September 30, 2016
Entity listed: *Hylaeus assimulans*
Classification: Endangered

Revised Listing, if applicable
FR notice: N/A
Date listed: N/A
Entity listed: N/A
Classification: N/A

1.3.3 Associated rulemakings:
FR notice: N/A

1.3.4 Review History:
This is the first 5-year review for *Hylaeus assimulans*.

1.3.5 Species' Recovery Priority Number at start of this 5-year review:
5

1.3.6 Current Recovery Plan or Outline:
Name of plan or outline: Recovery Outline for the Multi-Island Species (USFWS 2020).
Date issued: July 30, 2020
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?
____**Yes**
__X_**No**

2.1.2 Is the species under review listed as a DPS?
____**Yes**
____**No**

2.1.3 Was the DPS listed prior to 1996?
____**Yes**

____No

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

____Yes
____No

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

____Yes
____No

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

____Yes
____No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

____Yes
__X_No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

____Yes
____No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery?

____Yes
____No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:
The draft Recovery Plan for the Multi-Island Species that will include assimulans yellow-faced bee (*Hylaeus assimulans*) is scheduled to be developed and in 2021.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

In general, *Hylaeus* species are small to medium sized bees with forewing lengths of about 0.12 to 0.31 inches (in) (3 to 8 millimeters [mm]), slender bodies that are usually black, short-bilobed tongues, and two submarginal cells in the forewing (Daly and Magnacca 2003, p. 12). Males of most of the *Hylaeus* species and females of several species have yellow marks on their face, hence the common name "yellow-faced bees." *Hylaeus* bees, in general, lack the elongated hairs on the hind legs that other bee genera use to carry pollen externally. The lack of these hairs gives them a wasp-like appearance. But, yellow-faced bees can be distinguished from wasps by the presence of branched hairs on the body that are longest on the sides of the thorax. *Hylaeus assimulans* is distinguished by its large size relative to other coastal *Hylaeus* species in the family Colletidae and subfamily Hylaeinae. It has slightly smoky to smoke-colored wings. The male is black with yellow face marks, with an almost entirely yellow lower face region and additional marks on the sides that narrow towards the top. The male also has brown appressed hairs on the tip of the abdomen. The female is entirely black, large-bodied, and has no distinct punctation on the abdomen (Daly and Magnacca 2003, p. 56). A more detailed description of the species can be found in Daly and Magnacca (2003, pp. 55-58). Transport of the pollen in the internal crop is unique to bees in the subfamily Hylaeinae (Michner 2000, p. 15).

Ground-nesting species, like assimulans yellow-faced bee, need relatively dry conditions for nesting (Daly and Magnacca 2003, p. 11). *Hylaeus* species that nest in the ground lack the physical characteristics necessary for digging a nest, such as strong mandibles and terminal abdominal plate (pygidial plate) that would allow them to excavate hard-packed soil (Daly and Magnacca 2003, entire; Magnacca 2007, p. 187). As a result, ground nesting *Hylaeus* species do not usually initiate their own nest holes; rather they utilize vacant burrows made by other insects such as beetles or wasps or natural crevices in or on the ground (Magnacca 2007, p. 188). Bees in the family Colletidae are also referred to as plasterer bees because they line their nests with a cellophane-like membrane secreted from their salivary and Dufour's gland (Espelie et al. 1992, entire; Day and Magnacca 2003, p. 9). The female assimulans yellow-faced bee lines and provisions her own nest, even if nesting in aggregations, hence the name solitary bees (Daly and Magnacca 2003, p. 9). After lining the nest, the female lays her eggs. Prior to sealing the nest, the female provides her brood (young) with a mass of semiliquid nectar and pollen left alongside her eggs (Day and Magnacca 2003, p. 9).

Within the nest, the general life cycle for *Hylaeus* spp. is as follows: eggs hatch and develop into grub-like larvae. As larvae grow, they molt through

three successive stages. During this time, the larvae consume the nectar and pollen provisions left for them by the female (Daly and Magnacca 2003, p. 9; Michener 2000, p. 24). After the third molt, the larvae change into pupae (a resting form). It is in this stage that they metamorphose (i.e. undergo change) and emerge as adults. The brood cycle from egg to adult takes about 30 to 60 days (Graham 2015 in litt., entire), during which time, the solitary females do not provide parental care or defend their brood.

Our knowledge of the breeding and longevity of assimulans yellow-faced bee individuals is very limited. *Hylaeus* females mate as young adults and store the sperm for the rest of their lives (Daly and Magnacca 2003, pp. 7–8). Based on Daly and Magnacca (2003, p. 7–8), *Hylaeus* females, in general, appear to live longer than males. An adult male of the wood nesting species *Hylaeus pubescens*, survived 74 days (Daly and Coville 1982, p. 76), but little else is known about average longevity of the coastal and dry forest nesting species.

Adult yellow-faced bees consume pollen and nectar, but their exact nutritional needs are unknown. Yellow-faced bees very rarely visit non-native plants for nectar and pollen; consequently, the bees are almost completely absent from habitats dominated by exotic plant species (Daly and Magnacca 2003, p. 11; Magnacca 2007, pp. 186,– 188). According to Magnacca (2007, entire), coastal nesting bees are almost exclusively found in areas dominated by a variety of native shrub and herb species rather than a single species. *Scaevola* spp. (naupaka kahakai), for example, is common and widespread in the coastal strand habitat, yet *Hylaeus* are apparently not capable of surviving solely on this plant species (Magnacca 2007 p. 187). Analyses of pollen loads show that coastal *Hylaeus* species, in particular, use many different plants as food sources, not only seasonally, but also at any given time (Magnacca 2007, entire). The presence of diverse, simultaneously available native pollen sources that support the adults and are used for provisioning the nest are likely a necessary part of suitable habitat for assimulans yellow-faced bee survival and reproduction.

Assimulans yellow-faced bee appears to be more closely associated with plants in the genus *Sida*, in the mallow family (Malvaceae), than are other *Hylaeus*. The species visits *Sida fallax* (‘ilima) for both nectar and pollen. The larger size of assimulans yellow-faced bee, relative to most Hawaiian *Hylaeus*, may be an adaptation to handling the large pollen of *Sida* sp. Studies thus far suggest this yellow-faced bee species may be more common where this plant is abundant (Daly and Magnacca 2003, pp. 58, 217; Magnacca 2007, p. 183). Assimulans yellow-faced bee appears to be more common in dry forest at relatively higher elevations, which may be related to the abundance of ‘ilima in the understory (Magnacca 2005, p.

2); ʻilima species are less often found in coastal habitat. Adults have also been also observed visiting the flowers of *Lipochaeta lobata* (nehe) (Daly and Magnacca 2003, pp. 58, 217), which grows on Oʻahu and Maui. Recently on Maui, assimulans yellow-faced bee was photo-documented visiting flowers of *Lycium sandwicense (*ʻohelo kai), naupaka kahakai, *Osteomeles anthyllidifolia* (ʻūlei), and *Sesbania tomentosa* (ʻōhai) (Kenolio 2020 in litt., entire). It is likely *H. assimulans* visits several other native plants, including *Acacia koa* (koa), *Metrosideros polymorpha* (ʻōhiʻa), *Styphelia tameiameiae* (pukiawe), and *Euphorbia* spp., which are frequented by other *Hylaeus* species as well (Magnacca 2005, entire).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Historically, *Hylaeus assimulans* was widely distributed, though not as abundant, as other coastal inhabiting species such as *Hylaeus anthracinus* and *Hylaeus longiceps* (Perkins 1899, pp. 75, 98, 101-102). The species was known from numerous coastal and lowland dry forest habitats up to 2,000 ft (610 m) in elevation on the islands of Oʻahu, Lānaʻi, and Maui. There are no collections from Molokaʻi on record, though it is theorized the species may have occurred there (Daly and Magnacca 2003, entire; Magnacca 2007, entire). Native coastal and lowland dry habitat of each island were among the first habitats effected by anthropomorphic actions. Much of the coastal habitat has been either developed or degraded and is no longer suitable for assimulans yellow-faced bee (Liebherr and Polhemus 1997, pp. 346–347; Magnacca 2007, pp. 186–188). Native-dominated habitats that do remain are highly fragmented throughout the historical range of the bee.

After the major collections conducted in the early 1900's, about 70 to 100 years elapsed before surveys were again conducted for assimulans yellow-faced bee. Between 1997 and 1998, surveys for Hawaiian *Hylaeus* were conducted at 25 sites on Oʻahu, Molokaʻi, Lānaʻi, Maui, and Kahoʻolawe (Daly and Magnacca 2003, pp. 217-225). The species was absent from 6 of its historical localities on Oʻahu, Lānaʻi, and Maui, and was not observed at the remaining 19 sites that had potentially suitable habitat (Daly and Magnacca 2003, pp. 7, 56, 217–229; Magnacca 2005, entire; Magnacca 2007, pp. 177, 181, 183).

Assimulans yellow-faced bee is most recently known from a few small patches of coastal and lowland dry forest habitat in two locations on Lānaʻi in the dry forest ecosystem; six locations on Maui in the coastal and lowland dry ecosystems; and one location on Kahoʻolawe in the coastal ecosystem (Daly and Magnacca 2003, p. 58; Magnacca 2005 in litt., p. 2; Kenolio 2020 in litt., entire).

Assimulans yellow-faced bee has likely been extirpated from Oʻahu. In surveys conducted from 1998 to 2008, the species was not found in its historically known locations nor was it observed in locations with suitable habitat, though other rare *Hylaeus* species were found (Daly and Magnacca 2003, pp. 58, 217). Locations surveyed included the islet of Mokuʻauia (Goat Island), Kaʻena Point, Kahuku, Makapuʻu, and Kalaeloa (Daly and Magnacca 2003, p. 58, 217; Magnacca 2005, entire; Magnacca 2007, p. 181; Sahli et al. 2008, entire; Magnacca and King 2013, entire; Magnacca 2019 in litt., entire).

On Lānaʻi, assimulans yellow-faced bee is most recently known from small patches of coastal and lowland dry forest habitat in two locations in the dry forest ecosystem. Seven sites with potentially suitable habitat, including Mt. Kōʻele and Awalua, were surveyed between 1998 and 2006. The species was found only near Mānele Road and Polihua Road in small pockets of native vegetation, including ʻilima (Daly and Magnacca 2003; p. 217; Magnacca 2007, p. 182-183, 217). At the Mānele Road site, north of Mānele Beach, one male was identified from lowland dry forest at the 600 ft (≈ 180 m) elevation in southern Lānaʻi (Daly and Magnacca 2003, p. 217). The canopy was dominated by invasive kiawe trees and the understory had a dense stand of ʻilima. However, with the exception of a few stunted plants at the roadside where moisture had accumulated, the rest of the stand of ʻilima had senesced (reached maturity) or died. Native plants at this site appeared to be drought-intolerant and probably did not provide consistent habitat for assimulans yellow-faced bee throughout the year (Magnacca 2007, p. 183). In the lowland dry forest along Polihua Road, two males were identified from the 1000 ft (≈ 300 m) where the species was observed on ʻilima (Daly and Magnacca 2003, p. 217).

On Maui, six potentially suitable habitat locations distributed across the island were surveyed between 1997 and 2007; assimulans yellow-faced bee was found within small pockets of native plants at only two sites. In 1999, one individual was collected near Lahainaluna on ʻilima in dry forest at 1,800 ft (550 m) within the State's West Maui Natural Area Reserve (Daly and Magnacca 2003, p. 217). In 2000, four individuals were collected on private land near Waikapū south of Īao Valley at the 400 ft (≈120 m) elevation (Daly and Magnacca 2003, p. 217). The bees were observed on nehe in lowland dry shrubland dominated by *Dodonaea viscosa* (ʻaʻaliʻi) (Daly and Magnacca 2003, p. 217). Although assimulans yellow-faced bee were historically collected in the Wailuku sand hills and Waiehu dunes area, the species was not found in surveys conducted in 1999 and 2001 (Daly and Magnacca 2003, pp. 217-229). In addition, assimulans yellow-faced bee was not found in suitable lowland dry forest habitat in Kanaio Natural Area Reserve nor coastal habitat at Manawainui Gulch, though other rare *Hylaeus* species were present (Daly and Magnacca 2003, pp. 217-229). Assimulans yellow-faced bee may exist in potentially suitable habitat in rugged and inaccessible portions of West

Maui (Magnacca in litt. 2010, p. 1) where areas of native vegetation exist on the northern coast but have not been investigated (Magnacca 2007 p. 182).

Most recently, assimulans yellow-faced bee has been photo-documented at several locations in west and east Maui (Kenolio 2020 in litt., entire). K. Magnacca confirmed the identifications of the species in the photos. The sightings include the following four general locations: on the southwest coast of east Maui near Makena, Maui; in 2013, on an ūlei flower near the north coast of west Maui in the Kahakuloa area; in 2011 in the Honolua area; and in 2018 in the Papanalahoa Point area, near Wailuku. The bees were seen visiting flowers of ʻōhelo kai, naupaka kahakai, ʻūlei, and ʻōhai (Kenolio 2020 in litt., entire).

Not historically known from Kahoʻolawe (Daly and Magnacca 2003, p. 217), assimulans yellow-faced bee was discovered in 1997 near the high cliffs of Kamōhio Bay in the center of the southern coast of the island (Daly and Magnacca 2003, p 217). The species was absent from one other site on the island in lowland habitat on the east coast at Pali O Kalapakea, where other *Hylaeus* species were collected (Daly and Magnacca 2003, pp. 217-229).

The current population size or demographics of assimulans yellow-faced bee is unknown; however, the species is believed to be extant in low numbers in nine populations located on three islands in Hawaiʻi. Resiliency of the populations is considered low because of limited populations, abundance of individuals limited by size of available habitat, isolation of populations from other suitable habitats, and habitat quality that is at risk from environmental and anthropomorphic related threats. Though the species is present on three islands, we consider it to have low redundancy because of the limited number of populations on each island and their vulnerability to catastrophic events. The species representation is also considered low because only nine populations remain including the recent discovery on Kahoʻolawe and all populations are found only within Maui Nui. Genetic exchange between isolated populations is limited by flight distance and is expected to be low. The species is not currently in captivity.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

The diversity of habitat and the breadth of genetic diversity of assimulans yellow-faced bee is strongly influenced by the current and historic biogeographical range of the species. Much of the historical coastal habitat has been lost. While there are no historic population estimates or genetic information, qualitative accounts of this yellow faced bee indicate that

they were widely dispersed, though not abundant, in their habitat. In recent decades, assimulans yellow-faced bee have been absent at sites previously occupied. Because we have no historical genetic information, we cannot determine how much genetic variation has been lost since humans arrived in Hawai‘i. The mobility of yellow-faced bees, in general, provides a means of short-range connectivity between populations, which in turn, can support genetic exchange and representation. However, genetic exchange is likely limited by the isolation and distance between the nine known populations. It is unknown if the population recently discovered on Kaho‘olawe is of historic origin or if it is a recent migration from a neighbor island. The extirpation of the O‘ahu population, combined with no known populations occurring on Moloka‘i, likely represents the loss of some genetic diversity. Though *Hylaeus* females can store sperm for life, small isolated populations are particularly vulnerable to reduced mating encounter and decreased reproductive vigor caused by inbreeding depression. They may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and lessened ability to cope with environmental change (Lande 1988, entire). It is possible that traits have also been lost over time given the reduction in habitat range. Representation of assimulans yellow-faced bee is conferred by stable to increasing populations embodying the existing full genetic diversity being dispersed throughout its full coastal and dry forest ranges (O‘ahu, Lāna‘i, Maui, and Kaho‘olawe). The nine extant populations distributed across three islands provide low representation.

2.3.1.4 Taxonomic classification or changes in nomenclature:
Hylaeus assimulans is the most recent taxonomic treatment for this species (Daly and Magnacca 2003, pp. 55–58).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):
See section 2.3.1.2 above for historic and current spatial distribution of the species. Historically, the species is known from numerous coastal and dry forest habitats up to 2,000 feet (610 meters [m]) in elevation on O‘ahu (coastal and dry forest ecosystem), Lāna‘i (dry forest ecosystem), Maui (coastal and dry forest ecosystems), and Kaho‘olawe (coastal ecosystem) (Daly and Magnacca 2003, pp. 56–58, 217–229). Coastal habitat occurs in a relatively narrow belt around each island from sea level to 980 ft (300 m) in elevation. Habitat loss and degradation have contributed significantly to population declines of assimulans yellow-faced bee. Native coastal strand habitat is now one of the rarest habitats on each island (Wagner et al. 1999, pp. 45, 54; Cuddihy and Stone 1990, pp. 94–95; Magnacca 2007, p. 180). Much of the coastal strand and dunes and the lowland dry forest ecosystems have been modified, degraded, fragmented,

and lost by land use conversion (e.g. development, agriculture, road building), invasion by nonnative species, fire, bombing and target practice (Kahoʻolawe), and environmental changes (Cuddihy and Stone 1990, pp. 94–95; Wagner et al. 1999, entire; Javar-Salas 2020, entire; Kim et al. 2020, entire; Peʻa et al. 2020, entire). The quality of these degraded areas no longer sustain assimulans yellow-faced bee. Nesting and foraging resources are becoming increasingly rare in coastal and the lowland dry shrubland and forest habitats (Cuddihy and Stone 1990, entire; Magnacca 2005, entire; Magnacca 2007, entire). As a result, *H. assimulans* have disappeared from much of the historical range they once occupied on Oʻahu, Lānaʻi, Maui, and likely, Kahoʻolawe.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Historically, coastal strand vegetation was dominated by *Achyranthes splendens* var. *rotundata* (ʻewa hinahina), *Euphorbia* spp. (pōpolo, ʻakoko), *Gossypium tomentosum* (maʻo, Hawaiian cotton), *Hibiscus* spp. (hibiscus), *Jacquemontia ovalifolia* subsp. *sandwicensis* (pāʻū o Hiʻiaka), *Myoporum sandwicense* (naio), *Nama sandwicensis* (nama), *Santalum elipticum* (ʻiliahi, sandalwood), *Scaevola* spp. (naupaka kahakai), *Sesbania tomentosa* (ʻōhai), *Sesuvium portulacastrum* (ʻākulikuli), *Sida fallax* (ʻilima), *Sophora chrysophylla* (māmane), *Vigna* spp., *Vitex rotundifolia*, and *Wikstroemia uva-ursi* (ʻakiʻa) (Kim et al. 2020, entire), some of which are known food resources for assimulans yellow-faced bee (Daly and Magnacca 2003, p. 217; Magnacca 2007, entire). Coastal habitats are highly valued for development, popular for recreation, typically dry and therefore vulnerable to fire, susceptible to invasion by exotic plants, and cover a relatively small area (Magnacca 2007, entire). As a result, intact coastal habitats have become extremely limited in Hawaiʻi; most islands have few, if any, coastal sites with diverse native vegetation that are protected. The majority of the coastal and lowland dry forest habitats below 2,000 ft (610 m) once occupied by assimulans yellow-faced bee are now dominated by invasive plant species that are replacing native flora (Cuddihy and Stone 1990, pp. 73-74; Wagner et al. 1999, p. 52; Mascaro et al. 2008, entire; Javar-Salas et al. 2020, entire; Kim et al. 2020, entire). Most of the coastal habitats of the Hawaiian islands lack significant amounts of native foraging plants besides naupaka kahakai, which cannot support yellow-faced bee populations on its own (Magnacca 2007, p. 187).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range (Factor A):

Ungulates and degradation of habitat—Nonnative animals such as feral pigs (*Sus scrofa*), goats (*Capra hircus*), horses (*Equus ferus caballus*), mouflon sheep (*Ovis gmelini musimon*), axis deer (*Axis axis*), and cattle (*Bos taurus*), are considered one of the primary factors underlying degradation of native vegetation in Hawai‘i. These habitat changes remove food sources and nesting sites for assimulans yellow-faced bee (Stone 1985, pp. 262–263; Cuddihy and Stone 1990, pp. 60–66, 73). Browsing, grazing, and trampling by these mammals degrades native plant communities and facilitates invasion of exotic plants by spreading seeds and creating disturbed areas where seeds can germinate (Hobdy 1993, entire). Specific threats to the yellow-faced bee bee habitat posed by introduced ungulates are: (1) crushing or trampling of ground nests; (2) trampling and grazing effects on the plants used for pollen and nectar, particularly *Sida* spp.; (3) ungulate paths leading to mechanical damage of host plant roots and substrate erosion; and (4) creation of open, disturbed areas facilitating weedy plant invasion and the establishment of nonnative plants from dispersed fruits and seeds, which results in the conversion of a native community to one dominated by nonnative vegetation.

Invasive, nonnative plants—Habitat destruction and modification by nonnative plants, such as *Asystasia gangetica* (Chinese violet), *Atriplex semibaccata* (saltbush), *Cenchrus ciliaris* (buffelgrass), *Chloris barbata* (swollen fingergrass), *Digitaria insularis* (sourgrass), *Leucaena leucocephala* (koa haole), *Melinis minutiflora* (molasses grass), *Pluchea carolinensis* (sourbush), *Pluchea indica* (Indian fleabane), *Prosopis pallida* (kiawe), *Schinus terebinthifolius* (Brazilian peppertree), and *Verbesina encelioides* (golden crown-beard), represents a serious and ongoing threat to assimulans yellow-faced bee (USFWS 2016, entire). Such nonnative plants adversely affect microhabitat by modifying the availability of light, shifting soil-water regimes, changing nutrient cycling processes, altering fire characteristics of native plant habitat, outcompeting natives, and inhibiting the growth of native plant species (Vitousek 1987, p. 224). Each of these effects can convert native-dominated plant communities to nonnative plant communities (Cuddihy and Stone 1990, p. 74). This conversion has negative effects on the host plants that yellow-faced bees feed upon and use for provisioning their nests. *Hylaeus* species are dependent on having a variety of native plants for pollen and nectar. The presence of assimulans yellow-faced bee is closely associated with the presence of blooming ‘ilima (Daly and Magnacca 2003, p. 217; Magnacca 2007, entire). The conversion of native plant communities to nonnative communities can also alter or remove ground nesting sites. The loss of native plant species from coastal and dry lowland habitats is one of the main causes of decline of *Hylaeus* species (Sakai et al. 2002, pp. 276, 291; Liebherr 2005, p. 186).

Drought—Drought can modify and destroy habitat of assimulans yellow-faced bee (Magnacca 2007, pp. 181, 183). The dry coastal, shrubland, forest habitats already incur cyclical droughts, which in turn, effect vegetation flushes and food availability. For example, the kiawe forests of southern Lānaʻi have underwent recent prolonged drought, resulting in ʻilima dying and the absence of assimulans yellow-faced bee (Magnacca 2007, p. 183). Though rare, assimulans yellow-faced bee may survive in small numbers and increase once conditions improve (Magnacca 2007, p. 181). Drought also creates disturbed areas conducive to invasion by nonnative plants and eliminates food and nesting resources (Kitayama and Mueller-Dombois 1995, p. 671; Businger 1998, pp. 1–2; Magnacca 2015 in litt., entire). Droughts lead to an increase in the number of forest and brushfires (Giambelluca et al. 1991, p. v), causing a reduction of native plant cover and habitat (D'Antonio and Vitousek 1992, pp. 77-79). Such environmental events can be particularly devastating to assimulans yellow-faced bee because they have restricted geographic ranges.

Fire—Fire is a threat to assimulans yellow-faced bee because it destroys native coastal and dry shrubland habitats on which this species depends and opens habitat for increased invasion by nonnative plants. Human alteration of landscapes and the introduction of nonnative plants, especially grasses, has led to greater frequency, intensity, and duration of fires (Brown and Smith 2000, p. 172). Grass-fueled fire often kills most native trees and shrubs (D'Antonio and Vitousek 1992, p. 70, 73-74). The dry coastal and forest ecosystems of assimulans yellow-faced bee are highly vulnerable to wildfire, which destroys food and nesting resources. The number and size of wildfires are increasing in the main Hawaiian Islands; however, their occurrences and locations are unpredictable, and could affect the remaining habitat of this yellow-faced bee at any time (USFWS 2016, entire; USFWS 2019, entire).

Fire poses a risk to the species because their habitat is located in or near areas that have burned previously or is in areas considered at risk due to the cumulative and compounding effects of drought and the presence of highly flammable nonnative grasses (USFWS 2016, entire). Two fires have occurred in the immediate area occupied by assimulans yellow-faced bee in lowland dry shrubland in Waikapū Valley, on the east side of west Maui (USFWS 2011, p. 55176). In 2020, about one third of the island of Kahoʻolawe (about 9,000 acres [about 3,650 hectares]) burned (Kahoʻolawe Island Reserve Commission Newsletter 2020, entire).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):
Not known to be a threat.

2.3.2.3 Disease or predation (Factor C):

Disease—Introduced disease is suggested as a threat because pathogens carried by nonnative bees, wasps, and ants may be transmitted to assimulans yellow-faced bee through shared food sources (Graham 2015, in litt., entire). However, we have no confirmed reports of this type of disease transmission in assimulans yellow-faced bee.

Western yellow-jacket wasp—Predation by nonnative western yellow jacket wasps (*Vespula pensylvanica*) is a threat to assimulans yellow-faced bee. This wasp species is an aggressive generalist predator that will opportunistically predate *Hylaeus* species, although *Hylaeus* is not its primary prey source (Gambino et al. 1987, entire). In temperate climates, *V. pensylvanica* has an annual life cycle; but, in Hawai‘i, colonies often persist through a second year. This allows them to have larger numbers of individuals per colony (Gambino et al. 1987, entire) and thus, a greater impact on prey populations. Most colonies are found between elevations of 1,969 to 3,445 ft (600 to 1,050 m), but they can occur down to sea level where assimulans yellow-faced bee occur (Gambino et al. 1987, p. 169; Graham 2015 in litt., entire). Although assimulans yellow-faced bee is a rare solitary bee, the presence of *V. pensylvanica* colonies near a yellow-faced bee nest may extirpate a local population.

Ants—Several nonnative ant species have a deleterious effect on the native Hawaiian invertebrate fauna including *Hylaeus* (Perkins 1913, entire; Gagne 1979, entire; Cole et al. 1992, entire; Reimer 1993, entire; Daly and Magnacca 2003, p. 10; Krushelnycky et al. 2005, entire; Krushelnycky et al. 2017, entire). Assimulans yellow-faced bee populations are drastically reduced in ant infested areas (Medeiros et al. 1986, pp. 45-46; Stone and Loope 1987, entire; Cole et al. 1992, entire; Reimer 1993, p. 17).

Big-headed ants (*Pheidole megacephala*), yellow crazy ants (*Anoplolepis gracilipes*), Papuan thief ants (*Solenopsis papuana*), and tropical fire ants (*Solenopsis geminata*) are aggressive, generalist predators (preying on a variety of species) that occur in the coastal and shrubland habitat. Ground-nesting species like assimulans yellow-faced bee are particularly vulnerable to predation by nonnative ants (Medeiros et al. 1986, entire; Cole et al. 1992, entire). Ants are primarily a threat to the brood (i.e. egg, larvae, and pupal stages) of assimulans yellow-faced bee because the brood are immobile, nests are easily accessible in or near the ground, and are undefended. In general, big-headed ants and yellow crazy ants are ubiquitous in the coastal and shrubland habitat of assimulans yellow-faced bee. Both of these ant species are abundant and colonize native and nonnative plant communities (Holway et al. 2002, entire; Reimer 1993, entire). The threat of ant predation is intensified by the fact that most ant species have winged reproductive adults and can quickly establish new colonies (Staples and Cowie 2001, p. 55). This attribute allows ants to access and potentially destroy otherwise geographically isolated

populations of native arthropods (Nafus 1993, pp. 19, 22-23). With few exceptions, native insects have been eliminated in habitats where big-headed ant is present (Perkins 1913, p. xxxix; Gagne 1979, p. 81; Gillespie and Reimer 1993, p. 22). Consequently, nonnative ant species represent a significant threat to the remaining populations of assimulans yellow-faced bee (Reimer 1993, p. 14, 17; Daly and Magnacca 2003, pp. 9-10).

In addition to predation, nonnative ants also compete with yellow-faced bees for nectar resources (Howarth 1985, p. 155; Hopper et al. 1996, p. 9; Holway et al. 2002, pp. 188, 209; Daly and Magnacca 2003, p. 9; Lach 2008, p. 155; Magnacca 2015 in litt., entire). Native *Hylaeus* bees are less likely to land on flowers occupied by big-headed ant (Krushelnycky et al. 2005, p. 9; Magnacca 2015 in litt., entire).

2.3.2.4 Inadequacy of existing regulatory mechanisms:
Existing State and Federal regulatory mechanisms are not effectively preventing introduction and spread of nonnative species from outside the State of Hawai‘i, or within the State, between islands and watersheds. Predation by nonnative invertebrate species such as introduced ants, and habitat-altering, nonnative plant species and ungulates pose major ongoing threats to the yellow-faced bees. The State’s current management of nonnative game mammals is inadequate to prevent the degradation and destruction of the native plants and habitat used by yellow-faced bee.

Nonnative feral ungulates pose a threat to assimulans yellow-faced bee through destruction and degradation of the species’ habitat and herbivory of its pollen and nectar hosts. Regulatory mechanisms are inadequate to address this threat (USFWS 2013, p. 64679). The State of Hawai‘i provides game mammal (feral pigs and goats, axis deer, and mouflon sheep) hunting opportunities on State-designated public hunting areas on the island of Hawai‘i (State of Hawai‘i Department of Land and Natural Resources [HDLNR] 2015, pp. 19–21 and 66–77). The State’s management objectives for game animals range from maximizing public hunting opportunities to support sustained yield in some areas to completely removing game animals by State staff, or their designees, in other areas (HDLNR 2015, entire).The State’s current management of nonnative game mammals is inadequate to prevent the degradation and destruction of habitat of the yellow-faced bee.

Currently, four agencies are responsible for inspection of goods arriving in Hawai‘i (USFWS 2013, p. 64679). The Hawai‘i Department of Agriculture inspects domestic cargo and vessels and focuses on pests of concern to Hawai‘i, especially insects or plant diseases not yet known to be present in the State. The U.S. Department of Homeland Security‘s Customs and Border Protection is responsible for inspecting commercial, private, and military vessels and aircraft and related cargo and passengers

arriving from foreign locations (USFWS 2013, p. 64679). The U.S. Department of Agriculture-Animal and Plant Health Inspection Service-Plant Protection and Quarantine inspects propagative plant material, provides identification services for arriving plants and pests, and conducts pest risk assessments among other activities (USFWS 2013, p. 64679–64680). The Service inspects arriving wildlife products, enforces the injurious wildlife provisions of the Lacey Act (18 U.S.C. 42; 16 U.S.C. 3371 *et seq*.), and prosecutes CITES (Convention on International Trade in Wild Fauna and Flora) violations (USFWS 2013, p. 64680). The State of Hawai‘i allows the importation of most plant taxa, with limited exceptions (USFWS 2013, p. 64680). It is likely that the introduction of most nonnative invertebrate pests to the State has been and continues to be accidental and incidental to other intentional and permitted activities. Many invasive weeds established on Hawai‘i have currently limited but expanding ranges. Resources available to reduce the spread of these species and counter their negative ecological effects are limited. Control of established pests is largely focused on a few invasive species that cause significant economic or environmental damage to public and private lands, and comprehensive control of an array of invasive pests remains limited in scope (USFWS 2013, p. 64680–64681).

2.3.2.5 Other natural or manmade factors affecting its continued existence (Factor E):

Competition—Nonnative bees competing for food resources is a potential threat to assimulans yellow-faced bee (Magnacca 2007, p. 188; Graham 2015 in litt., entire; Magnacca 2015 in litt., entire). Most non-native bees inhabit areas dominated by invasive vegetation and thus, are not competing with *Hylaeus* species (Daly and Magnacca 2003, pp. 10-13). European honeybee (*Apis mellifera*) is one of the exceptions; this social species is often very abundant in areas with native vegetation and aggressively competes with *Hylaeus* species for nectar and pollen (Snelling 2003, p. 345; Magnacca 2007, p. 188).

Other nonnative bee species also use the same native vegetation as assimulans yellow-faced bee. These include carpenter bees (*Ceratina* spp.), sweat bees (*Lasioglossum* spp.), and the nonnative *Hylaeus albonitens* and *Hylaeus strenuus* (Snelling 2003, entire; Magnacca 2007, entire; Magnacca et al. 2013, p. 61;). *Hylaeus strenuus* has been found on O‘ahu visiting naupaka kahakai, a host also visited by assimulans yellow-faced bee on Maui (Kenoloi 2020 in litt., entire). The impact of competition for nectar and pollen from nonnative bee species may have a significant impact on assimulans yellow-faced bee through competition for pollen, because they are similar in size and probably visit similar flowers (Magnacca 2007, p. 189; Magnacca et al. 2013, entire).

Limited populations and individuals—Like most native island biota, the yellow-faced bees are particularly sensitive to disturbances due to low number of individuals, low population numbers, and small geographic ranges. Assimulans yellow-faced bee is vulnerable to extinction due to threats associated with low number of individuals and low number of populations. As a result of having extremely low numbers, the species may experience the following: reduced reproductive vigor due to inbreeding depression; reduced levels of genetic variability leading to diminished capacity to respond and adapt to environmental changes; and increased vulnerability to localized catastrophes such as hurricanes, tsunami, and drought (Daly and Magnacca 2003, p. 3; Magnacca 2007, p. 173; Magnacca 2015 in litt., entire). Together these may result in population extirpation and extinction of this species.

Because of limited numbers of individuals and populations, a single catastrophic event (e.g., hurricane, drought) may result in extirpation of the extant populations and extinction of this species. Species with few known locations, such as assimulans yellow-faced bee, are less resilient to threats that might otherwise have a relatively minor impact on widely distributed species. For example, the reduced availability of nesting substrate or an increase in predation of the yellow-faced bee that might be absorbed in a widely distributed species could result in a significant decrease in survivorship or reproduction of a species with limited distribution. The limited distribution of this species thus magnifies the severity of the impact of the other threats.

The persistence of assimulans yellow-faced bee is hampered by having only nine known populations (Daly and Magnacca 2003, pp. 55-58, 217; Magnacca 2007, entire). This limited number leaves the species vulnerable to extinction from natural and anthropogenic caused factors. The demographic structure needed to support this species is unknown. Though *Hylaeus* females can store sperm for life, small isolated populations are particularly vulnerable to reduced mating encounter and decreased reproductive vigor caused by inbreeding depression. They may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and lessened ability to cope with environmental change (Lande 1988, entire).

Stochastic events—Stochastic events such as hurricanes, earthquakes, and tsunamis can result in the direct loss of assimulans yellow-faced bee individuals and brood, nests, and foraging resources due to wind, rain, flooding and tidal surge. The coastal habitat inhabited by the species is extremely vulnerable to storm surge and flooding associated with severe storms. Indirect effects include creating disturbed areas conducive to invasion by nonnative plants, which outcompete the native plants (Harrington et al. 1997, pp. 539-540; Mitchell et al. 2005, p. 4-3). This

would further decrease the remaining native-plant-dominated habitat that supports this bee species (Bellingham et al. 2005, p. 681). Stochastic events may also alter microclimatic conditions (e.g. soil erosion, and decreasing soil moisture) so that the habitat no longer supports the native host plants necessary for nectar and pollen or provides nesting substrates or existing burrows. In addition, stochastic events can exacerbate the impacts of other threats such as habitat destruction and modification by ungulates, erosion, invasion of nonnative predators, and increased competition for foraging resources. Small populations are demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio. Thus, random and stochastic events may extirpate a species from an island with a single population (Lande 1988, p. 1,455).

Changes in environmental conditions— Climate change has the potential to adversely affect *Hylaeus assimulans*. The species reproduces in the coastal habitat. Sea level rise may further reduce the already small amount of remaining coastal habitat forcing the species to nest more frequently in the dry habitat. With the exception of Kahoʻolawe, assimulans yellow-faced bee may have already began a shift to the lowland dry forest given the degraded condition of the coastal strand habitats on the other islands it inhabits. Coastal and dry forest habitats of the species are likely to be affected by changes in temperature, humidity, precipitation and the frequency and severity of storms. These stressors may change the habitats on the islands occupied by the species and exacerbate the threats described above (Kim et al. 2020, entire) making the habitats unsuitable for assimulans yellow-faced bee.

Conservation Actions

Endangered Species Act—The Service in 2016 determined endangered status under the Endangered Species Act of 1973 (Act), as amended, for 49 species from the Hawaiian Islands including assimulans yellow-faced bee (USFWS 2016, entire). The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The long-term goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Conservation measures provided to species listed as endangered or threatened under the Act include recognition of threatened or endangered status, recovery planning, requirements for Federal protection, and prohibitions against certain activities. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The Act and its implementing regulations in addition set forth a series of general prohibitions and exceptions that apply to all endangered wildlife and plants. For plants listed as endangered, the Act prohibits the malicious damage or destruction on areas under Federal jurisdiction and the removal, cutting,

digging up, or damaging or destroying of such plants in knowing violation of any State law or regulation, including State criminal trespass law. Certain exceptions to the prohibitions apply to agents of the Service and State conservation agencies. The Service may issue permits to carry out otherwise prohibited activities involving endangered or threatened wildlife and plant species under certain circumstances. With regard to endangered plants, a permit must be issued for scientific purposes or for the enhancement of propagation or survival. For federally listed species unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act, is prohibited. In addition, damaging or destroying any of the listed species is violation of the Hawai‘i State law prohibiting the take of listed species. The State of Hawai’i’s endangered species law (HRS, Section 195-D) is automatically invoked when a species is Federally listed, and provides supplemental protection, including prohibiting take of listed species and encouraging conservation by State government agencies. Assimulans yellow-faced bee occurs on State and private lands.

Fencing—The population of assimulans yellow-faced bee in the Waikapū Valley of West Maui occurs inside a fenced area. The 10,000-square ft (0.09-square hectare) site is privately owned and surrounded by a fence to exclude nonnative axis deer. The fence was built in the mid-1980s by the Native Hawaiian Plant Society, and is currently managed by inspecting the fence for breaks, removing nonnative, invasive weeds, and collecting seeds of native plants for propagation (USFWS 2011, entire).

Management— The population of assimulans yellow-faced bee near Lahainaluna in dry forest at 1800 ft (550 m) is in the State of Hawai‘i West Maui Natural Area Reserve (NAR). Established in 1986, the NARs management plan calls for the control and removal of feral ungulates, and the control of selected priority invasive plant species (http://hawaii.gov/dlnr/dofaw/nars/reserves/maui/west-maui).

On Kaho‘olawe, overgrazing by introduced cattle and goats, and bombing and target practice by the U.S. military, led to soil erosion resulting in the loss of almost all coastal and lowland dry forest habitat on this island (Warren 2004, p. 461). In 1993, Congress ended military use on Kaho‘olawe, and the Kaho‘olawe Island Reserve Commission was created to manage land use and restore the islands natural resources. Access to the island is limited and controlled by the Kaho‘olawe Island Reserve Commission, and activities conducted on the island include fishing, habitat restoration, historical preservation, and education. Commercial enterprises are currently prohibited on the island (Warren 2004, p. 1). In

February 2020 a wildfire burned approximately 9,000 acres, or about a third of the island (Kahoʻolawe Island Reserve Commission Newsletter 2020, entire).

Table 1. Number of populations and individuals of assimulans yellow-faced bee from listing to this 5-year review.

Date	Number of Populations	Number of Individuals
2016 listing	≥5 (based on surveys from 1997 to 2007)	unknown
2020 species report	≥9 (based on surveys from 1997 to 2007 and photo-documentation through 2020)	unknown
2021 5-year review	≥9 (based on surveys from 1997 to 2007 and photo-documentation through 2020)	unknown

Table 2 – Status of threats to assimulans yellow-faced bee from listing through the current 5-year review.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Agriculture and urban development	A	Ongoing	Partial—some presently unoccupied areas on Oʻahu are undergoing restoration to provide potentially suitable habitat
Ungulates	A	Ongoing	Partial—some strategic fencing in the Waikapū Valley of West Maui is in place to exclude axis deer; control and removal of feral ungulates is ongoing on the Natural Area Reserve near Lahainaluna; ungulates have been removed from Kahoʻolawe
Invasive nonnative plants	A	Ongoing	Partial—control and removal of nonnative invasive plants is ongoing on the Natural Area Reserve near Lahainaluna, on provate lands of Waikapū Valley, and on Kahoʻolawe
Fire	A	Ongoing	Partial—general fire management plans are in place for the Natural Area Reserve near Lahainaluna; fire destroyed about a third of Kahoʻolawe in 2020; fires also threaten the private-owned fenced area in Waikapū Valley.
Stochastic events (drought, hurricane, tsunami)	A	Ongoing	None
Disease (potential)	B	Ongoing	None

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Predation by nonative wasps	C	Ongoing	None
Predation by ants	C	Ongoing	None
Inadequate existing regulatory mechanisms	D	Ongoing	Partial—restrictions on transport of invasive species to the islands are insufficient to prevent introduction of invasive species and diseases; regulatory mechanisms are inadequate to address the threat of ungulate destruction of assimulans yellow-faced bee habitat;
Competition from nonnative bees	E	Ongoing	None
Lack of sufficient food resources	E	Ongoing	None
Lack of nesting resources	E	Ongoing	None
Limited numbers	E	Ongoing	None
Not in captive rearing	E	Ongoing	None
Climate change	E	Ongoing	None

2.4 Synthesis

Assimulans yellow-faced bee is an endangered Hawaiian archipelago endemic species that nests opportunistically in existing burrows or natural crevices under bark or rocks. The species is historically known from coastal and lowland dry forest habitat up to 2,000 feet (ft) (610 meters [m]) in elevation on Oʻahu, Lānaʻi, and Maui. Assimulans yellow-faced bee occurs at nine sites on Lānaʻi, Maui, and Kahoʻolawe, but appears extirpated from Oʻahu. The known populations occur in the coastal strand shrubland and dry forest.

Habitat loss and predation have largely reduced the suitable habitat for this species. Ground-nesters need relatively dry conditions and existing burrows for nesting. They require foraging habitats nearby that provide a variety of suitable native plant pollen and nectar. Assimulans yellow-faced bee is associated with plants from the genus *Sida*, though they visit other native plants that meet their specific needs. For an individual bee, the nutritional resources need to come from a diverse group of native plant species that are simultaneously available; individuals appear to need nutritional variety to survive. Additionally, the bee may be present at any time during the year; thus, the plant species the bee visits may change with the time of year and resource availability. In general, the remaining assimulans yellow-faced bee inhabited areas are highly fragmented and surrounded by degraded habitats. The unprotected areas occupied by the bees are

shrinking in size due to development, drought, and encroachment by nonnative plants and predators, such as ants and yellow-jacket wasps. The size of the occupied habitat also limits the abundance of individuals because of burrow availability and native pollen and nectar food resources, especially during drought.

There is little information about demographics or rate of mating encounter, other than to confirm the species is rare. Upon successfully mating, a mated female needs to find an acceptable burrow for nest preparation. All known populations are vulnerable to catastrophic events such as flooding or fire in their coastal habitat. Aside from the likely extirpation of the species on Oʻahu, the stability and growth rate of each remaining populations are not known. While there are no historic population estimates or genetic information, qualitative accounts of this yellow faced bee indicate that they were widely dispersed though not known to be abundant in their habitat.

In recent decades, assimulans yellow-faced bee have been absent at sites previously occupied. We have no historical genetic information, and thus cannot determine how much genetic variation has been lost since humans arrived in Hawaiʻi. The diversity of habitat and the breadth of genetic diversity is strongly influenced by the current and historic biogeographical range of assimulans yellow-faced bee. Much of the historical coastal habitat has been lost. The mobility of yellow-faced bees provides a means of short-range connectivity between populations, which in turn, can support genetic exchange and representation. However, genetic exchange is likely limited by the isolation of the nine known occurrences. As a result, populations within Maui Nui (Lānaʻi, Maui, and Kahoʻolawe) may have a low level of exchange because of the mobility of the bees. It is unknown if the population recently discovered on Kahoʻolawe is of historic origin or if it is a recent migration from a neighbor island. The extirpation of the Oʻahu population representation, combined with no known populations occurring on Molokaʻi, likely represents the loss of some genetic diversity.

In summary, the primary factors that pose serious and ongoing threats to the species, its plant hosts, and its habitat range include the following: habitat degradation and destruction, nonnative ungulates and plants, drought, fire, predation, inadequate regulatory mechanisms to address nonnative species, natural disasters, limited numbers of populations and individuals, competition, potential environmental changes, and the interaction of these threats. Initial management actions benefitting the species have been extremely limited. A recovery plan is expected to be completed in 2022.

3.0 RESULTS

3.1 Recommended Classification:

____Downlist to Threatened
____Uplist to Endangered

____**Delist**

___*Extinction*

____*Recovery*

____*Original data for classification in error*

__X__**No change is needed**

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number:____
Reclassification (from Endangered to Threatened) Priority Number:____
Delisting (regardless of current classification) Priority Number:____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Develop measurable downlisting and delisting criteria for the recovery of assimulans yellow-faced bee.
- Identify habitats that may support assimulans yellow-faced bee and survey for extant individuals and populations.
- Conduct studies on the range, demography, and dispersal of assimulans yellow-faced bee.
- Develop microclimate models and identify suitable habitat based on historical and existing species distribution and potential future climate conditions.
- Identify and prioritize management units that are necessary for assimulans yellow-faced bee recovery.
- Ensure long-term protection of management units.
- Identify threats specific to management units.
- Construct and maintain ungulate fences around management units where needed.
- Remove ungulates from fenced areas.
- Control or eradicate habitat-modifying invasive plants from management units.
- Provide wildfire protection as necessary.
    - Develop management-unit specific fire management plans and infrastructure, and initiate management actions to reduce the likelihood of fire, especially in dry and mesic habitats.
    - Assess the need for fire management plans in habitats affected by climate change.
- Protect management units from human disturbance as necessary.
- Conduct surveys, focused on likely source areas (e.g., airports, docks), and control newly discovered pest or invasive species prior to their dispersal to management units.

- Control other threats to management units as appropriate.
- Monitor management and use results to adapt management actions.
- Develop and implement control programs for nonnative ants (e.g. big-headed ant, yellow crazy ant, Papuan thief ant, and tropical fire ant).
- Develop and implement control programs for nonnative western yellow jacket wasps.
- Monitor populations to detect disease, assess impacts, and control outbreaks as soon as possible, if needed.
- Control other threats to assimulans yellow-faced bee as appropriate.
- Establish a captive rearing program for assimulans yellow-faced bee and establish populations from appropriate genetic sources.
- Determine if translocation is appropriate for assimulans yellow-faced bee.
- Identify areas within management units appropriate for translocating individuals.
- If translocation is appropriate, develop and implement translocation plans according to IUCN Reintroduction Guidelines (2013).
- Select populations for translocation.
- Prepare reintroduction sites.
- Translocate genetically appropriate individuals into managed sites.
- Develop tools to enhance habitat and species survival and reproduction.
- Develop tools to inform actions that will improve assimulans yellow-faced bee viability.
- Conduct research on threats to species' viability.
- Develop tools for monitoring population growth and status.
- Conduct population viability analyses for each population.
- Conduct studies on the optimization of conservation translocation survival and success.
- Implement the Hawai‘i interagency biosecurity plan to prevent the influx of new pests and invasive species into Hawai‘i and habitats of assimulans yellow-faced bee.
- Implement public outreach and education and enforce policies that prohibit species collection and harassment.
- Identify, develop, and support alliances and partnerships to plan and implement assimulans yellow-faced bee habitat restoration and management to benefit and recover the species.

5.0 REFERENCES

Bellingham, P.J., E.V.J. Tanner, and J.R. Healey. 2005. Hurricane disturbance accelerates invasion by the alien tree *Pittosporum undulatum* in Jamaican montane rain forests: Journal of Vegetation Science 16:675-684.

Brown, J.K., and J.K. Smith. 2000. Wildland fire in ecosystems: effects of fire on flora. General Technical Report RMRS-GTR-42-vol.2, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden. 257 pp.

Businger, S. 1998. Hurricanes in Hawai‘i. Available online at: http://www. soest.Hawai‘i.edu/ MET/Faculty/ businger/poster/hurricane.

Cole, F.R., A.C. Medeiros, L.L. Loope, and W.W. Zuehlke. 1992. Effects of the Argentine ant on arthropod fauna of Hawaiian high-elevation shrubland. Ecology 73:1313-1322.

Cuddihy, L.W. and C.P. Stone. 1990. Alteration of Native Hawaiian Vegetation: Effects of Humans, Their Activities and Introductions. Honolulu: University of Hawaii Cooperative National Park Resources Studies Unit. 138 pp.

Daly, H.V. and R.E Coville. 1982. Hylaeus pubescens and associated arthropods at Kilauea, Hawaii Volcanoes National Park (Hymenoptera: Apoidea and Chalcidoidea: Mesostigmata: Ameroseiidae). Proceedings of the Hawaiian Entomological Society 24:75-81.

Daly, H.V., and K.N. Magnacca. 2003. Insects of Hawaii, Vol. 17: Hawaiian *Hylaeus* (*Nesoprosopis*) Bees (Hymenoptera: Apoidea). University of Hawaii Press, Honolulu. 234 pp.

D'Antonio, C.M., and P.M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23:63-87.

Espelie, K.E., J.H. Cane, and D.S. Himmelsbach. 1992. Nest cell lining of the solitary bee, *Hylaeus bisnuatus*. Experientia (Basel) 48:414-416.

Gagne, W.C. 1979. Canopy-associated arthropods in *Acacia koa* and *Metrosideros* tree communities along an altitudinal transect on Hawaii Island. Pacific Insects 21:56-82.

Gambino, P., A.C. Medeiros, and L.L. Loope. 1987. Introduced vespids *Paravespula pensylvanica* prey on Maui’s endemic arthropod fauna. Journal of Tropical Ecology 3:169-170.

Gillespie, R.G., and N. Reimer. 1993. The effect of alien predatory ants (Hymenoptera: Formicidae) on Hawaiian endemic spiders (Araneae: Tetragnathidae). Pacific Science 47:21-33.

Giambelluca, T.W., M.A. Nullet, M.A. Ridgley, P.R. Eyre, J.E.T. Moncur, and S. Price. 1991. Drought in Hawaii. Report 87. State of Hawaii Department of Land and Natural Resources, Commission on Water Resource Management. 177 pp.

Graham, J.R. October 30, 2015. Letter to USFWS on proposed rule to list *Hylaeus* bee species. p. 1.

Harrington, R.A., J.H. Fownes, P.G. Scowcroft, and C.S. Vann. 1997. Impact of hurricane Iniki on native Hawaiian *Acacia koa* forests: damage and two-year recovery: Journal of Tropical Ecology 13:539-558.

[HDLNR] State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2015. Hawai‘i Administrative Rules Title 13 Department of Land and Natural Resources Subtitle 5 Forestry and Wildlife Part 2 Wildlife Chapter 123. Rules Regulating Game Mammal Hunting. 78 pp. https://dlnr.hawaii.gov/dofaw/files/2013/09/HAR-123-Game-Mammals.pdf Accessed on August 11, 2020.

Hobdy, R. 1993. Lanai -- a case study: the loss of biodiversity on a small Hawaiian island. Pacific Science 47:201-210.

Holway, D.A., L. Lach, A.V. Suarez, N.D. Tsutsui, and T.J. Case. 2002, The causes and consequences of ant invasions: Annual Review of Ecology and Systematics 33:181-233.

Hopper, D., A. Asquith, and M. Bruegmann. Hawaii’s Birds and Bees. Endangered Species Bulletin 11:8-10.

Howarth, F.G. 1985. Impacts of invasive land arthropods and mollusks on native plants and animals in Hawaii. pp. 149-179. *In* Hawaii’s Terrestrial Ecosystems: Preservation and Management. Stone, C.P., and J.M. Scott (eds.). Honolulu: University of Hawaii Press.

Javar-Salas, C., R. P‘ea, F. Amidon, M.K. Reeves, and S.E. Miller. 2020. Hawaiian Islands Dry Forest. *In* Encyclopedia of the Worlds Biomes. M. I. Goldstein and D. A. DellaSala. Elsevier. https://doi.org/10.1016/B978-0-12-409548-9.11890-1

Kenoloi, J. Email correspondence and shared photo images and documentation available at https://www.lahainaphotography.net/Wildlife/Hylaeus-Hawaiian/n-z2NfM/ and https://www.flickr.com/photos/hoomaluo/ between J. Kenoloi, Lahaina Photography, Dr. K. Magnacca, and D. Sether, USFWS. February to March 2020.

Kim, J.Y., E.E. Naboa, F. Amidon, and S.E. Miller. 2020. Hawaiian Islands Coastal Ecosystems: Past, Present, and Future. *In* Reference module in earth systems and Environmental Sciences. Elsevier, Inc. https://doi.org/10.1016/B978-0-12-409548-9.12418-2.

[KIRC] Kaho‘olawe Island Reserve Commission. 2020. Ko Hema Lamalama Newsletter. Spring 2020. http://www.kahoolawe.hawaii.gov/newsletters/Spring_2020.pdf. Last accessed June 11, 2020.

Kitayama, K., and D. Mueller-Dombois. 1995. Biological invasion on an oceanic island mountain: do alien species have wider ecological ranges than native species? Journal of Vegetation Science 6:667-674.

Krushelnycky, P.D., L.L. Loope, and N.J. Reimer. 2005. The ecology, policy, and management of ants in Hawaii. Proceedings of the Hawaiian Entomological Society 37:1-25.

Krushelnycky, P.D., C.S. Ogura-Yamada, K.M. Kanegawa, K.Y. Kaneshiro, and K.N. Magnacca. 2017. Quantifying the effects of an invasive thief ant on the reproductive success of rare Hawaiian picture-winged flies. Biological Conservation 215:254-259.

Lach, L. 2008. Floral visitation patterns of two invasive ant species and their effects on other Hymenopteran visitors. Ecological Entomology 33:155-160.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241:1455-1460.

Liebherr, J.K. 2005. Patterns of endangerment or pathways to enlightenment? Reconstructing the Fauna Hawaiiensis. Systematics and Biodiversity 2:175-189.

Liebherr, J.K., and D.A. Polhemus. 1997. R.C.L. Perkins: 100 years of Hawaiian entomology. Pacific Science 51:343-355.

Magnacca, K.N. 2005. Species profile: *Hylaeus assimulans*. *In* Red List of Pollinator Insects of North America. CD-ROM Version 1 (May 2005). The Xerces Society for Invertebrate Conservation. M. D. Shepherd, D. M. Vaughan, and S. H. Black (Eds). Portland, OR.

Magnacca, K.N. 2007. Conservation status of the endemic bees of Hawaii, *Hylaeus* (*Nesoprosopis*) (Hymenoptera: Colletidae). Pacific Science 61:173-190.

Magnacca, K.N. 2010. Comments on the 90-day finding on listing seven Hawaiian *Hylaeus* species as endangered. Received from Dr. Magnacca to USFWS.

Magnacca, K.N. 2015. Letter to USFWS on proposed rule to list *Hylaeus* bee species. November 24, 2015. 2 pp.

Magnacca, K.N. 2019. Email correspondence between D. Sether, US Fish and Wildlife and K. Magnacca regarding the status of *Drosophila* and *Hylaeus* species. November 14, 2019.

Magnacca, K.N., J. Gibbs, S. Droege. 2013. Notes on alien and native bees (Hymenoptera: Apoidea) from the Hawaiian Islands. Records of the Hawaii

Biological Survey for 2012. Neal L. Evenhuis & Lucius G. Eldredge (Eds). Bishop Museum Occasional Papers 114: 61–65.

Magnacca, K.N. and C.B.A. King. 2013. Assessing the presence and distribution of 23 Hawaiian yellow-faced bee species on lands adjacent to military installations on Oʻahu and Hawaiʻi Island. Technical Report No. 185. Pacific Cooperative Studies Unit, University of Hawaiʻi, Honolulu, Hawaiʻi. 39 pp.

Mascaro, J., K.K. Becklund, R.F. Hughes, and S.A. Schnitzer. 2008. Limited native plant regeneration in novel, exotic-dominated forests on Hawaii. Forest Ecology and Management 256: 593-606.

Medeiros, A.C., L.L. Loope, and F.R. Cole. 1986. Distribution of ants and their effects on endemic biota of Haleakala and Hawaii Volcanoes National Park: a preliminary assessment. Pages 39-52. *In* Proceedings of the 6th Conference of National Science. Hawaii Volcanoes National Park. Hawaii.

Michener, C.D. 2000. The Bees of the World. The Johns Hopkins University Press: Baltimore and London.

Mitchell, C., C. Ogura, D. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaii's Comprehensive Wildlife Conservation Strategy: Honolulu, Hawaii, Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife. p. 722.

Nafus, D.M. 1993. Extinction, biological control, and insect conservation on islands. Pages 139-154. *In* Perspectives on Insect Conservation. K. J. Gaston, T. R. New, and M .J. Samways (Eds.). Intercept Ltd. Andover.

Peʻa, R., C. Javar-Salas, M.K. Reeves, F. Amidon, and S.E. Miller. 2020. Hawaiʻi Dry Grasslands and Shrublands. *In* Encyclopedia of the Worlds Biomes. M. I. Goldstein and D. A. DellaSala. Elsevier. https://doi.org/10.1016/B978-0-12-409548-9.11961-X

Perkins, R.C.L. 1899. Hymenoptera, Aculeata. pp. 1-115, Plates 1-2. *In* Fauna Hawaiiensis, Vol. 1. D. Sharp (Ed.). Cambridge University Press, Cambridge, United Kingdom.

Perkins, R.C.L. 1913. Introduction. Pages i–ccxxvii. *In* Fauna Hawaiiensis. Vol. 1. D. Sharp (Ed.) Cambridge University Press, London.

Reimer, N.J. 1993. Distribution and impact of alien ants in vulnerable Hawaiian ecosystems. Pages 11-22. *In* Exotic Ants: Biology, Impact, and Control of Introduced Species Williams. D. F. (Ed.). Westview Press, Boulder.

Sahli, H., D. Drake, A. Taylor, T. Fukami, and E. Stacy. 2008. Changes in pollination across an elevation gradient on the island of Hawaii. Abstract, 93rd ESA Annual Meeting, Milwaukee, Wisconsin, Aug 3-Aug 8, 2008. http://eco.confex.com/eco/2008/ techprogram/P12618.HTM

Sakai, A.K., W.L. Wagner, and L.A. Mehrhoff. 2002. Patterns of endangerment in the Hawaiian flora. Systematic Biology 51:276-302.

Snelling, R.R. 2003. Bees of the Hawaiian Islands, exclusive of *Hylaeus* (*Nesoprosopis*) (Hymenoptera: Apoidea). Journal of the Kansas Entomological Society 76**:**342 – 356.

Staples, G.W., and R.H. Cowie (Eds.). 2001. Hawaii's Invasive Species. Mutual Publishing and Bishop Museum Press. Honolulu. 111 pp.

Stone, C.P. 1985. Invasive animals in Hawaii's native ecosystems: toward controlling the adverse effects of introduced vertebrates. Pages 251-288. *In* Hawaii's Terrestrial Ecosystems: Preservation and Management. C. P. Stone and J. M. Scott (Eds.), Cooperative National Park Resources Study Unit. Honolulu. University of Hawaii. Hawaii.

Stone, C.P., and L.L. Loope. 1987. Reducing negative effects of introduced animals on native biotas in Hawaii: What is being done, what needs doing, and the role of national parks. Environmental Conservation 14:245-258.

[USFWS] U.S. Fish and Wildlife Service. 2011. Endangered and threatened wildlife and plants; 12-month finding on five petitions to list seven species of Hawaiian yellow-faced bees as endangered. Federal Register 76:55170-55203.

[USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; determination of endangered species status for 15 species on Hawai`i island; final rule. Federal Register 78:64638–64690.

[USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; Determination of endangered status for 49 species from the Hawaiian Islands. Federal Register 81:67786-67860.

[USFWS] U.S. Fish and Wildlife Service. 2019. Endangered and threatened wildlife and plants; Initiation of 5-year status reviews for 91 species in Oregon, Washington, Hawaii, and American Samoa. Federal Register 84 27152-27154.

[USFWS] U.S. Fish and Wildlife Service. 2020. Recovery Outline for the Multi-Island Species. 31 pp.

Vitousek, P. M., L.L. Loope, and C.P. Stone. 1987. Introduced species in Hawaii: Biological effects and opportunities for ecological research. Trends in Ecology and Evolution 2:224-227.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the Flowering Plants of Hawaii. University of Hawaii and Bishop Museum Press, Honolulu. 2 v., 1948 pp.

Warren, S.D. 2004. Degradation and recovery of vegetation on Kaho‘olawe Island, Hawaii: A photographic journey. Pacific Science 58(3):461-495.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Hylaeus assimulans*
(assimulans yellow-faced bee)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____Downlist to Threatened
____Uplist to Endangered
____Delist
_X__No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:
Diane Sether, Ph.D., Invertebrate and Wildlife Biologist, PIFWO
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

MEGAN LAUT Digitally signed by MEGAN LAUT
Date: 2021.05.12 10:22:02 -10'00'

for _____

Field Supervisor, Pacific Islands Fish and Wildlife Office