# U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

## Scientific Name:

Hylaeus longiceps

## Common Name:

Hawaiian yellow-faced bee

## Lead region:

Region 1 (Pacific Region)

## Information current as of:

06/19/2014

## Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

## Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 03/23/2009

90-Day Positive:06/16/2010

12 Month Positive:09/06/2011

Did the Petition request a reclassification? **No**

**For Petitioned Candidate species:**

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, the majority our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements; meeting statutory deadlines for petition findings or listing determinations; emergency listing evaluations and determinations; and essential litigation-related administrative and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of Progress on Revising the Lists, in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).

## Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Honolulu, HI, Maui, HI
- **Countries**: United States

## Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Honolulu, HI, Maui, HI
- **Countries**: United States

## Land Ownership:

Currently, *Hylaeus longiceps* is restricted to a total of seven populations in small patches of coastal and lowland dry forest habitat: three sites on Lanai, one site each on the islands of Maui and Molokai, and two sites on Oahu (Magnacca 2005f, p. 2). The lands on which *H. longiceps* occurs are under a variety of jurisdictions including private (e.g., The Nature Conservancy (TNC) and State Natural Area Reserves (NARS)).

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## Biological Information

### Species Description:

*Hylaeus longiceps* is similar in structure to other hymenopterans (bees, wasps, and ants) in that adults have three main body parts-a head, thorax, and abdomen. One pair of antennae arises from the front of the head, between the eyes. Two pairs of wings and three pairs of legs are attached to the thorax. The abdomen is composed of multiple segments (Borror et al. 1989, pp. 665-666).

The *Hylaeus* genus, which includes *H. longiceps*, are commonly known as yellow-faced bees or masked bees for their yellow-to-white facial markings. All of the *Hylaeus* species roughly resemble small wasps in appearance, due to their slender bodies and their seeming lack of setae (sensory hairs). However, *Hylaeus* bees have plumose (branched) hairs on the body that are longest on the sides of the thorax. To a discerning eye, it is these plumose setae that readily distinguish them from wasps (Michener 2000, p. 55).

More specifically, *H. longiceps* is a small to medium-sized, black bee with clear to slightly smoky-colored wings. Its distinguishing characteristics are its long head and the facial marks of the male. The lower face of the male is marked with a yellow band that extends at the sides of the face in a broad stripe above the antennal sockets. The area above the clypeus (lower face region) is very long and narrow, and the scape (the first antennal segment) is noticeably twice as long as it is wide. The female is entirely black and unmarked (Daly and Magnacca 2003, p. 133).

### Taxonomy:

*Hylaeus longiceps* was first described in 1899 as Nesoprosopis longiceps (Perkins 1899, pp. 75, 98), and then *Nesoprosopis* was reduced to a subgenus of *Hylaeus* in 1923 (Meade-Waldo 1923, p. 1). Daly and Magnacca (2003, pp. 133-134) most recently described the species as *H. longiceps*.

### Habitat/Life History:

The general life cycle of *Hylaeus longiceps* is typical of most solitary bees: after mating, females create a nest in which to lay eggs that will hatch and develop into larvae (immature stage); as larvae grow, they molt (shed their skin) through three successive stages (instars); when fully grown, the larvae change into pupae (a resting form) in which they metamorphose and emerge as adults (Borror et al. 1989, p. 665).

Hawaiian *Hylaeus* species are grouped within two categories: ground-nesting species that require relatively dry conditions, and stem-nesting species that are often found within wetter areas (Zimmerman 1972, p. 533; Daly and Magnacca 2003, p. 11). *H. longiceps* is a ground-nesting species currently known from the islands of Lanai, Maui, Molokai, and Oahu. Nests of *H. longiceps* are usually constructed opportunistically within existing burrows or small natural cavities under bark or rocks, which they seek out to suit to their own needs.

This is unlike the nest construction of many other bee species, which are purposefully excavated or constructed underground. All *Hylaeus* spp., including the Hawaiian *Hylaeus* species, lack strong mandibles and other adaptations for digging and often use nest burrows abandoned by other insect species (Daly and Magnacca 2003, p. 9). The female *H. longiceps* lays eggs in brood cells she constructs in the nest and lines with a self-secreted, cellophane-like material. Prior to sealing the nest, the female provides her young with a mass of semiliquid nectar and pollen left alongside her eggs. Upon hatching, the grub-like larvae eat the provisions left for them, grow and molt through three instar stages, pupate, and eventually emerge as adults (Michener 2000, p. 24). The adult male and female bees feed upon flower nectar for nourishment. *H. longiceps*, like most *Hylaeus* species, lack an external structure for carrying pollen, called a scopa, and instead internally transport collected pollen, often mixed with nectar, within their crop (stomach).

The exact diet of the larval stage of *H. longiceps* is unknown, although the larvae are presumed to feed on stores of pollen and nectar collected and deposited in the nest by the female adult (Daly and Magnacca 2003, p. 9). Likewise, the exact nesting habits of *H. longiceps* are not known, but the species is thought to nest underground, as in other closely related species (Magnacca 2005f, p. 2).

*H. longiceps* adults have been observed visiting the flowers of a wide variety of native plants, including *Chamaesyce degeneri* (beach sandmat), *Myoporum sandwicense* (naio), *Santalum ellipticum* (iliahialoe), *Scaevola coriacea* (dwarf naupaka), *Sesbania tomentosa* (ohai), *Sida fallax* (ilima), and *Vitex rotundifolia* (pohinahina) (Daly and Magnacca 2003, p. 135). It is also likely *H. longiceps* visits several plant species other *Hylaeus* species are known to frequently visit, including *Chamaesyce* spp., *Jacquemontia ovalifolia* (pauohiiaka), other *Scaevola* spp. (naupaka), and *Tournefortia argentea* (tree heliotrope) (Magnacca 2005f, p. 2).

Recent studies of visitation records of Hawaiian *Hylaeus* bees, including *H. longiceps*, to native flowers (Daly and Magnacca 2003, p. 11) and pollination studies of native plants (Sakai et al. 1995, pp. 2,524-2,528; Cox and Elmqvist 2000, p. 1,238; Sahli et al. 2008, p. 1) have demonstrated Hawaiian *Hylaeus* species almost exclusively visit native plants to collect nectar and pollen, pollinating those plants in the process. *Hylaeus* bees are very rarely found visiting nonnative plants for nectar and pollen (Magnacca 2007a, pp. 186, 188) and are almost completely absent from habitats dominated by nonnative plant species (Daly and Magnacca 2003, p. 11). Sahli et al. (2008, p. 1) quantified pollinator visitation rates to all of the flowering plant species in communities on a Hawaiian lava flow dating from 1855 to understand how pollination webs and the integration of native and nonnative species changes with elevation. In that study, eight flowering plants were observed at six sites, which ranged in elevation from approximately 2,900 to 7,900 feet (ft) (approximately 880 to 2,400 meters (m)). The study also found the proportion of native pollinators changed along the elevation gradient; at least 40 to 50 percent of visits were from nonnative pollinators at low elevation, as opposed to 4 to 20 percent of visits by nonnative pollinators at mid to high elevations. *Hylaeus* bees were less abundant at lower elevations, and there were lower visitation rates of any pollinators to native plants at lower elevations, which suggests *Hylaeus* may not be easily replaceable by nonnative pollinators (Sahli et al. 2008, p. 1).

## Historical Range/Distribution:

*Hylaeus longiceps* is historically known from coastal and lowland dry shrubland habitat up to 2,000 ft (610 m) in elevation in numerous locations on the islands of Lanai, Maui, Molokai, and Oahu. Perkins (1899, p. 98) noted *H. longiceps* was locally abundant and probably occurred historically throughout much of the leeward and lowland areas on Lanai, Maui, Molokai, and Oahu, as its host plants, *Chamaesyce* spp., *Jaquemontia ovalifolia*, *Scaevola* spp., and *Sida fallax*, occurred throughout these areas (Magnacca 2005f, p. 2). Most of the habitat in these areas has been either developed or degraded and is no longer suitable for *H. longiceps* (Liebherr and Polhemus 1997, pp. 346-347; Magnacca 2007a, pp. 186-188).

## Current Range Distribution:

*Hylaeus longiceps* is now restricted to small populations in small patches of coastal and lowland dry habitat on Lanai, Maui, Molokai, and Oahu (Magnacca 2005f, p. 2). Twenty-five sites that were either historical collecting localities for *H. longiceps* or contained potentially suitable habitat for this species were surveyed between 1997 and 2008. *H. longiceps* was observed at only six of the surveyed sites: three sites on Lanai and one site each on the islands of Maui, Molokai, and Oahu. Only one historical location, Waieu dunes on Maui, still supports a population of *H. longiceps* (Daly and Magnacca 2003, p. 135). Presented below is more specific information regarding the populations found on each island.

<u>Lanai</u>

Perkins (1899) collected *Hylaeus longiceps* at Manele, and other unspecified localities (labeled Lanai). Between 1999 and 2001, researchers surveyed seven sites for *Hylaeus* species, and were unable to find *H. longiceps* at Manele Bay, although other rare *Hylaeus* species were observed there (Daly and Magnacca 2003, pp. 217-229). In addition, researchers did not find *H. longiceps* at three other sites within potentially suitable lowland dry habitat, including the Kahue unit of the privately owned Kanepuu Preserve, Garden of the Gods, and the Munro Trail/Kaiholena area of the Koele Mountains (Daly and Magnacca 2003, pp. 217-229). *H. longiceps* is now known only from very small pockets of native vegetation in three locations on private land, including lowland dry forest habitat at Kahue and Polihua Road and coastal habitat at Shipwreck Beach. Descriptions of these three locations follow:

(A) Kahue and Polihua Road: In 1999, Magnacca collected *H. longiceps* in lowland dry forest at Kahue (south of Kanepuu Preserve) at an elevation of 1,400 ft (427 m) (Daly and Magnacca 2003, p. 135). Researchers also surveyed the Kanepuu Preserve for H. longiceps, but were unable to find this species. In 1999, researchers collected *H. longiceps* in lowland dry forest at 1,000 ft (300 m) in elevation, along Polihua Road in central Lanai (Daly and Magnacca 2003, p. 135).

(B) Shipwreck Beach: Although he did not collect *H. longicep s* at Shipwreck Beach, Perkins collected other species of *Hylaeus* at Awalua, about four miles to the west (Daly and Magnacca 2003, p. 58). In 2001, researchers collected *H. longiceps* in native, coastal habitat at Shipwreck Beach (Daly and Magnacca 2003, p. 135). Shipwreck Beach is a popular tourist site on Lanai and accessible by four-wheel drive vehicles.

<u>Maui</u>

Perkins (1899) collected *H. longiceps* at the Wailuku sand hills (Waiehu Dunes) and on Haleakala. In addition, some of his specimens were collected from unknown localities labeled Maui. Perkins collected *H. longiceps* in dry forest habitat at an elevation of 2,000 ft (610 m) on Haleakala, probably near the towns of Pukalani or Makawao, where he stopped on his way to Wailuku (Daly and Magnacca 2003, p. 135). Native dry forests that supported populations of *Hylaeus* were common in lowland areas when Perkins collected, but this habitat has been greatly reduced and fragmented.

*H. longiceps* is now known from only one Maui location, at the Wailuku sand hills (Waiehu dunes). Between 1999 and 2001, a total of seven specimens were collected in native habitat in the northern portion of the dunes (Daly and Magnacca 2003, p. 224). Researchers surveyed for, but did not find, *H. longiceps* in the southern (Kahului) portion of the dunes (Daly and Magnacca 2003, p. 224).

*H. longiceps* was not found at five other sites on Maui surveyed between 1999 and 2001 (Daly and Magnacca, pp. 217-229). One historical site, in dry forest habitat on the slopes of Haleakala, has been developed and is overgrown with nonnative, invasive plants (Magnacca 2008f, pers. comm.). *H. longiceps* was absent from four sites (Kanaio Natural Area Reserve (NAR), Lahainaluna, Manawainui Gulch, and Waikapu near Kaohonua) with potentially suitable habitat where other *Hylaeus* species with similar habitat requirements were recently collected (Daly and Magnacca 2003, pp. 217-229).

<u>Molokai</u>

Perkins (1899) collected *H. longiceps* at Kaunakakai, and at unknown locations labeled Molokai coast and plains, the west end [of the island], and the Molokai Mountains. Although Kaunakakai is the primary urban area on Molokai, researchers surveyed this area, noting any former *Hylaeus* habitat has been altered due to urban development and nonnative, invasive plants (Magnacca 2008f, pers. comm.). Most coastal habitat on the west end of Molokai, with the exception of TNCs Moomomi Preserve, has been degraded and converted to nonnative, invasive plants (Magnacca 2008f, pers. comm.).

Researchers surveyed a total of six sites on Molokai over the last several years for *H. longiceps*, and observed eight individuals at Moomomi Preserve (in 1999 and in 2001) (Daly and Magnacca 2003, p. 135). *H. longiceps* was notably absent from three sites on the Kalaupapa peninsula (Kuololimu Point, Hoolehua Beach, and Kaupikiawa), where other Hylaeus species have been recently collected (Daly and Magnacca 2003, pp. 217-229). Researchers were unable to find *H. longiceps* in sand dune habitat near the Kaluakoi Resort on Molokais northwest coastline (Magnacca 2008f, pers. comm.).

Oahu

Perkins (1899) collected *H. longiceps* from only one site, in a coastal area of southwest Waianae. In 1999, 2000, and 2002, researchers found *H. longiceps* in coastal habitat at the States Kaena Point NAR (Daly and Magnacca 2003, p. 224). Researchers did not find *H. longiceps* during surveys conducted at other coastal sites with potentially suitable habitat, including Makapuu in 1999 and Kalaeloa in 2002. Although both areas contain vegetation similar to the vegetation in the Kaena Point NAR, albeit less intact, no species of *Hylaeus* were observed in these areas (Daly and Magnacca 2003, pp. 217-229; Magnacca 2008f, pers. comm.). During surveys in 2012, researchers discovered a new population site at Kahuku Point on northern Oahu near the Turtle Bay Resort. This low-density population extends for nearly 0.62 mile (1 kilometer) in scattered native coastal plant habitat segments along the coast, extending eastward from the shoreline beginning near the Turtle Bay Resort golf course (Magnacca and King 2013, p. 14). *H. longiceps* was observed in relatively high density on *Sesbania tomentosa* and *Tournefortia argentea*. Currently, this population site is privately owned by the Turtle Bay Resort, however it has been identified in a 2012 draft supplemental environmental impact statement for conversion into a park (Magnacca and King 2013, p. 14).

During the same 2012 surveys, researchers located only two individuals of *H. longiceps* at the Kaena Point population site during multiple visits despite good weather and a healthy abundance of host plants. Previously the species population at Kaena Point was considered fairly stable (Magnacca and King 2013, p. 14).

## Population Estimates/Status:

Currently, *Hylaeus longiceps* is restricted to a total of seven populations in small patches of coastal and lowland dry forest habitat: three sites on Lanai, two on Oahu, and one site each on the islands of Maui and Molokai (Magnacca 2005f, p. 2; Magnacca and King 2013, p. 16). The size of these populations is unknown. Table 1, below, summarizes information about the current population sites for this species.

Table 1. Occupied population sites and habitat conservation status of *Hylaeus longiceps* on the islands of Lanai, Maui, Molokai, and Oahu.

| | **Population Site** | **Land Owner** | **Island** | **Last Year Observed (or surveyed)** | **Approx. Size in Acres** | **Habitat Conservation Status & Threats** |
|---|---|---|---|---|---|---|
| 1 | Kahue | Lanai | Private | 1999 | Unknown | Not conserved |
| 2 | Polihua Road | Lanai | Private | 1999 | Unknown | Not conserved |
| 3 | Shipwreck Beach | Lanai | Private | 1999 | Unknown | Not conserved |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Waiehu Dunes | Maui | State | 2001 | 2.5 | Not conserved |
| 5 | Moomomi Preserve | Molokai | Private (TNC) | 2001 | Unknown | Conserved |
| 6 | Kaena Point NAR | Oahu | State | 2012 | 59 | Conserved |
| 7 | Kahuku Point | Oahu | Private | 2012 | Unknown | Not conserved |

# Threats

## A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Degradation and loss of coastal and lowland habitat used by *Hylaeus* bees on all of the main Hawaiian Islands is the primary threat to Hylaeus longiceps (Cuddihy and Stone 1990, pp. 60-61; Daly and Magnacca 2003, pp. 55, 173; Magnacca 2007a, p. 188). Coastal and lowland habitats have been severely altered and degraded, partly because of past and present land management practices, including agriculture, grazing, and urban development; the deliberate and accidental introductions of nonnative animals and plants; and recreational activities. In addition, fire is a potential threat to the habitat of *H. longiceps* in some locations.

Habitat Destruction and Modification by Urbanization and Land Use Conversion

Destruction and modification of *Hylaeus* bee habitat by urbanization and land use conversion leads to the direct loss and fragmentation of foraging and nesting habitat of *H. longiceps*. In particular, because native host plant species are known to be essential to *H. longiceps* for foraging of nectar and pollen, any further loss of this habitat may endanger its long-term chances for conservation and recovery. Additionally, conversion and modification of suitable habitat for *H. longiceps* is also likely to further exacerbate the introduction and spread of nonnative plants into and within these areas (see Habitat Destruction and Modification by Nonnative Plants section below).

Coastal Habitat

Native coastal habitat is one of the rarest habitats on the main Hawaiian Islands (Hawaii, Kahoolawe, Kauai, Lanai, Maui, Molokai, and Oahu) (Wagner et al. 1999, pp. 45, 54; Cuddihy and Stone 1990, pp. 94-95; Magnacca 2007, p. 180). Coastal habitat is highly valued for development, popular for recreation, typically dry on both the windward and leeward sides of the islands, vulnerable to fire, and especially susceptible to invasion by nonnative plants. Increased access to coastal areas, and resulting habitat disturbance, has been facilitated by development, road-building, and past agricultural activities (Cuddihy and Stone 1990, pp. 94-95). The native coastal habitat that remains is in small remnant patches, and most of these remnants have been overtaken by invasive plant species and have relatively low diversity (Cuddihy and Stone 1990, pp. 94-95) (see Habitat Destruction and Modification by Nonnative Plants section below). Most of the coastal areas of the main Hawaiian Islands now lack significant amounts of native plants suitable for foraging by *Hylaeus*, other than *Scaevola sericea* (naupaka kahakai), which alone cannot support *Hylaeus* populations (Magnacca 2007a, p. 187). The restricted and isolated nature of coastal habitat places species that depend on these areas even more at risk for a variety of reasons, including but not limited to their increased susceptibility to random and stochastic events such as hurricanes and wildfire, the reduced range of native plants including host plants, and the reduced number of suitable sites for species to expand their range (Sakai et al. 2002, p. 291).

Five species of candidate Hawaiian yellow-faced bees (*Hylaeus anthracinus, H. assimulans, H. facilis, H.*

*hilaris*, and *H. longiceps*) were once widespread and common in coastal habitat (Perkins 1912, p. 688) throughout the main Hawaiian Islands, with the exception of Kauai. These five species are now absent from all of Perkins coastal collection localities (Kealakekua Bay and Keei and the urban area near Kona on the island of Hawaii; the Awalua area on Lanai; the Wailuku sand hills area on Maui; the northwest dunes and Kaunakakai areas on Molokai; Waikiki, the Waianae area, and the Honolulu mountains on Oahu) (Daly and Magnacca 2003, pp. 217-229). However, they have recently been collected in disparate coastal habitat on one or more of the islands of Hawaii, Kahoolawe, Lanai, Maui, Molokai, and Oahu (Daly and Magnacca 2003, pp. 217-229).

Lowland Dry Habitat

Lowland dry forests and shrublands have also been heavily impacted by urbanization and conversion to agriculture or pasture throughout the Hawaiian Islands, with the estimated loss of more than 90 percent of dry forests and shrublands (Bruegmann 1996, p. 26; Juvik and Juvik 1998, p. 124). Less than 1 percent of lowland dry forest and shrubland remains on Oahu, Molokai, and Lanai; less than 2 percent remains on Maui; and less than 17 percent remains on Hawaii Island (Sakai et al. 2002, p. 296). Without greater conservation and restoration efforts, we believe the remaining lowland dry forest and shrublands, which were once abundant and perhaps the most diverse of all Hawaiian habitat types (Medeiros et al. 2006, p. 1), could completely disappear due to continued development and other land use conversion, compounded by the effects of nonnative species, wild fire, and other random and stochastic events (see following sections on Habitat Destruction and Modification by Nonnative Plants; by Nonnative Ungulates; by Fire; by Recreational Activities; by Hurricanes and Drought; and by Climate Change) (Cabin et al. 2000, p. 449).

Four species of *Hylaeus* sp. candidate bees (*H. anthracinus*, *H. assimulans*, *H. facilis*, and *H. longiceps*) were once widespread (i.e., there were several populations across two or more islands) and found within lowland dry habitat on several islands, including Hawaii, Lanai, Maui, Molokai, and Oahu. However, these species have not been observed during recent surveys from their historical population sites on these islands (Magnacca 2005a, b, c, f, pp. 1-2). Five of the seven candidate *Hylaeus* bee species (*H. assimulans*, *H. facilis* , *H. kuakea*, *H. longiceps,* and *H. mana*) are most often found in dry and mesic forest (see discussion below) and shrubland habitat (Daly and Magnacca 2003, p. 11), and the greatest proportion of endangered or at-risk Hawaiian plant species are also limited to these same habitats; 25 percent of Hawaiian listed plant species are from dry forest and shrubland alone (Sakai et al. 2002, pp. 276, 291, 292). According to Magnacca (2007, pp. 186-187), lowland dry and mesic forests now support less-diverse *Hylaeus* communities because many native plants used for foraging are extirpated from these habitats.

In summary, destruction and modification by urbanization and land use conversion of the coastal and lowland habitat of *H. longiceps* is continuing, and is expected to continue reducing and fragmenting the remaining habitat available to this species in the future, endangering the species long-term chances for conservation and recovery. Because of the decreased amount of suitable native coastal and lowland habitat remaining in the Hawaiian Islands and the continued conversion of these native habitats by development, road building, or agriculture, we conclude the ongoing habitat loss and land modification is a significant ongoing threat to *H. longicep s*.

Habitat Destruction and Modification by Nonnative Plants

Native vegetation on all of the main Hawaiian Islands has undergone extreme alteration because of past and present land management practices, including ranching, agricultural development, and the deliberate introduction of nonnative plants and animals (Cuddihy and Stone 1990, pp. 27, 58). The original native flora of Hawaii (species that were present before humans arrived) consisted of about 1,000 taxa, 89 percent of which were endemic (species that occur only in the Hawaiian Islands). Over 800 plant taxa have been introduced from elsewhere, and nearly 100 of these have become pests (e.g., injurious plants) in Hawaii (Smith 1985, p. 180; Cuddihy and Stone 1990, p. 73; Gagne and Cuddihy 1999, p. 45). Some of these plants were brought to Hawaii by various groups of people, including the Polynesians, for food or cultural reasons.

Beginning in the early 1900s, plantation owners (and the territorial government of Hawaii), alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral and domestic animals, introduced nonnative trees for reforestation and continued the practice through the late 1930s (TNC 2003, p. 19). Ranchers intentionally introduced pasture grasses and other nonnative plants for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Scott et al. 1986, pp. 361-363; Cuddihy and Stone 1990, p. 73).

Nonnative plants adversely impact native Hawaiian habitat, including that of *H. longiceps*, by modifying the availability of light, altering soil-water regimes, modifying nutrient cycling, and altering fire characteristics of native plant communities. A major concern is that successive fires burn farther and farther into native habitat, destroy native plants, and remove habitat for native species by altering microclimatic conditions to favor nonnative species), and ultimately converting native dominated plant communities to nonnative plant communities (Smith 1985, pp. 180-181; Cuddihy and Stone 1990, p. 74; DAntonio and Vitousek 1992, p. 73; Vitousek et al. 1997, p. 6). Nonnative plants directly and indirectly affect *H. longiceps* by modifying or destroying its coastal and lowland terrestrial habitat and reducing food sources.

The spread of nonnative plant species is one of the primary causes of decline of *H. longiceps*, and a current threat to its existing populations because the species depends closely on native vegetation for nectar and pollen. *Hylaeus* bees in general are almost entirely absent from habitat dominated by invasive, nonnative vegetation (Sakai et al. 2002, pp. 276, 291; Daly and Magnacca 2003, p. 11; Liebherr 2005, p. 186). The native flora within most of lowland habitat in the Hawaiian Islands is being replaced by aggressive, nonnative plant species (Cuddihy and Stone 1990, pp. 73-74; Wagner et al. 1999, p. 52). Many native plant species communities that have been replaced by often monotypic communities of nonnative plants were once foraging resources for numerous species of *Hylaeus* bees including *H. longiceps* (Cox and Elmqvist 2000, p. 1238; Daly and Magnacca 2003, p. 11; USFWS 1999, pp. 145, 163, 171, 180; USFWS 2008b, pp. 7, 9).

Many of the native plants that currently serve as foraging resources for *H. longiceps* are declining due to a lack of pollinators and competition with nonnative plants (Daly and Magnacca 2003, p. 11; USFWS 2008b, pp. 7, 9; Smith 1985, pp. 180-181; Cuddihy and Stone, 1990, p. 74; DAntonio and Vitousek 1992, p. 73; Vitousek et al. 1997, p. 6) and are found only in very small populations (USFWS 1999, pp. 145, 163, 171, 180; Cox and Elmqvist 2000, p. 1,238). For example, *H. longiceps* is known to forage on the federally endangered plants *Sesbania tomentosa* and *Scaevola coriacea* (USFWS 1999, p. 145; Daly and Magnacca 2003, pp. 55, 135). *H. longiceps* also visits *Chamaesyce celastroides* var. *kaenana*, a federally endangered plant endemic to coastal dry shrubland on Oahu (Koutnik 1999, p. 606; Daly and Magnacca 2003, pp. 55, 74). Several other widespread nonnative plant species threaten coastal habitats of *H. longiceps* known from these areas. Understory and sub-canopy species include *Asystasia gangetica* (Chinese violet), *Atriplex semibaccata* (Australian saltbush), *Leucana leucocephala* (koa haole), *Pluchea indica* (Indian fleabane), *P. symphytifolia* (sourbush), and *Verbesina encelioides* (golden crown-beard) (DOFAW 2007, pp. 20-22, 54-58; HBMP 2008). Nonnative canopy species include *Prosopis pallida* (kiawe) (DOFAW 2007, pp. 20-22, 54-58; HBMP 2008), an invasive, nonnative, deciduous thorny tree (TNC 2009, p. 8). In addition, several nonnative grasses such as *Cenchrus ciliaris* (buffelgrass), *Chloris barbata* (swollen fingergrass), *Digitaria insularis* (sourgrass), and *Panicum maximum* (guinea grass) threaten the coastal habitats in which this native species is known to occur (DOFAW 2007, pp. 20-22, 54-58; HBMP 2008).

As noted in the Life History section, above, *Hylaeus* species almost exclusively visit native plants to collect nectar and pollen (Daly and Magnacca 2003, p. 11), pollinating those plants in the process (Sakai et al. 1995, pp. 2,524-2,528; Cox and Elmqvist 2000, p. 1,238; Sahli et al. 2008, p. 1). *Hylaeus* bees are very rarely found visiting nonnative plants for nectar and pollen (Magnacca 2007a, pp. 186, 188). Unpublished data on *Hylaeus* spp. pollen use (Magnacca, in litt. 2011, p. 65) suggest only approximately three percent of pollen collected by yellow-faced bees in general is from nonnative plant sources. These data do not include observations regarding yellow-faced bee use of *Tournefortia argentea*, which is a naturalized and relatively recent arrival to the Hawaiian Islands, as a pollen resource (Magnacca, in litt. 2011, p. 65) (see additional information on this species below). Other than *Scaevola sericea*, native vegetation is lacking along most of the coastline of the main Hawaiian Islands. As *Hylaeus* spp. have not been observed at coastal sites where *S. sericea* represents the only native plant species occurrence, researchers believe yellow-faced bees including *H. longiceps*, are unable to survive on this species alone (Magnacca 2007, p. 187; Magnacca, in litt. 2011, p. 65).

In summary, the spread of nonnative plants throughout the coastal and lowland habitat of *H. longiceps* represents a serious and ongoing threat to this species. Many of the native plant species being replaced by invasive, nonnative plants provide foraging resources (e.g. pollen, nectar) for *Hylaeus* bees, including *H. longiceps*. The best available information indicates *H. longiceps* does not characteristically forage on nonnative plants (Daly and Magnacca 2003, p. 13). Only 14 of 820 recent (1998 to 2010) *Hylaeus* spp. observations were on flowers of nonnative plant species; however, none of those observations involved *H. longiceps*. Therefore, we conclude that the ongoing spread of nonnative plants into the habitats of H. longiceps remains a significant threat due to manner in which nonnative plants alter and fragment habitat, increase the likelihood of fire, and attract nonnative insect species. This threat further endangers the species long-term chances for conservation and recovery.

<u>Habitat Destruction and Modification by Nonnative Ungulates</u>

The presence of nonnative mammals, such as feral pigs (*Sus scrofa*), cattle (*Bos taurus*), goats (*Capra hircus* ), and axis deer (*Axis axis*), is considered one of the primary factors underlying the alteration and degradation of native vegetation and habitat in the Hawaiian Islands (Stone 1985, pp. 262-263; Cuddihy and Stone 1990, pp. 60-66; 73 FR 73801). Beyond the direct effects of trampling and consuming native plants, nonnative ungulates contribute significantly to increased erosion, and their behavior (i.e., rooting and moving across large areas) facilitates the spread and establishment of competing, invasive, nonnative plant species (Cuddihy and Stone 1990, p. 65). Feral pigs occur on all of the main Hawaiian Islands except Kahoolawe and Lanai (HEAR 1998; Kessler 2011, pers. comm.); goats are found on all of the main Hawaiian Islands except Lanai (HEAR 1998); feral cattle are found on Hawaii and Maui (HEAR 1998); Mouflon sheep and hybrids are found on Hawaii and Lanai (Hawaii Conservation Alliance (HCA) 2007); and axis deer are found on Lanai, Maui, Molokai, Oahu, and Hawaii (HCA 2007). At least one endangered coastal and lowland plant species, *Sesbania tomentosa*, threatened by the browsing, trampling, and digging activities of nonnative ungulates (e.g., axis deer, goats, and cattle), is a foraging source for *H. longiceps* (USFWS 1999, pp. 145, 163, 171, 180; Daly and Magnacca 2003, pp. 11, 13).

The State of Hawaii provides game mammal (e.g., feral pigs, goats, and deer) hunting opportunities on State-designated public hunting areas on the islands of Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu (Hawaii Administrative Rules § 13-123-1413-123-20; DLNR 1999). The States management objectives for game animals ranges from maximizing public hunting opportunities (e.g., sustained yield) in some areas to removal by State staff, or their designees, in other areas (Hawaii Administrative Rules § 13-123). *H. longiceps* has populations in or adjacent to areas where terrestrial habitat may be manipulated for game enhancement and where game populations are maintained at certain levels for public hunting (Hawaii Administrative Rules § 13-123). Public hunting areas are predominantly not fenced, and game mammals have unrestricted access to most areas across the landscape, regardless of underlying land use designation. While fences are sometimes built to provide protection from game mammals to the natural resources within the fenced area, the current number and locations of fences are not adequate to prevent habitat destruction and degradation of the lowland forest habitat of *H. longiceps*.

In summary, feral pigs, cattle, goats, and axis deer continue to alter and degrade native vegetation within *H. longiceps* habitat in the Hawaiian Islands. We believe these ungulates represent a significant and ongoing threat to the continued existence of *H. longiceps*, endangering the species long-term chances for conservation and recovery. Ungulates directly trample and consume native plants, including plants used for foraging by *H. longiceps*. The best available information indicates that other than the plant *Tournefortia argentea*, *H. longiceps* does not use nonnative plants for foraging (Daly and Magnacca 2003, p. 13). While some specific areas throughout the State, including some *H. longiceps* habitat sites, are managed to exclude the presence of or control ungulates, we are unaware of any plans to entirely eradicate or eliminate ungulates from the Hawaiian Islands. In addition, public hunting areas maintain populations of nonnative ungulates and often do not provide adequate fencing to prevent nonnative ungulates from negatively impacting the habitat of *H. longiceps*. Therefore, the ongoing alteration and degradation of many of the native coastal and lowland habitat where *H. longiceps* occurs by ungulates is expected to further impact this species foraging and nesting habitat through the direct consumption and trampling of native plants, introduction and spread of nonnative plants, and increased erosion.

Habitat Destruction and Modification by Fire

Fire is a relatively new, human-exacerbated threat to native species and natural vegetation in Hawaii. The historical fire regime in Hawaii was characterized by infrequent, low severity fires, as few natural ignition sources existed (Cuddihy and Stone 1990, p. 91; Smith and Tunison 1992, pp. 395-397). Natural fuel beds were often discontinuous, with moderate to high rainfall in many areas on most islands. Fires inadvertently or intentionally ignited by the original Polynesians in Hawaii probably contributed to the initial decline of native vegetation in the drier plains and foothills. These early settlers practiced slash-and-burn agriculture that created open lowland areas suitable for the later colonization of nonnative, fire-adapted grasses (Kirch 1982, pp. 5-6, 8; Cuddihy and Stone 1990, pp. 30-31). Beginning in the late 18th century, Europeans and Americans introduced plants and animals that further degraded native Hawaiian ecosystems. Pasture areas and ranching, in particular, created highly fire-prone areas of nonnative grasses and shrubs (DAntonio and Vitousek 1992, p. 67). Fires of all intensities, seasons, and sources are destructive to native Hawaiian ecosystems (Brown and Smith 2000, p. 172), and a single grass-fueled fire can kill most native trees and shrubs in the burned area (DAntonio and Vitousek 1992, p. 74). Although Vogl (1969) (in Cuddihy and Stone 1990, p. 91) suggests naturally occurring fires, primarily from lightning strikes, have been important in the development of the original Hawaiian flora, and many Hawaiian plants might be fire-adapted, Mueller-Dombois (1981) (in Cuddihy and Stone 1990, p. 91) points out most natural vegetation types of Hawaii would not carry fire before the introduction of nonnative grasses. Smith and Tunison (in Cuddihy and Stone 1990, p. 91) state that native plant fuels typically have low flammability.

Fire represents a threat to *H. longiceps* in coastal and lowland dry habitat. Fire threatens *H. longiceps* by destroying the native plant species and communities on which the species depends and opening up habitat for increased invasion by nonnative plants. Fire can destroy dormant seeds of native plants as well as the plants themselves. Successive fires that burn farther and farther into native habitat destroy native plants and remove habitat for native plant and animal species by altering microclimate conditions favorable to nonnative plants. Nonnative plant species most likely to be spread as a consequence of fire are those that (1) produce a high fuel load; (2) are adapted to survive and regenerate after fire; and (3) establish rapidly in newly burned areas. Grasses (particularly those that produce mats of dry material or retain a mass of standing dead leaves) that invade native forests and shrublands provide fuels that allow fire to burn areas that would not otherwise easily burn, including even the edges of wetter forests (Fujioka and Fujii 1980, in Cuddihy and Stone 1990, p. 93; DAntonio and Vitousek 1992, pp. 70, 73-74; Tunison et al. 2002, p. 122). Native woody plants may recover from fire to some degree, but fire tips the competitive balance toward nonnative species (National Park Service 1989, in Cuddihy and Stone 1990, p. 93).

For example, on a post-burn survey at Puuwaawaa on the island of Hawaii, an area of native *Diospyros* forest with undergrowth of the nonnative grass *Pennisetum setaceum* (fountain grass), Takeuchi noted no regeneration of native canopy is occurring within the Puuwaawaa burn area (Takeuchi 1991, p. 2). Takeuchi also stated, Burn events served to accelerate a decline process already in place, compressing into days a sequence which would ordinarily have taken decades (Takeuchi 1991, p. 4). The author concluded that in addition to increasing the number of fires, the nonnative *P. setaceum* acted to suppress establishment of native plants after a fire (Takeuchi 1991, p. 6).

There have been several recent fires on Oahu that have impacted rare or endangered species in coastal, lowland dry, and mesic habitats. Between 2004 and 2005, wildfires burned more than 360 ac (146 ha) of mesic habitat in Honouliuli Preserve, home to more than 90 rare and endangered plants and animals and located along the windward side of the Waianae Mountains (TNC, in litt. 2005). In 2006, a fire at Kaena Point State Park burned 60 ac (24 ha) and encroached on endangered plants in Makua Military Reservation Army Training Area. The area that burned in this fire is near the Kaena Point NAR, where *H. longiceps* is still known to occur. In 2007, there was a significant fire in lowland dry and mesic habitat at Kaukonahua that crossed 12 gulches, eventually encompassing 5,655 ac (2,289 ha), negatively impacting seven endangered plant species. Occurrences of several native species were extirpated as a result of the fire. The Kaukonahua fire also provided pathways for nonnative ungulates (cattle, goats, and pigs) to access previously undisturbed areas. This fire opened gaps in previously densely vegetated areas allowing the growth of the invasive grass *Panicum maximum* (guinea grass), which is also used as a food source by cattle and goats. An area infested by *P. maximum* burned, and the grass resprouted blades over two feet in length only two weeks after the fire (U.S. Army Garrison 2007, p. 3). In 2009, there were two smaller fires which burned 200 ac (81 ha) at Manini Pali (Kaena Point State Park) and 3.8 ac (1.5 ha) at Makua Cave (at the mouth of Makua Valley). These examples of recent fires illustrate nonnative grass invasion leads to grass/fire cycles that convert native vegetation to grassland (DAntonio and Vitousek 1992, p. 77).

Several areas in the State of Hawaii, including some areas containing *Hylaeus* spp. habitat sites, are currently loosely addressed under fire management plans. For example, in 2003, the Army completed an Integrated Wildland Fire Management Plan (WFMP) for all of its Oahu training installations. This plan is currently being updated (U.S. Army 2009, pp. 4-73). The goal of the WFMP is to reduce the threat of wildfire that adversely affects listed and other rare species. Although no candidate yellow-faced bees are known from military land on Oahu, at least one species, *H. kuakea*, occurs on land roughly adjacent to military land along the Schofield Barracks East Range and could be impacted by fires caused by military activities, or conversely, could benefit from activities to suppress and control origination of fires either on or adjacent to military land.

Additionally, the State Division of Forestry and Wildlife (DOFAW) maintains a fire management program tasked with fire suppression activities targeted toward the protection of watershed areas, forest reserves, public hunting areas, wildlife and plant sanctuaries, and NARS. Their activities include the maintenance of firebreak roads, signage, and helicopter dip tanks; active fire control during fire outbreak; controlled burns when and where deemed necessary; fire training efforts, including education; and maintenance of a State fire management program website (http://www.state.hi.us/dlnr/dofaw/fmp). According to their website, DOFAW is involved in the protection of 3,360,000 acres statewide, which is approximately 81 percent of the State's land area.

In summary, while we are aware of fire management in some areas of the State, including some *H. longiceps* habitat sites, there is evidence that the repeated outbreak of fire within Hawaiis native coastal, lowland dry, and lowland mesic forests often leads to the irrevocable conversion of native to nonnative habitat (i.e., nonnative plant species). These nonnative habitats are unsuitable for nesting and foraging by *H. longiceps*. Therefore, we conclude fire is a significant ongoing threat to the habitat of *H. longiceps* in coastal and lowland dry habitat.

<u>Habitat Destruction and Modification by Recreational Activities</u>

Some of the best habitat areas for the seven candidate *Hylaeus* species, including *H. longiceps*, are also popular recreational sites, particularly those areas located within coastal habitat (Magnacca 2007a, p. 180). Suitable remaining habitat for *H. longiceps* are also popular hiking areas, including coastal sites such as Kaena Point (on Oahu); and Polihua Road, and Shipwreck Beach on Lanai. Human impacts at recreational sites can include removal or trampling of vegetation on or near trails and the compaction of vegetation by off-road vehicles (Magnacca 2007a, p. 180). However, we are not aware that any of these areas are actually being impacted by recreational activities currently.

In summary, while trampling and compaction of vegetation from human activities may negatively impact the habitat of some populations of *H. longiceps*, we have no basis to conclude these impacts would be at a scale that represents a threat to the species. While some areas, particularly coastal sites, are undoubtedly popular recreational sites, we believe this is a local rather than a range-wide problem for *H. longiceps*. Therefore, we conclude that recreational activities are not a threat to this species at this time.

Habitat Destruction and Modification by Hurricanes and Drought

Stochastic (random, naturally occurring) events, such as hurricanes and drought, can alter or degrade the habitat of *H. longiceps* directly by modifying and destroying native coastal and lowland dry habitats (e.g., by mechanical damage to vegetation). Indirect effects include creating disturbed areas conducive to invasion by nonnative plants, which outcompete the native plants used by the species for foraging of nectar and pollen. We presume these events also alter microclimatic conditions (e.g., opening the tree canopy leading to an increase in habitat temperature, soil erosion, and decreasing soil moisture) so that the habitat no longer supports the native host plants necessary to *H. longiceps* for nectar and pollen foraging, as well as nesting.

Hurricanes affecting Hawaii were only rarely reported from ships in the area from the 1800s until 1949. Between 1950 and 1997, 22 hurricanes passed near or over the Hawaiian Islands, 5 of which caused serious damage (Businger 1998, pp. 1-2). In November 1982, Hurricane Iwa struck the Hawaiian Islands, with wind gusts exceeding 100 miles per hour (mph) (161 kilometers per hour (kph)), causing extensive damage, especially on the islands of Niihau, Kauai, and Oahu (Businger 1998, pp. 2, 6). Many forest trees were destroyed (Perlman 1992, pp. 1-9), which opened the canopy and facilitated the invasion of nonnative plants (Kitayama and Mueller-Dombois 1995, p. 671). Habitat alteration and degradation by nonnative plants is a threat to the habitat of *H. longiceps*, as described in the Habitat Destruction and Modification by Nonnative Plants section above. In September 1992, Hurricane Iniki, a category 4 hurricane with maximum sustained wind speeds recorded at 140 mph (225 kph), passed directly over the island of Kauai and close to the island of Oahu, causing significant damage to areas along Oahus southwestern coast (Barbers Point or Kalaeloa, through Kaena) (Blake et al. 2007, p. 20), where a population of *H. longiceps* is found. Damage by future hurricanes could further decrease the remaining native-plant-dominated habitat areas that support this species (Bellingham et al. 2005, p. 681).

*H. longiceps* may also be affected by temporary habitat loss (e.g., desiccation of habitats, die-off of host plants) associated with droughts, which are not uncommon on the Hawaiian Islands. Between 1860 and 2002, the Hawaiian Islands were affected by approximately 49 periods of drought (Giambelluca et al. 1991, pp. 3-4; Hawaii Commission on Water Resource Management 2009a and 2009b). These drought events lead to an increase in the number of forest and brush fires (Giambelluca et al. 1991, p. v), causing a reduction of native plant cover and habitat (DAntonio and Vitousek 1992, pp. 77-79). With populations that have already been severely reduced in both abundance and geographic distribution, even such a temporary loss of habitat can have a severe negative impact on *H. longiceps* if, for example, the host plants for nectar and pollen foraging are lost for one or more seasons. Because small populations are demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio, stochastic events such as hurricanes pose the threat of immediate extinction of a species with a very small and geographically restricted distribution such as *H. longiceps* (Lande 1988, p. 1,455).

In summary, natural disasters, such as hurricanes and drought, represent a significant threat to coastal and lowland dry habitats and *H. longiceps*, endangering its chance for conservation and recovery. These types of events are known to cause significant habitat damage, and because the species now persists in low numbers within a restricted range, it is more vulnerable to these events and less resilient to such habitat disturbances. Hurricanes and drought, even though unpredictable, have been and are expected to continue to be threats to the *H. longiceps*, and they therefore pose immediate and ongoing threats to the species and its habitat.

Habitat Destruction and Modification by Climate Change

Climate change will be a particular challenge for biodiversity because the interaction of additional stressors may push species beyond their ability to survive (Lovejoy et al. 2005, pp. 325-326). The synergistic implications of climate change and habitat fragmentation are the most threatening facet of climate change for biodiversity (Lovejoy et al. 2005, p. 4). The magnitude and intensity of the impacts of global climate change and increasing temperatures on native Hawaiian ecosystems are unknown; we are not aware of climate change studies specifically related to the coastal and lowland habitat areas occupied by *H. longiceps*, or to other *Hylaeus* bee species. Based on the best available information, climate change impacts could include the loss of native plant species that comprise the habitats in which *H. longiceps* occurs (Pounds et al. 1999, pp. 611-612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246, 14,248); however, because no climate change studies have looked at the effects to coastal and lowland habitat, we have no way of predicting the amount or extent of any such possible habitat loss. Because the host plant habitat of *H. longiceps* is outside of the tidal and immediate near shore zone, we do not expect any direct effects to its habitat from sea level rise itself.

In addition, *H. longiceps* may be vulnerable to changes in precipitation caused by global climate change. However, future changes in precipitation are uncertain because they depend in part on how El Nino (a disruption of the ocean atmospheric system in the tropical Pacific having important global consequences for weather and climate) might change, and reliable projections of changes in El Nino have yet to be made (Benning et al. 2002, pp. 14,248-14,249). Oki (2004, p. 4) has noted long-term evidence of decreased precipitation and stream flow in the Hawaiian Islands, based upon evidence collected by stream gauging stations. This long-term drying trend, coupled with periodic El Nino-caused drying events, has created a pattern of severe and persistent stream dewatering events (Polhemus, in litt 2008, p. 26). Future changes in precipitation and the forecast of those changes are highly uncertain because they depend, in part, on how the El Nino-La Nina (a different disruptive extreme weather and climate pattern that can alternate with El Nino) weather cycle might change (Hawaii Climate Change Action Plan 1998, pp. 2-10).

If precipitation is significantly reduced, *H. longiceps* may be among the species most vulnerable to extinction, with possible impacts expected to include habitat loss and alteration or changes in disturbance regimes (e.g., storms and hurricanes), in addition to possible direct physiological stress of an unknown nature, which could potentially cause the species to seek out less suitable habitats as its preferred habitats become degraded. The probability of a species going extinct as a result of these factors increases when ranges are restricted, habitat decreases, and population numbers decline (Intergovernmental Panel on Climate Change 2007, p. 8). Such is the case for *H. longiceps*, which is characterized by a limited climatic range and restricted habitat requirements, small population size, and low number of individuals. However, without reliable predictions of the amount and extent of anticipated precipitation change, we are unable to determine whether precipitation changes would result in negative impacts to *H. longiceps* at this time.

In summary, *H. longiceps*, like most insects, is presumed to have limited environmental tolerances. This species also has a limited range and restricted habitat requirements (Daly and Magnacca 2003, p. 11). The projected effects of global climate change and increasing temperatures on *H. longiceps* would likely be related to changes in microclimatic conditions in its habitats. These changes may also lead to the loss of native plant species due to direct physiological stress, the loss or alteration of habitat, increased competition from nonnative bee species, and changes in disturbance regimes (e.g., fire, storms, and hurricanes). Therefore, we believe *H. longiceps* will be exposed to projected environmental impacts that may result from changes in climate, and subsequent impacts to its habitats (Pounds et al. 1999, pp. 611-612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246, 14,248), and we do not anticipate a reduction in this ongoing threat any time in the near future. However, because the specific and cumulative effects of climate change on this species are presently unknown, we are not able to determine the magnitude of this potential threat with confidence or precision.

<u>Summary of Factor A</u> - The present or threatened destruction, modification, or curtailment of its habitat or range

*Hylaeus longiceps* is dependent upon the persistence of native Hawaiian plants and their increasingly rare associated habitat types, particularly coastal and lowland dry habitat areas. As identified above in our Factor A analysis, the native habitats on which *H. longiceps* depend have been drastically directly altered during the last century, with many areas either converted for development or agriculture, or indirectly altered due to the effects of nonnative ungulates, nonnative plants, and fire. Habitat conversion and loss of host plants, and other stochastic events (e.g., hurricanes and drought), are all contributing factors to the present and threatened destruction, modification, and curtailment of the habitat and range of *H. longiceps*.

Land conversion and fragmentation of remaining coastal and lowland dry habitat is continuing throughout this species known range, particularly due to the effects of feral ungulates, fire, and nonnative plants. We anticipate habitat conversion and fragmentation to continue, and likely increase, throughout its known range. As discussed above, *H. longiceps* has experienced significant habitat losses. As more habitats become unsuitable, we expect its population declines to continue or accelerate.

We have evaluated the best scientific and commercial information available regarding the present or threatened destruction, modification, or curtailment of *H. longiceps* habitat or range. Based on the current and ongoing habitat issues identified, their synergistic effects, and their likely continuation, we have determined this factor poses a significant threat to *H. longiceps*.

## B. Overutilization for commercial, recreational, scientific, or educational purposes:

We are unaware of any collections of *Hylaeus longiceps* by recreational or insect enthusiast collectors. However, insect collecting is a valuable component of research, including taxonomic work, and is often necessary to document the existence of populations and population trends. Based on comments received in response to the 90-day finding for this species, *H. longiceps* is not believed to be particularly threatened by over-collection (Magnacca, in litt. 2010, p. 2).

## C. Disease or predation:

**Disease**

We are not aware of any information indicating disease presents a threat to *Hylaeus longiceps*.

**Predation**

<u>Predation by Nonnative Ants</u>

Ants are known to prey upon *Hylaeus* species (Medeiros et al. 1986, pp. 45-46; Reimer 1994, p. 17), thereby directly eliminating them from specific areas. In one particular study, nests of *Nesoprosopis* sp., an endemic ground-nesting bee, could not be found in ant-infested plots but were commonly encountered in ant-free sites of the same habitat. *Nesoprosopis* was reduced to a subgenus of *Hylaeus* in 1923 (Meade-Waldo 1923, p. 1). Ants are not a natural component of Hawaii's arthropod fauna, and the native *Hylaeus* species of the islands evolved in the absence of predation pressure from ants. Ants can be particularly destructive predators because of their high densities, recruitment behavior, aggressiveness, and broad range of diet (Reimer 1993, pp. 17-18). The threat of ant predation on *H. longiceps* is amplified by the fact that most ant species have winged reproductive adults (Borror et al. 1989, p. 738) and can quickly establish new colonies in suitable habitats (Staples and Cowie 2001, p. 55). In addition, these attributes allow some ants to destroy otherwise geographically isolated populations of native arthropods (Nafus 1993, pp. 19, 22-23). Ants have not been observed preying upon *H. longiceps*. However, at least one or more of the most aggressive and widespread species (discussed below) occur in every known population site of *H. longiceps* and are presumed to be a serious threat due to the impact of predation.

At least 47 species of ants are known to be established in the Hawaiian Islands (Hawaii Ants 2008, pp. 1-11). Native insect fauna, likely including *H. longiceps* (Zimmerman 1948, p. 173; Reimer et al. 1990, pp. 40-43;

HEAR database 2005, pp. 1-2), have been severely impacted by at least four particularly aggressive ant species: *Pheidole megacephala* (big-headed ant), *Anoplolepis gracilipes* (long-legged ant or yellow crazy ant), *Solenopsis papuana* (no common name), and *Solenopsis geminata* (no common name). Numerous other species of ants are recognized as threats to Hawaiis native invertebrates, and an unknown number of new species of ants are established every few years (Staples and Cowie 2001, p. 53). Due to their preference for drier habitat sites, ants are more likely to occur in high densities in the coastal and dry habitat currently occupied by *H. longiceps* (Reimer 1994, p. 12).

*Pheidole megacephala* originated in central Africa (Krushelnycky et al. 2005, p. 24) and was first reported in Hawaii in 1879 (Krushelnycky et al. 2005, p. 24). This species is considered one of the most invasive and widely distributed ants in the world (Krushelnycky et al. 2005, p. 5). In Hawaii, this species is the most ubiquitous ant species found, from coastal to mesic habitat up to 4,000 ft (1,219 m) in elevation, including within the habitat areas of *H. longiceps*. With few exceptions, native insects have been eliminated in habitats where *P. megacephala* is present (Perkins 1913, p. xxxix; Gagne 1979, p. 81; Gillespie and Reimer 1993, p. 22). Consequently *P. megacephala* represent a threat to populations of *H. longiceps* in coastal to dry areas on Lanai, Maui, Molokai, and Oahu (Reimer 1993, p. 14; Reimer 1994, p. 17; Daly and Magnacca 2003, pp. 9-10).

*Anoplolepis gracilipes* appeared in Hawaii in 1952, and now occurs on Hawaii, Kauai, Maui, and Oahu (Reimer et al. 1990, p. 42; Antweb 2011). It inhabits low- to mid-elevation (less than 2,000 ft (600 m)) rocky areas of moderate rainfall (less than 100 in (250 cm) annually) (Reimer et al. 1990, p. 42). Although surveys have not been conducted to ascertain this species presence in each of the known habitat sites occupied by *H. longiceps*, we may presume *A. gracilipes* likely occurs within some of the identified population sites based upon anecdotal evidence of their expanding range and their preference (as indicated where the species is most commonly collected) for coastal and dry forest habitats (Antweb 2011). Direct observations indicate Hawaiian arthropods are susceptible to predation by this species; Gillespie and Reimer (1993, p. 21) and Hardy (1979, pp. 37-38) documented the complete extirpation of several native insects within the Kipahulu area on Maui after this area was invaded by *A. gracilipes*. Lester and Tavite (2004, p. 391) found that *A. gracilipes* in the Tokelau Atolls (New Zealand) can form very high densities in a relatively short period of time with locally serious consequences for invertebrate diversity. Densities of 3,600 individuals collected in pitfall traps within a 24-hour period were observed, as well as predation upon invertebrates ranging from crabs to other ant species. On Christmas Island in the Indian Ocean, numerous studies have documented the range of impacts to native invertebrates, including *Gecarcoidea natalis* (red land crab), as a result of predation by supercolonies of *A. gracilipes* (Abbott 2006, p. 102). *A. gracilipes* colonies have the potential as predators to profoundly affect the endemic insect fauna in territories they occupy. Studies comparing insect populations at otherwise similar ant-infested and ant-free sites found extremely low numbers of large endemic noctuid moth larvae (*Agrostis* spp. and *Peridroma* spp.) in ant-infested areas. Nests of ground-nesting cottelid bees (*Nesoprosopis* spp.) were eliminated from ant-infested sites (Reimer et al. 1990, p. 42). Although only cursory observations exist in Hawaii (Reimer et al. 1990, p. 42), we believe these ants are a threat to populations of *H. longiceps*, in coastal and dry habitat areas within its elevation range.

*Solenopsis papuana* is the only abundant, aggressive ant that has invaded intact mesic to wet forest, as well as coastal and lowland dry habitats. This species occurs from sea level to over 2,000 ft (600 m) on all of the main Hawaiian Islands, and is still expanding its range (Reimer 1993, p. 14). Although surveys have not been conducted to ascertain the presence of S. papuana in each of the known habitat sites occupied by *H. longiceps* , because of the expanding range of this species and its widespread occurrence in coastal and dry lowland habitats, it is a possible threat to all known populations of *H. longiceps* (Reimer et al. 1990, p. 42; Reimer 1993, p. 14).

Like *Solenopsis papuana*, *S. geminata* is also considered a significant threat to native invertebrates (Gillespie and Reimer 1993) and occurs on all the main Hawaiian Islands (Reimer et al. 1990; Nishida 1997). Found in drier areas of the Hawaiian Islands, it has displaced *P. megacephala* as the dominant ant in some localities (Wong and Wong 1988, p. 175). Known to be a voracious nonnative predator in many areas to where it has spread, the species was documented to significantly increase fruit fly mortality in field studies in Hawaii (Wong and Wong 1988, p. 175). In addition to predation, *S. geminata* workers tend honeydew-producing members of the Homoptera suborder, especially mealybugs, which can impact plants directly and indirectly through the spread of disease (Manaaki Whenua Landcare Research 2011).

*Solenopsis geminata* was included among the eight species ranked as having the highest potential risk to New Zealand in a detailed pest risk assessment for the country (Global Invasive Species Database 2011), and is included as one of five ant species listed among the 100 of the Worlds Worst invaders (Manaaki Whenua Landcare Research 2011).

Although surveys have not been conducted to ascertain the presence of *S. geminata* in each of the known habitat sites occupied by *H. longiceps*, because of the expanding range of this species and its widespread occurrence in coastal and dry lowland habitats, it is a possible threat to all known populations of *H. longiceps* (Wong and Wong 1988, p. 175).

The *Hylaeus* egg, larvae, and pupal stages are more vulnerable to attack by ants than the mobile adult bees (Daly and Magnacca 2003, p. 10). Invasive ants have severely impacted ground-nesting *Hylaeus* species in particular (Cole et al. 1992, pp. 1317, 1320; Medeiros et al. 1986, pp. 45-46), because their nests are easily accessible and in or near the ground. Because *H. longiceps* is believed to be a ground-nesting species, it may also be more susceptible to ant predation (Magnacca 2005g, p. 2).

*Hylaeus* populations are known to be drastically reduced in ant-infested areas (Medeiros et al. 1986, pp. 45-46; Stone and Loope 1987, p. 251; Cole et al. 1992, pp. 1313, 1317, 1320; Reimer 1994, p. 17). The presence of ants in nearly all of the low-elevation habitat sites historically and currently occupied by *H. longiceps* may increase the uncertainty of this species recovery within some of these areas (Reimer 1994, pp. 17-18; Daly and Magnacca 2003, pp. 9-10). Although the primary impact of ants on the native invertebrate fauna is via predation (Reimer 1994, p. 17), they also compete for nectar (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) and nest sites (Krushelnycky et al. 2005, pp. 6-7). Some ant species may impact *H. longiceps* indirectly as well, by consuming seeds of native plants, thereby reducing the plants recruitment and fecundity (Bond and Slingsby 1984, p. 1,031). Several studies (Krushelnycky 2005, p. 9; Lach 2008, p. 155) suggest a serious ecosystem-level effect of invasive ants on pollination. Where ranges overlap, ants compete with native pollinators such as *Hylaeus* bees and preclude them from pollinating native plants. For example, *P. megacephala* is known to actively rob nectar from flowers without pollinating them (Howarth 1985, p. 157). Lach (2008, p. 155) found that *Hylaeus* bees that regularly consume pollen from flowers of *Metrosideros polymorpha* were entirely absent from trees with flowers exposed to foraging by *P. megacephala* individuals.

The rarity or disappearance of native *Hylaeus* species, including *H. longiceps*, from historically documented localities over the past 100 years is due to a variety of factors. Although we have no direct information that conclusively correlates the decrease in populations of *H. longiceps* due to the establishment of nonnative ants, severe predation of other *Hylaeus* species by ants has been documented, resulting in clear reductions in populations. We expect similar predation impacts to *H. longiceps* to continue as a result of the widespread presence of ants throughout the Hawaiian Islands, their highly efficient and non-specific predatory behavior, and their ability to quickly disperse and establish new colonies. Therefore, we conclude that predation by nonnative ants represents a serious threat to the continued existence of *H. longiceps*, now and into the future.

Predation by Nonnative Western Yellow Jacket Wasps

*Vespula pensylvanica* (the western yellow jacket wasp) is a potentially serious threat to *H. longiceps* (Gambino et al. 1987, p. 170; Wilson et al. 2009, pp. 1-5). *V. pensylvanica* is a social wasp species native to the mainland of North America. It was first reported from Oahu in the 1930s (Sherley 2000, p. 121), and an aggressive race became established in 1977 (Gambino et al. 1987, p. 170). In temperate climates, *V. pensylvanica* has an annual life cycle, but in Hawaiis tropical climate, colonies of this species persist through a second year, allowing them to have larger numbers of individuals (Gambino et al. 1987, p. 170) and thus a greater impact on prey populations. Most colonies are found between approximately 2,000 and 3,500 ft (approximately 600 and 1,050 m) in elevation (Gambino et al. 1990, p. 1,088), although they can also occur at sea level. *V. pensylvanica* is known to be an aggressive, generalist predator (Gambino et al. 1987, p. 170), and has been documented preying upon Hawaiian *Hylaeus* species (although not specifically upon *H. longiceps*) (Wilson et al. 2009, p. 2). However, predation by *V. pensylvanica* occupied by the species combined with its small population sizes. It has been suggested the western yellow jacket wasp may compete for nectar with *Hylaeus* species, but we have no information to suggest this represents a threat to *H. longiceps* .

<u>Predation by Nonnative Parasitoid Wasps</u>

Native and nonnative parasitoid wasps are known to parasitize some *Hylaeus* species on Oahu, and may pose a threat to the Oahu population of *H. longiceps*, (Daly and Magnacca 2003, p. 10). While the available information indicates some Oahu *Hylaeus* larvae have been parasitized (and subsequently killed) by parasitoid wasps from the Encyrtidae and Eupelmidae families, it is unknown whether these wasps also utilize *H. longiceps* as nutritional hosts for their larvae (Daly and Magnacca 2003, p. 98). We are concerned that *H. longiceps* may be exposed to wasp parasitism, but we are unaware of any information to indicate this is a threat to this species.

<u>Summary of Factor C</u> - Disease or predation

We do not find evidence that disease is currently impacting *H. longiceps*, nor do we have information to indicate disease outbreaks will occur in the future. Although we have no direct information that conclusively correlates the decrease in populations of this species due to the establishment of *V. pensylvanica*, severe predation of other *Hylaeus* species by yellow jacket wasps has been documented, resulting in clear reductions in populations. We expect similar predation impacts to *H. longiceps* to continue as a result of the widespread presence of yellow jacket wasps in many areas throughout the Hawaiian Islands, their highly efficient and non-specific predatory behavior, and their ability to quickly disperse and establish new colonies.

While we are concerned that *H. longiceps* may be threatened by wasp parasitism on Oahu, we are unaware of any information to indicate this is a threat to this species at this time, or that it is likely to become so in the future. The presence of nonnative ants in nearly all lowland habitat historically and currently occupied by *H. longiceps*, combined with the near extirpation of native insects in these areas, suggest predation by nonnative ants is a serious threat to the species. Observations and reports have documented that ants are particularly destructive predators because of their high densities, broad ranges of diet, and ability to establish new colonies in otherwise geographically isolated locations because the reproductive adult ants are able to fly. Because the ranges of *Pheidole megacephala*, *Anoplolepis gracilipe*, *Solenopsis geminata*, and *Solenopsis papuana* overlap the ranges of *H. longiceps*, and based on their observed predatory behavior at other locations where they occur, these nonnative predators represent an imminent and serious threat to *H. longiceps*. Unless these aggressive, nonnative ant predators are eliminated or controlled, we expect this threat to continue or increase. Furthermore, a decrease in the amount and distribution of suitable host plants for foraging could indirectly impact *H. longiceps* by forcing the species to seek less optimal, but predator-free, foraging sites.

## D. The inadequacy of existing regulatory mechanisms:

Currently, there are no Federal, State, or local laws, treaties, or regulations that specifically conserve or protect *Hylaeus longiceps* from the numerous threats facing this species. However, there are some regulations that potentially address the threats posed by introduced, nonnative species; these are discussed below.

<u>Inadequate Protection from Nonnative Ungulates</u>

Nonnative ungulates pose a major ongoing threat to *H. longiceps* through destruction and degradation of its habitat. Although some public hunting areas are fenced to prevent the movement of nonnative ungulates to other areas, there are currently no Federal, State, or local laws, treaties, or regulations that adequately address the threats from nonnative ungulates to *H. longiceps* habitat. The absence of regulatory mechanisms exacerbates the threats discussed under Factor A.

Inadequate Protection from Introduction of Nonnative Species

The Hawaii Department of Agriculture (HDOA) is the lead State agency in protecting Hawaiis agricultural and horticultural industries, animal and public health, natural resources, and environment from the introduction of nonnative, invasive species (HDLNR 2003, p. 3-10). While there are several State agencies (HDOA, DLNR, and Hawaii Department of Health) authorized to prevent the entry of pest species into the State, the existing regulations are inadequate for the reasons discussed in the sections below.

In 1995, a partnership called the Coordinating Group on Alien Pest Species (CGAPS), comprised primarily of managers from every major Federal, State, county, and private agency and organization involved in invasive species work in Hawaii, was formed in an effort to influence policy and funding decisions, improve communication, increase collaboration, and promote public awareness (CGAPS 2009). This group facilitated the formation of the Hawaii Invasive Species Council (HISC), which was created by gubernatorial executive order in 2002 to coordinate local initiatives for the prevention and control of invasive species by providing policy-level direction and planning for the State departments responsible for invasive species issues. In 2003, the governor signed into law Act 85, which conveys statutory authority to the HISC to coordinate approaches among the various State and Federal agencies, and international and local initiatives, for the prevention and control of invasive species (HDLNR 2003, p. 3-15; HISC 2009; Haw. Rev. Stat. section 194-2(a)). Some of the recent priorities for the HISC include interagency efforts to control nonnative species such as the plants *Miconia calvescens* (miconia) and *Cortaderia* sp. (pampas grass), coqui frogs (*Eleutherodactylus coqui*), and ants (HISC 2009). However, in October 2009, HISC approved a 2010 budget that, due to a tighter economy in Hawaii and anticipated budget cuts in State funding support, resulted in a 50 percent reduction in funding with an anticipated setback in conservation achievements and the loss of experienced, highly trained staff (HISC 2009).

Inadequate Regulatory Control of Nonnative Invertebrate Species

As noted above (see Factor C, Disease and Predation), predation by nonnative ants and the nonnative yellow jacket wasp is a potentially significant threat to *H. longiceps*. Commercial shipping and air cargo, as well as biological introductions to Hawaii, have resulted in the establishment of over 3,372 species of nonnative insects (Howarth 1990, p. 18; Staples and Cowie 2001, p. 52), with an estimated continuing establishment rate of 20 to 30 new species per year (Beardsley 1962, p. 101; Beardsley 1979, p. 36; Staples and Cowie 2001, p. 52). The prevention and control of introduced pest species in Hawaii is the responsibility of Hawaii State government and Federal agencies, along with a few private organizations. Even though these agencies have regulations and some controls in place, complete control of introduced pest species is difficult to achieve. Consequently, the introduction and movement of nonnative invertebrate pest species, including nonnative ants and yellow jacket wasps, between islands and from one watershed to the next, continues.

Inadequate Regulatory Control of Nonnative Plant Species

Nonnative plants destroy and modify habitat throughout the range of *H. longiceps*. As such, they represent a significant and immediate threat to this species. In addition, nonnative plants have been shown to outcompete native plants and convert native-dominated plant communities to nonnative plant communities (see Factor A, Habitat Destruction and Modification by Nonnative Plants). The HDOA regulates the import of plants into the State from domestic origins under Hawaii State law (Haw. Rev. Stat. Ch. 150A). While all plants require inspection upon entry into the State and must be apparently free of insects and diseases, not all plants require import permits. Parcels brought into the State by mail or cargo must be clearly labeled as Plant Materials or

Agricultural Commodities, but, given budget constraints and an insufficient number of personnel, it is unlikely that all of these parcels are inspected or monitored prior to delivery in Hawaii. Shipments of plant material into Hawaii must be accompanied by an invoice or packing manifest listing the contents and quantities of the items imported, although it is unclear if all of these shipments are inspected or monitored prior to delivery (HDOA 2009). There are only 12 plant crops regulated (H.A.R. chapter 4-70) to some degree: sugarcane and grasses, pineapple and other bromeliads, coffee, cruciferous vegetables, orchids, banana, passion fruit, pine, coconut, and palms, and any host plants that harbor either Caribbean fruit fly or European corn borer (HDLNR 2003, p. 3-11). The HDOA also maintains the State list of noxious weeds, and these plants are restricted from entry into the State except by permit from the HDOAs Plant Quarantine Branch.

Although the State has general guidelines for the importation of plants, and regulations are in place regarding the plant crops mentioned above, the intentional or inadvertent introduction of nonnative plants outside the regulatory process and movement of species between islands and from one watershed to the next continues, which represents a threat to native flora and fauna for the reasons described above. In addition, government funding is inadequate to provide for sufficient inspection services and monitoring. One study concluded plant importation laws virtually ensure new invasive plants will be introduced via the nursery and ornamental trade, and outreach efforts cannot keep up with the multitude of new invasive plants being distributed. The author states the only thing wide-scale public outreach can do in this regard is to let the public know new invasive plants are still being sold, and suggest that people should ask for noninvasive or native plants instead (Martin, in litt. 2007, p. 9).

On the basis of the above information, existing regulatory mechanisms do not adequately protect *H. longiceps* from the threat of new introductions of nonnative species, and the continued expansion of nonnative species populations on and between islands and watersheds. Nonnative species may directly compete with, prey upon, consume, or modify or destroy the habitat of *H. longiceps* for food, space, and other necessary resources. Because current Federal, State, and local laws, treaties, and regulations are inadequate to prevent the introduction and spread of nonnative species from outside the State of Hawaii, as well as between islands and watersheds, the threats from these introduced species remain immediate and significant due to an inadequacy of existing regulatory mechanisms.

<u>Summary of Factor D</u> - The inadequacy of existing regulatory mechanisms

Existing regulatory mechanisms and agency policies do not address the primary threats to *H. longiceps* and its habitat from nonnative species including ungulates, plants, and arthropods, and the States current management of nonnative game mammals does not prevent the degradation and destruction of habitat of *H. longiceps* (see discussion under Factor A).

We consider the threat from inadequate regulatory mechanisms to be immediate and significant for the following reasons:

1. Existing State and Federal regulatory mechanisms are not preventing the introduction and spread of nonnative species between islands and watersheds; and
2. Habitat-altering nonnative plant species (Factor A) and predation by nonnative animal species (Factor C) pose major ongoing threats to *H. longiceps*. Because existing regulatory mechanisms are inadequate to maintain habitat for *H. longiceps* and to prevent the spread of nonnative species, the inadequacy of existing regulatory mechanisms is considered to be a significant and immediate threat to *H. longiceps*.

## E. Other natural or manmade factors affecting its continued existence:

Species endemic to single islands or known from few, widely dispersed locations are inherently more vulnerable to extinction than widespread species because of the higher risks from genetic bottlenecks, random demographic fluctuations, climate change, and localized catastrophes such as hurricanes, landslides, and drought (Lande 1988, p. 1,455; Mangel and Tier 1994, p. 607; Pimm et al. 1988, p. 757). These problems can be further magnified when populations are few and restricted to a limited geographic area, and the number of individuals is very small. Populations with these characteristics face an increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors, in a process described as an extinction vortex (Gilpin and Soule 1986, pp. 24-25). Small, isolated populations often exhibit a reduced level of genetic variability or genetic depression due to inbreeding, which diminishes a species capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (Frankham 2003, pp. S22-S29; Soule 1986, pp. 31-34). The negative impacts associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes can be further magnified by synergistic interactions with other threats.

*Hylaeus longiceps* very small populations are likely more vulnerable to habitat change and stochastic events due to low genetic variability (Daly and Magnacca 2003, p. 3; Magnacca 2007, p. 173). According to Magnacca (2007, p. 3), *H. longiceps* has not been collected recently from several historical populations and the species is restricted to rare habitat. Additionally, the small number of populations known for this species increases its risk of extinction due to stochastic events such as hurricanes, wildfires, or prolonged drought (Jones et al. 1984, p. 209; Smith and Tunison 1992, p. 398).

The recurrence intervals for stochastic events (e.g., wildfires, prolonged drought, and hurricanes) cannot be predicted, which introduces some uncertainty regarding potential effects to *H. longiceps*. The fact that a species is potentially vulnerable to stochastic processes does not necessarily mean it is reasonably likely to experience or have its status affected by a given stochastic process within timescales meaningful under the Act. Because of its small number of populations, negative impacts to *H. longiceps* from hurricanes, wildfires, and drought would be likely if these events occur. Because these events have been documented on Oahu and other Hawaiian islands in the past, we believe that they represent an ongoing threat to this species, although the specific timing, location, or magnitude is unknown. The threat from fire is unpredictable, but omnipresent in habitats that have been invaded by nonnative, fire-prone grasses. Hurricanes and drought conditions present an ongoing and ever-present threat, because they can occur at any time, although the incidence and magnitude of specific events is not predictable.

<u>Competition with Nonnative Insects</u>

There are 15 known species of nonnative bees in Hawaii (Snelling 2003, p. 342), including two nonnative *Hylaeus* species (Magnacca 2007, p. 188). Most nonnative bees inhabit areas dominated by nonnative vegetation and do not compete with native Hawaiian bees for foraging resources (Daly and Magnacca 2003, p. 13). *Apis mellifera*, the European honey bee, is an exception; this social species is often very abundant in areas with native vegetation and aggressively competes with *Hylaeus* for nectar and pollen (Hopper et al. 1996, p. 9; Daly and Magnacca 2003, p. 13; Snelling 2003, p. 345).

*Apis mellifera* was first introduced to the Hawaiian Islands in 1875, and currently inhabits areas from sea level to the upper tree line boundary (Howarth 1985, p. 156). *A. mellifera* individuals have been observed foraging on *Hylaeus* host plants such as *Scaevola* spp. and *Sesbania tomentosa* (Hopper et al. 1996, p. 9; Daly and Magnacca 2003, p. 13; Snelling 2003, p. 345). Although we lack information indicating Hawaiian *Hylaeus* populations have declined because of competition with *A. mellifera* for nectar and pollen, *A. mellifera* does forage in *Hylaeus* spp. habitat and may exclude *Hylaeus* spp. (Magnacca 2007, p. 188; Lach 2008, p. 155). *Hylaeus* species do not occur in native habitat where there are large numbers of *A. mellifera* individuals, but the impact of smaller, more moderate populations is not known (Magnacca 2007, p. 188). Nonnative, invasive bees are widely documented to decrease nectar volumes and usurp native pollinators (Lach 2008, p. 155). There are also indications that populations of the *A. mellifera* are not as vulnerable as *Hylaeus* bees to predation by nonnative ant species (see Factor C. Disease and Predation). Lach (2008, p. 155) observed that *Hylaeus* bees that regularly collect pollen from the flowers of *Metrosideros polymorpha* trees were entirely absent from trees with flowers visited by *Pheidole megacephala*, while visits by *A. mellifera* were not affected. As a result *A. mellifera* may have a competitive advantage over *Hylaeus* spp., as it is not excluded by *P. megacephala* (Lach 2008, p. 155).

Other nonnative bees found in areas of native vegetation include *Ceratina* spp. (carpenter bees), *Hylaeus albonitens* (Australian colletid bees), and *Lasioglossum impavidum* (no common name) (Magnacca 2007, p. 188). While it has been suggested these nonnative bees may impact native *Hylaeus* bees through competition for pollen based on their similar size and flower preferences, there is no information that demonstrates these nonnative bees forage on *Hylaeus* host plants (Magnacca 2007, p. 188). It has also been suggested parasitoid wasps may compete for nectar with native *Hylaeus* species (Daly and Magnacca 2003, p. 10); however, information demonstrating nonnative parasitoid wasps forage on the same host plants as *H. longiceps* is unavailable.

We acknowledge the potential for negative impacts on *H. longiceps* from competition with *Apis mellifera* for nectar and pollen (Magnacca 2007, p. 188). In addition, one study in Hawaii suggests *A. mellifera* may have an additional advantage for collecting pollen and nectar because it may not be negatively affected by the presence of predatory *P. megacephala* individuals on native vegetation (Lach 2008, p. 155). Competition with *A. mellifera* may be a potential threat to *H. longiceps* because: (1) *A. mellifera* forage on *Hylaeus* host plant species; (2) they may exclude *Hylaeus* spp. from those resources (*Hylaeus* spp. are never found foraging in the presence of *A. mellifera* bees); and (3) *A. mellifera* may have a competitive advantage over Hawaiian *Hylaeus* sp., as one study suggests honey bees are not negatively affected by the presence of *P. megacephala* individuals on native vegetation to the extent the *Hylaeus* species may be. *A. mellifera* bees have been known to exclude other *Hylaeus* species, and it is well-documented that they forage in native plant areas. However, the best available scientific information indicates that competition with *A. mellifera* may represent a threat to *H. longiceps*, but the threat is of unknown magnitude, and additional research would be helpful to better understand this interaction.

We have no information indicating other species of nonnative bees or parasitoid wasps negatively impact populations of *H. longiceps* due to competition for nectar and pollen, and have, therefore, determined that competition with other species of nonnative bees or parasitoid wasps is not a threat.

<u>Summary of Factor E</u> - Other natural or manmade factors affecting its continued existence

The small number of populations of *H. longiceps* and its inherently small gene pool increases its risk of extinction due to stochastic events such as hurricanes, wildfires, and drought, which although unpredictable, represent an ongoing and significant threat to the species. We have no information indicating other nonnative bees or parasitoid wasps compete for nectar and pollen on *Hylaeus* host plants. Therefore, we have determined that competition with these species does not present a significant threat to *H. longiceps*. While *A. mellifera* bees forage in native plant areas and have been known to exclude other *Hylaeus* species, the best available information does not indicate competition between *A. mellifera* and *H. longiceps* is a significantly quantifiable threat.

## Conservation Measures Planned or Implemented :

Some *Hylaeus longiceps* historic and current collection localities are protected from development, urbanization, and conversion to agriculture by Federal, State, or private agencies: for example one population of *H. longiceps* occurs within the TNCs Moomomi Preserve on Molokai; and one population occurs in the States Kaena Point NAR (Oahu). These areas are actively managed to restore native habitat and to reduce or eliminate many of the common threats to the native plant communities found there, including feral ungulates and wildfire. However, existing regulatory mechanisms are inadequate to provide the necessary active management needed to protect the habitat of the populations outside of these protected TNC or NAR areas (see discussion under Factor D, above). Conservation of *H. longiceps* will require active management of its known population sites, involving exclusion and removal of feral ungulates, control and removal of nonnative plant and insect species, and the restoration of native vegetation (Magnacca 2007, p. 185).

## Summary of Threats :

*Hylaeus longiceps* was originally known from numerous coastal and lowland dry forest habitats on six different main Hawaiian Islands. Now reduced to seven populations across four islands, this species remains threatened from habitat degradation by nonnative feral ungulates, nonnative plants, fire, stochastic events, inadequate regulatory protection, and climate change. The species itself is at risk from inadequate regulatory protection, small population size, and predation by and competition with nonnative insect species. We conclude there is sufficient information to develop a proposed rule for *H. longiceps*, and we find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

**For species that are being removed from candidate status:**

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

## Recommended Conservation Measures :

Because existing regulatory mechanisms are inadequate to provide the necessary active management to protect *Hylaeus longiceps*, conservation of the species will require the active control and management of natural areas where populations are known to exist. This active management will involve exclusion and removal of feral ungulates, control and removal of nonnative plant and insect species, improved and increased wild fire management and control, and the restoration of native vegetation. The continued impact of development, fire, feral ungulates, invasive ants, and the loss of native vegetation to invasive plant species will undoubtedly have a negative impact on the remaining populations of *H. longiceps* and may cause its extinction if habitat is not managed for conservation of this species (Magnacca 2007, p. 185). Necessary management actions should include:

- Protecting host plant populations from feral ungulates including pigs, goats, deer, and cattle;
- Researching and implementing methods to control nonnative plant species, particularly *Asystasia gangetica* (Chinese violet), *Atriplex semibaccata* (Australian saltbush), *Leucana leucocephala* (koa haole), *Pluchea indica* (Indian fleabane), *P. symphytifolia* (sourbush), and *Verbesina encelioides* (golden crown-beard), *Prosopis pallida* (kiawe), *Cenchrus ciliaris* (buffelgrass), *Chloris barbata* (swollen fingergrass), *Digitaria insularis* (sourgrass), and *Panicum maximum* (guinea grass);
- Researching and implementing control methods, such as poison baiting, for nonnative social insect species including ants;
- Further research intothe effects of honey bees on native *Hylaeus* spp.; and
- Conducting field surveys at known locations and in suitable habitat.

# Priority Table

| Magnitude | Immediacy | Taxonomy | Priority |
| --- | --- | --- | --- |
| **High** | **Imminent** | Monotypic genus | 1 |
| | | **Species** | **2** |
| | | Subspecies/Population | 3 |
| | Non-imminent | Monotypic genus | 4 |
| | | Species | 5 |
| | | Subspecies/Population | 6 |
| Moderate to Low | Imminent | Monotype genus | 7 |
| | | Species | 8 |
| | | Subspecies/Population | 9 |
| | Non-Imminent | Monotype genus | 10 |
| | | Species | 11 |
| | | Subspecies/Population | 12 |

## Rationale for Change in Listing Priority Number:

## Magnitude:

This species is highly threatened by feral ungulates that degrade and destroy host plant habitat and nonnative plants that degrade habitat and compete with native host plants for light, space, and nutrients. Predation by nonnative social insects is also a serious threat. Threats to the native forest habitat of *Hylaeus longiceps*, and to individuals of this species, occur throughout its range and are expected to continue or increase without their control or eradication. No known conservation measures have been taken to date to specifically address these threats.

## Imminence :

Threats to *Hylaeus longiceps* host plant habitat from feral ungulates and nonnative plants and direct predation by nonnative social insects are considered imminent because they are ongoing.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

## Emergency Listing Review

__No__ Is Emergency Listing Warranted?

The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of the species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

## Description of Monitoring:

Much of the information in this form is based upon five petitions we received and dated March 23, 2009, from Scott Hoffman Black, Executive Director of the Xerces Society. The five petitions requested that seven species of Hawaiian yellow-faced bees (including *Hylaeus longiceps*) be listed as Endangered under the Act and critical habitat be designated. Each petition contained information regarding the species taxonomy and ecology, historical and current distribution, present status, and current and potential threats. We acknowledged the receipt of the petitions in a letter to Mr. Black, dated May 8, 2009. In that letter we also stated that issuing an emergency regulation temporarily listing the species under section 4(b)(7) of the Act was not warranted at that time. We published the 90-day finding in the Federal Register on June 16, 2010 (75 FR 34077). On September 6, 2011, we published a 12-month finding in the Federal Register (76 FR 55170), which determined that listing was warranted but precluded.

**Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:**

none

**Indicate which State(s) did not provide any information or comment:**

Hawaii

## State Coordination:

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. No additional information or comments on this species were received from the State. We are in frequent contact with State biologists and believe this assessment contains the most recent available information on the species.

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## Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  06/18/2014
Date

Concur:  11/18/2014
Date

Did not concur: ______________________ ____________
Date

Director's Remarks: