DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket Number FWS–R1–ES–2012–0070: 4500030113]

RIN 1018–AY09

Endangered and Threatened Wildlife and Plants; Listing 15 Species on Hawaii Island as Endangered and Designating Critical Habitat for 3 Species

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), propose to list 15 species on the Hawaiian island of Hawaii as endangered species under the Endangered Species Act of 1973, as amended (Act), and to designate critical habitat for 1 of these species. For the remaining 14 species that we are proposing to list in this rule, we find that critical habitat is not determinable at this time. We also propose to designate critical habitat for two plant species that were listed as endangered species in 1986 and 1994. The proposed critical habitat designation totals 18,766 acres (ac) (7,597 hectares (ha)), and includes both occupied and unoccupied habitat. Approximately 55 percent of the area being proposed as critical habitat is already designated as critical habitat for 42 plants and the Blackburn's sphinx moth (*Manduca blackburni*). In addition, we propose a taxonomic change for one endangered plant species.

DATES: We will accept comments received on or postmarked on or before December 17, 2012. Please note that if you are using the Federal eRulemaking Portal (See **ADDRESSES** section below), the deadline for submitting an electronic comment is 11:59 p.m. Eastern Time on this date. We must receive requests for public hearings, in writing, at the address shown in the **FOR FURTHER INFORMATION CONTACT** section by December 3, 2012.

ADDRESSES: You may submit comments by one of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Search for FWS – R1–ES–2012–0070, which is the docket number for this proposed rule. You may submit a comment by clicking on ''Comment Now!''
- *U.S. Mail or Hand Delivery:* Public Comments Processing, Attn: FWS–R1–ES–2012–0070; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, MS 2042–PDM; Arlington, VA 22203.

We will post all comments on *http://www.regulations.gov*. This generally means that we will post any personal information you provide us (see the **Public Comments** section below for more information).

The coordinates or plot points or both from which the maps were generated are included in the administrative record for the proposed critical habitat designation and are available at *http://www.fws.gov/pacificislands, http://www.regulations.gov* at Docket No. FWS–R1–ES–2011–0070, and at the Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT**). Any additional tools or supporting information that we may develop for this critical habitat designation will also be available at the above locations.

FOR FURTHER INFORMATION CONTACT: Loyal Mehrhoff, Field Supervisor, Pacific Islands Fish and Wildlife Office, 300 Ala Moana Boulevard, Box 50088, Honolulu, HI 96850; by telephone at 808–792–9400; or by facsimile at 808–792–9581. If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Act, we are required to list a species if we determine that it meets the definition of an endangered species or a threatened species as defined in the Act. If this determination is made, we publish a proposed rule in the **Federal Register**, seek public comment on our proposal, and issue a final rule. This action consists of a proposed rule to list 15 species (13 plants, 1 insect (picture-wing fly), and 1 crustacean (anchialine pool shrimp)) from the Island of Hawaii in the State of Hawaii, as endangered. Further, under the Act, we are to designate critical habitat to the maximum extent prudent and determinable concurrently with a listing determination. We are proposing to designate critical habitat concurrently with listing for the plant *Bidens micrantha* ssp. *ctenophylla,* due to the imminent threat of urban development to 98 percent of the individuals known for this species and its habitat within the lowland dry ecosystem. In addition, we are proposing to designate critical habitat for two previously listed plant species. *Isodendrion pyrifolium,* listed as an endangered species on March 4, 1994 (59 FR 10305), and *Mezoneuron kavaiense,* listed as an endangered species on July 8, 1986 (51 FR 24672). These species co-occur with *Bidens micrantha* ssp. *ctenophylla* in the same lowland dry ecosystem, but do not have designated critical habitat on Hawaii Island. We are also correcting critical habitat unit maps for *Cyanea shipmanii, Phyllostegia racemosa, Phyllostegia velutina,* and *Plantago hawaiensis* to accurately reflect the designated critical habitat units for those plant species. These map corrections do not change the designated critical habitat for these plants. For the remaining 14 species that we are proposing to list in this rule, we find that critical habitat is not determinable at this time. This proposed rule is organized by ecosystem, which will allow the Service to better prioritize, direct, and focus conservation and recovery actions on Hawaii Island.

The basis for our action. Under the Endangered Species Act, a species may be determined to be an endangered species or a threatened species based on any of five factors: (1) Destruction, modification, or curtailment of its habitat or range; (2) Overuse; (3) Disease or predation; (4) Inadequate existing regulations; or (5) Other natural or manmade factors.

One or more of the species proposed for listing in this rule face the following threats related to these criteria:

- Habitat loss and degradation due to agriculture and urban development; nonnative feral ungulates (*e.g.,* pigs, goats) and plants; wildfire; hurricanes; flooding; and drought.
- Predation or herbivory by nonnative feral ungulates, rats, snails, and slugs.
- Inadequate existing regulatory mechanisms to prevent the introduction and spread of nonnative plants and animals.
- Small number of individuals and populations, and lack of reproduction in the wild.

This rule proposes to designate critical habitat for 3 plant species.

- Approximately 18,766 acres (7,597 hectares) is being proposed as critical habitat in seven multi-species critical habitat units on lands owned by the U.S. National Park Service, State of Hawaii, County of Hawaii, and private interests.
- Approximately 55 percent, or 10,304 acres (4,170 hectares), of the area being proposed as critical habitat overlaps with areas already designated as critical habitat for previously listed plant and animal species.
- Approximately 45 percent, or 8,464 acres (3,426 hectares), of the area does not overlap with areas already designated as critical habitat for previously listed plant and animal species.

• The proposed critical habitat units encompass areas containing physical and biological features essential to the conservation of these species and that may require special management considerations, or are otherwise essential for the conservation of these species.

• The proposed designation includes both occupied and unoccupied critical habitat for the three species for which we are proposing to designate critical habitat.

• The Secretary may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless the exclusion will result in the extinction of the species. We are considering excluding approximately 4,102 acres of privately owned and State lands from the critical habitat designation.

We are preparing an economic analysis of the proposed critical habitat designation. To consider economic impacts, we are preparing an analysis of the economic impacts of the proposed critical habitat designation and related factors. We will announce the availability of the draft economic analysis as soon as it is completed, at which time we will seek public review and comment. We will use information from this analysis to inform the development of our final designation of critical habitat for these species.

We will seek peer review. We will obtain opinions from knowledgeable individuals with scientific expertise regarding our technical assumptions, analysis, adherence to regulations, and use of the best available information.

Public Comments

We intend that any final action resulting from this proposal will be based on the best scientific and commercial data available and be as accurate and as effective as possible. Therefore, we solicit comments or suggestions on this proposed rule from other concerned governmental agencies, the scientific community, industry, or other interested parties concerning this proposed rule. We are proposing to list 15 species (13 plants, 1 anchialine pool shrimp, and 1 picture-wing fly) as endangered species. We are also proposing to designate critical habitat for one of the proposed endangered plant species and two plant species that are already listed as endangered species, but that do not have designated critical habitat on Hawaii Island. We particularly seek comments concerning:

(1) Biological, commercial trade, or other relevant data concerning threats (or the lack thereof) to the 15 species proposed for listing, and the adequacy of the existing regulations that may be addressing those threats.

(2) Additional information concerning the range, distribution, and population sizes of each of the 15 species proposed for listing, including the locations of any additional populations of these species.

(3) Any information on the biological or ecological requirements of the 15 species proposed for listing.

(4) Current or planned activities within the area being proposed for critical habitat and possible impacts to these activities.

(5) The reasons why we should or should not designate areas for *Bidens micrantha* ssp. *ctenophylla, Mezoneuron kavaiense* (taxonomic revision proposed for *Caesalpinia kavaiense* to *Mezoneuron kavaiense*), and *Isodendrion pyrifolium* as ''critical habitat'' under section 4 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*). We specifically seek information on any threats to these species from human activity, the degree of which can be expected to increase due to the designation, and whether the benefit of designation would outweigh threats to these species caused by the designation, such that the designation of critical habitat is prudent.

(6) Specific information on:

• The amount and distribution of critical habitat for the species included in this proposed rule;

• Areas that are currently occupied and contain the necessary physical or biological features essential for the conservation of the species that we should include in the designation, and why;

• Whether special management considerations or protections may be required for the physical or biological features essential to the conservation of the species in this proposed rule; and

• What areas outside the geographical area occupied at the time of listing are essential to the conservation of the species, and why.

(7) Any reasonably foreseeable economic, national security, or other relevant impacts of the proposed critical habitat designation. We are particularly interested in any impacts on small entities, and the benefits of including or excluding areas that may experience these impacts.

(8) Whether the benefits of excluding any particular area from critical habitat outweigh the benefits of including that area as critical habitat under section 4(b)(2) of the Act, after considering the potential impacts and benefits of the proposed critical habitat designation. Under section 4(b)(2), the Secretary may exclude an area from critical habitat if he or she determines that the benefits of such exclusion outweigh the benefits of including that particular area as critical habitat, unless failure to designate that specific area as critical habitat will result in the extinction of the species. We request specific information on:

• The benefits of and supporting rationale for including specific areas in the final designation;

• The benefits of and supporting rationale for excluding specific areas from the final designation; and

• Whether any specific exclusions may result in the extinction of the species, and why.

(9) Whether the private and State lands being considered for exclusion from critical habitat designation under section 4(b)(2) of the Act should or should not be excluded, and why.

(10) Information on the projected and reasonably likely impact of climate change on the species included in this proposed rule, and any special management needs or protections that may be needed in the critical habitat areas we are proposing.

(11) Whether we could improve or modify our approach to designating critical habitat in any way to provide for greater public participation and understanding, or to better accommodate public concerns and comments.

(12) Specific information on ways to improve the clarity of this rule as it pertains to completion of consultations under section 7 of the Act.

(13) Comments on our proposal to revise the taxonomic classification for *Caesalpinia kavaiense to Mezoneuron kavaiense.*

You may submit your comments and materials concerning this proposed rule by one of the methods listed in the **ADDRESSES** section. We request that you send comments only by the methods described in the **ADDRESSES** section.

We will post your entire comment—including your personal identifying information—on *http://www.regulations.gov.* If you provide personal identifying information in your comment, such as your street address, phone number, or email address, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection at

http://www.regulations.gov, or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT**). You may obtain copies of the proposed rule by mail from the Pacific Islands Fish and Wildlife Office (See **FOR FURTHER INFORMATION CONTACT**) or by visiting the Federal eRulemaking Portal at *http://www.regulations.gov.*

Background

Hawaii Island Species Addressed in This Proposed Rule

Table 1 below provides the scientific name, common name, listing status, and critical habitat status for the species that are the subjects of this proposed rule.

TABLE 1—THE HAWAIIAN ISLAND SPECIES ADDRESSED IN THIS PROPOSED RULE (NOTE THAT MANY OF THE SPECIES SHARE A COMMON NAME. ''E'' DENOTES ENDANGERED STATUS UNDER THE ACT; ''C'' DENOTES A SPECIES CURRENTLY ON THE CANDIDATE LIST.)

Scientific name	Common name(s)	Listing status	Critical habitat status
Plants			
Bidens hillebrandiana ssp. *hillebrandiana.*	kookoolau	Proposed—Endangered	Not determinable.
Bidens micrantha ssp. *ctenophylla*	kookoolau	Proposed—Endangered (C)	Proposed.
Caesalpinia kavaiense (taxonomic revision proposed, to *Mezoneuron kavaiense*).	uhiuhi	Listed 1986—E	Proposed.
Cyanea marksii	haha	Proposed—Endangered	Not determinable.
Cyanea tritomantha	aku	Proposed—Endangered (C)	Not determinable.
Cyrtandra nanawaleensis	haiwale	Proposed—Endangered	Not determinable.
Cyrtandra wagneri	haiwale	Proposed—Endangered	Not determinable.
Isodendrion pyrifolium	wahine noho kula	Listed 1994—E	Proposed.
Phyllostegia floribunda	no common name (NCN)	Proposed—Endangered (C)	Not determinable.
Pittosporum hawaiiense	hoawa, haawa	Proposed—Endangered	Not determinable.
Platydesma remyi	NCN	Proposed—Endangered (C)	Not determinable.
Pritchardia lanigera	loulu	Proposed—Endangered	Not determinable.
Schiedea diffusa ssp. *macraei*	NCN	Proposed—Endangered	Not determinable.
Schiedea hawaiiensis	NCN	Proposed—Endangered	Not determinable.
Stenogyne cranwelliae	NCN	Proposed—Endangered (C)	Not determinable.
Animals			
Drosophila digressa	picture-wing fly	Proposed—Endangered (C)	Not determinable.
Vetericaris chaceorum	anchialine pool shrimp	Proposed—Endangered (C)	Not determinable

[NCN] = no common name.

Previous Federal Actions

Seven of the 15 species proposed for listing are candidate species (76 FR 66370; October 26, 2011). Candidate species are those taxa for which the Service has sufficient information on their biological status and threats to propose them for listing as endangered or threatened species under the Act, but for which the development of a listing regulation has been precluded to date by other higher priority listing activities. The current candidate species addressed in this proposed listing rule include the five plants *Bidens micrantha* ssp. *ctenophylla, Cyanea tritomantha, Phyllostegia floribunda, Platydesma remyi,* and *Stenogyne cranwelliae;* and the anchialine pool shrimp *Vetericaris chaceorum,* and the picture-wing fly *Drosophila digressa.* The candidate status of all of these species was most recently assessed and reaffirmed in the October 26, 2011, Review of Native Species that are Candidates for Listing as Endangered or Threatened (CNOR) (76 FR 66370).

On May 4, 2004, the Center for Biological Diversity petitioned the Secretary of the Interior to list 225 species of plants and animals, including the 7 candidate species listed above, as endangered or threatened under the provisions of the Act. Since then, we have published our annual findings on the May 4, 2004, petition (including our findings on the 7 candidate species listed above) in the CNORs dated May 11, 2005 (70 FR 24870), September 12, 2006 (71 FR 53756), December 6, 2007 (72 FR 69034), and December 10, 2008 (73 FR 75176), November 9, 2009 (74 FR 57804), November 10, 2010 (75 FR 69222), and October 26, 2011 (76 FR 66370). This proposed rule constitutes a further response to the 2004 petition.

In addition to the seven candidate species, we are proposing to list four plant species, *Cyanea marksii, Cyrtandra wagneri, Schiedea diffusa* ssp. *macraei,* and *Schiedea hawaiiensis,* that have been identified as the ''rarest of the rare'' Hawaiian plant species in need of immediate conservation under the multi-agency (Federal, State, and private) Plant Extinction Prevention Program (PEPP). The goal of PEPP is to prevent the extinction of plant species that have fewer than 50 individuals remaining in the wild on the islands of Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii (PEPP 2012, in litt.). We have determined that these four plant species warrant listing under the Act for the reasons discussed in the Summary of Factors Affecting the 15 Species Proposed for Listing section (below). Because these 4 plant species occur within 4 of the ecosystems identified in this proposed rule, and share common threats with the other 11 species proposed for listing under the Act, we have included them in this proposed rule to provide them with protection under the Act in an expeditious manner.

We are also proposing to list four other plant species (*Bidens hillebrandiana* ssp. *hillebrandiana, Cyrtandra nanawaleensis, Pittosporum hawaiiense,* and *Pritchardia lanigera*) that occur on Hawaii Island. We have

determined that these four Hawaii Island plant species warrant listing under the Act for the reasons discussed in the Summary of Factors Affecting the 15 Species Proposed for Listing section (below). Because these 4 plant species occur within 7 of the ecosystems identified in this proposed rule, and share common threats with the other 11 species proposed for listing under the Act, we have included them in this proposed rule to provide them with protection under the Act in an expeditious manner.

We are proposing critical habitat for two endangered plant species, *Mezoneuron kavaiense* (currently listed as *Mezoneuron kavaiense* but listed in error as *Caesalpinia kavaiense* in 50 CFR 17.12, see taxonomic change discussion below) (51 FR 24672; July 8, 1986) and *Isodendrion pyrifolium* (59 FR 10305, March 4, 1994; 68 FR 39624, July 2, 2003) for which critical habitat has not been previously designated on the island of Hawaii. We are also proposing critical habitat for *Bidens microthia* ssp. *ctenophylla,* a candidate species proposed for listing in this rule (76 FR 66370; October 26, 2011).

Proposed Taxonomic Change Since Listing for One Plant Species

We listed *Mezoneuron kavaiense* as an endangered species in 1986 (51 FR 24672; July 8, 1986), based on the taxonomic treatment of Hillebrand (1888, pp. 110–111). Following the reduction of *Mezoneuron* to *Caesalpinia* by Hattink (1974, p. 5), Geesink *et al.* (1990, pp. 646–647) changed the name to *Caesalpinia kavaiensis.* In 1989, the List of Endangered and Threatened Plants was revised to identify the listed entity as *Caesalpinia kavaiense.* Recent phylogenetic studies support separation of *Mezoneuron* from *Caesalpinia* (Bruneau *et al.* 2008, p. 710). The recognized scientific name for this species is *Mezoneuron kavaiense* (Wagner *et al.* 2012, p. 37). The range of the species between the time of listing and now has not changed. Therefore, we propose to recognize the listed species as *Mezoneuron kavaiense.*

Critical Habitat Unit Map Corrections

Critical habitat was designated for *Cyanea shipmanii, Phyllostegia racemosa, Phyllostegia velutina,* and *Plantago hawaiensis* in 2003 (68 FR 39624; July 2, 2003). In this proposed rule, we are correcting critical habitat unit maps published in 50 CFR 17.99(k)(1) for these four species to accurately reflect their designated critical habitat units. We are amending 50 CFR 17.99(k)(1) by removing four maps (Map 97, Unit 30—*Cyanea stictophylla*—d; Map 100, Unit 30—*Phyllostegia hawaiiensis*—c; Map 101, Unit 30—*Phyllostegia racemosa*—c; and Map 102, Unit 30—*Phyllostegia velutina*—b) that are either a duplicate of another unit map or labeled with the incorrect species name. We are replacing these four maps, using the same map numbers, with correctly labeled maps that accurately represent the geographic location of each species' critical habitat unit.

An Ecosystem-Based Approach to Listing 15 Species on Hawaii Island

On the island of Hawaii, as on most of the Hawaiian Islands, native species that occur in the same habitat types (ecosystems) depend on many of the same biological features and the successful functioning of that ecosystem to survive. We have therefore organized the species addressed in this proposed rule by common ecosystem. Although the listing determination for each species is analyzed separately, we have organized the individual analysis for each species within the context of the broader ecosystem in which it occurs to avoid redundancy. In addition, native species that share ecosystems often face a suite of common factors that may be a threat to them, and ameliorating or eliminating these threats for each individual species often requires the exact same management actions in the exact same areas. Effective management of these threats often requires implementation of conservation actions at the ecosystem scale to enhance or restore critical ecological processes and provide for long-term viability of those species in their native environment. Thus, by taking this approach, we hope not only to organize this proposed rule efficiently, but also to more effectively focus conservation management efforts on the common threats that occur across these ecosystems. Those efforts would facilitate restoration of ecosystem functionality for the recovery of each species, and provide conservation benefits for associated native species, thereby potentially precluding the need to list other species under the Act that occur in these shared ecosystems. In addition, this approach is in accord with the primary stated purpose of the Act (see section 2(b)): ''to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved.''

We propose to list the plants *Bidens hillebrandiana* ssp. *hillebrandiana, B. micrantha* ssp. *ctenophylla, Cyanea marksii, Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei, Schidea hawaiiensis,* and *Stenogyne cranwelliae;* and the animals *Drosophila digressa* and *Vetericaris chaceorum,* from Hawaii Island as endangered species. These 15 species (13 plants, 1 anchialine pool shrimp, and 1 picture-wing fly) are found in 10 ecosystem types: anchialine pool, coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff (Table 2).

TABLE 2—SPECIES PROPOSED FOR LISTING ON HAWAII ISLAND AND THE ECOSYSTEMS UPON WHICH THEY DEPEND

Ecosystem	Species	
	Plants	Animals
Anchialine Pool		*Vetericaris chaceorum.*
Coastal	*Bidens hillebrandiana* ssp. *hillebrandiana*	
Lowland Dry	*Bidens micrantha* ssp. *ctenophylla*	
Lowland Mesic	*Pittosporum hawaiiense*	*Drosophila digressa.*
	Pritchardia lanigera	
Lowland Wet	*Cyanea marksii*	
	Cyanea tritomantha	
	Cyrtandra nanawaleensis	
	Cyrtandra wagneri	
	Phyllostegia floribunda	
	Platydesma remyi	
	Pritchardia lanigera	
Montane Dry	*Schiedea hawaiiensis*	

TABLE 2—SPECIES PROPOSED FOR LISTING ON HAWAII ISLAND AND THE ECOSYSTEMS UPON WHICH THEY DEPEND—Continued

Ecosystem	Species	
	Plants	Animals
Montane Mesic	*Phyllostegia floribunda* *Pittosporum hawaiiense*	*Drosophila digressa.*
Montane Wet	*Cyanea marksii* *Cyanea tritomantha* *Phyllostegia floribunda* *Pittosporum hawaiiense* *Platydesma remyi* *Pritchardia lanigera* *Schiedea diffusa* ssp.*macraei* *Stenogyne cranwelliae*	*Drosophila digressa.*
Dry Cliff	*Bidens hillebrandiana* ssp. *hillebrandiana*	
Wet Cliff	*Cyanea tritomantha* *Pritchardia lanigera* *Stenogyne cranwelliae*	

For each species, we identified and evaluated those factors that threaten the species and that may be common to all of the species at the ecosystem level. For example, the degradation of habitat by nonnative ungulates is considered a threat to 14 of the 15 species proposed for listing, and is likely a threat to many, if not most or all, of the native species within a given ecosystem. We consider such a threat factor to be an ''ecosystem-level threat,'' as each individual species within that ecosystem faces a threat that is essentially identical in terms of the nature of the impact, its severity, its timing, and its scope. Beyond ecosystem-level threats, we further identified and evaluated threat factors that may be unique to certain species, but do not apply to all species under consideration within the same ecosystem. For example, the threat of predation by nonnative wasps is unique to the picture-wing fly in this proposed rule, and is not applicable to any of the other species proposed for listing. We have identified such threat factors, which apply only to certain species within the ecosystems addressed here, as ''species-specific threats.''

An Ecosystem-Based Approach to Determining Primary Constituent Elements of Critical Habitat

Under section 4(a)(3)(A) of the Act, we are required to designate critical habitat to the maximum extent prudent and determinable concurrently with the publication of a final determination that a species is an endangered or threatened species. We are proposing to designate critical habitat concurrently with listing for the plant *Bidens micrantha* ssp. *ctenophylla,* and for two previously listed plant species: *Isodendrion pyrifolium,* which was listed as an endangered species on March 4, 1994 (59 FR 10305), and *Mezoneuron kavaiense,* which was listed as an endangered species on July 8, 1986 (51 FR 24672). These two species are included in this proposed rule because they share proposed occupied and unoccupied critical habitat with *Bidens micrantha* ssp. *ctenophylla.*

In this proposed rule, we propose to designate critical habitat for three species in seven multiple-species critical habitat units. Although critical habitat is identified for each species individually, we have found that the conservation of each depends, at least in part, on the successful functioning of the physical or biological features of the commonly shared ecosystem. Each critical habitat unit identified in this proposed rule contains the physical or biological features essential to the conservation of those individual species that occupy that particular unit at the time of listing, or contains areas essential for the conservation of those species identified that do not presently occupy that particular unit. Where the unit is not occupied by a particular species, we believe it is still essential for the conservation of that species because the designation allows for the expansion of its range and reintroduction of individuals into areas where it occurred historically, and provides area for recovery in the case of stochastic events that otherwise hold the potential to eliminate the species from the one or more locations where it is presently found. Under current conditions, many of these species are so rare in the wild that they are at high risk of extirpation or even extinction from various stochastic events, such as hurricanes or landslides. Therefore, building up resilience and redundancy in these species through the establishment of multiple robust populations is a key component of recovery.

Each of the areas proposed for designation represents critical habitat for multiple species, based upon their shared habitat requirements (*i.e.,* physical or biological features) essential for their conservation. The identification of critical habitat also takes into account any species-specific conservation needs as appropriate.

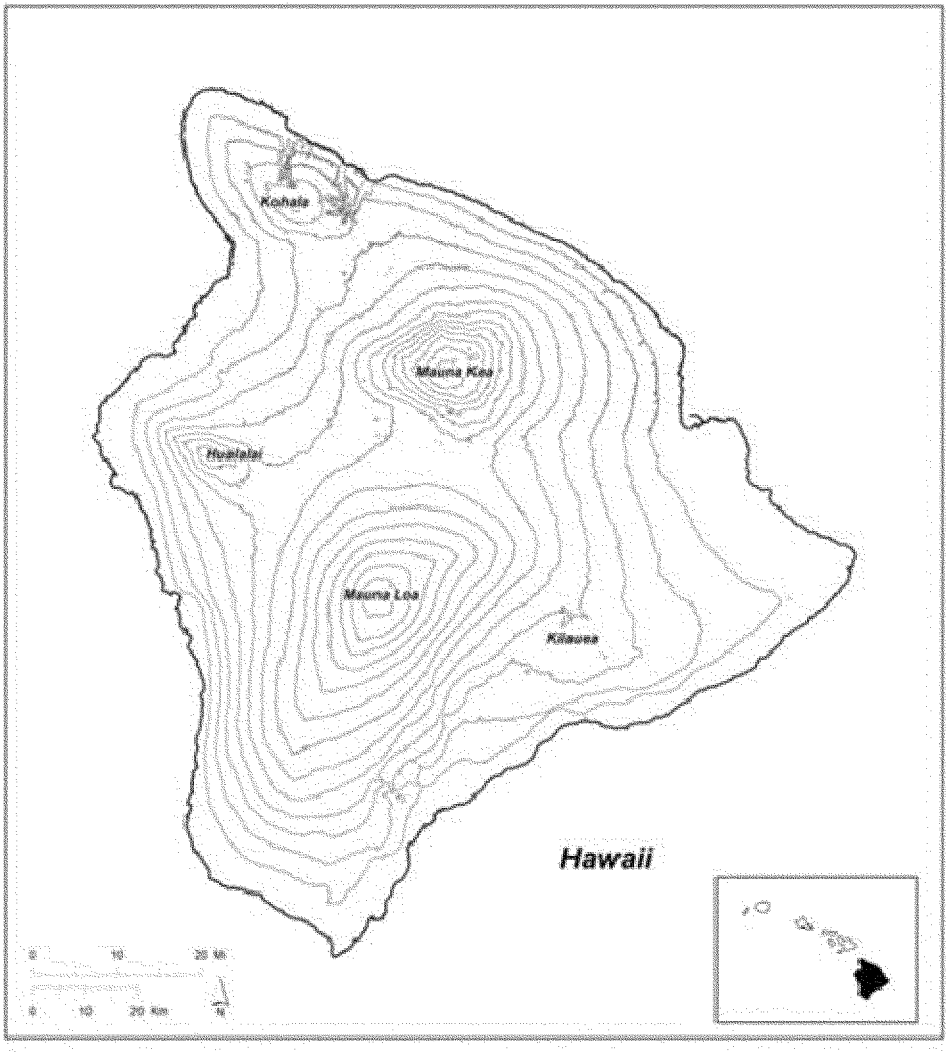
The proposed species *Bidens micrantha* ssp. *ctenophylla,* and the listed species *Isodendrion pyrifolium* and *Mezoneuron kavaiense* co-occur in the same lowland dry ecosystem on the island of Hawaii. These three species (*Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense*) share many of the same physical or biological features (*e.g.,* elevation, annual rainfall, substrate, associated native plant genera), as well as the same threats from development, fire, and nonnative ungulates and plants. However, for the remaining 14 species proposed for listing in this rule, we do not have the analysis necessary to refine the identification of the physical and biological features and delineate the specific areas that contain those features in the appropriate arrangement and quantity or the specific unoccupied areas essential to the species' conservation. As a result, we find that, for the remaining 14 species that we are proposing to list in this rule, the designation of critical habitat is not determinable at this time.

The Island of Hawaii

The island of Hawaii, located southeast of the islands of Maui and Kahoolawe, is the largest, highest, and youngest island of the Hawaiian archipelago (Figure 1). At 4,038 square

(sq) miles (mi) (10,458 sq kilometers (km)) in area, it comprises approximately two-thirds of the land area of the State of Hawaii, giving rise to its common name, the ''Big Island.'' Five large shield volcanoes make up the island of Hawaii: Mauna Kea at 13,796 feet (ft) (4,205 meters (m)) and Kohala at 5,480 ft (1,670 m) are both extinct volcanoes (volcanoes that are not expected to erupt again); Hualalai at 8,271 ft (2,521 m) is dormant (an active volcano that is not erupting, but expected to erupt again); and Mauna Loa at 13,677 ft (4,169 m) and Kilauea at 4,093 ft (1,248 m) are both active (volcanoes that are currently erupting or showing signs of unrest, such as significant new gas emission) (McDonald *et al.* 1990, pp. 345–379; 59 FR 10305, March 4, 1994; USGS 2012, pp. 1–2). Hawaii Island, with its greater mass and higher elevations, has more distinctive climatic zones and ecosystems than can be found elsewhere in the State (Juvik and Juvik 1998, p. 22). The highest and lowest recorded temperatures in the State occur on Hawaii Island (USFWS 1996, p. 6; Wagner *et al.* 1999a, p. 38).

Figure 1. Map of Hawaii Island



The island of Hawaii lies within the trade wind belt. Moisture derived from the Pacific Ocean is carried to the island by north-easterly trade winds. Heavy rains fall when the moisture in clouds makes contact with windward (the direction upwind from the point of reference, usually the more wet side of an island) mountain slopes (Wagner *et al.* 1999a, pp. 38–42). Considerable moisture reaches the leeward (the course in which the wind is blowing, typically the dryer side of an island) slopes of the saddle area between Mauna Loa and Mauna Kea, but dries out rapidly as elevation increases. This orographic (associated with or induced by the presence of mountains) effect reaches an elevation of about 2,000 to 3,000 m (6,500 to 9,850 ft) and tends to go around rather than over the high mountains. Thus, in the leeward saddle area, and high-elevation areas of Mauna Kea and Mauna Loa, dry or arid conditions predominate (USFWS 1996, p. 6; Mitchell *et al.* 2005a, pp. 6–71).

A rain shadow effect, created by Mauna Kea and Mauna Loa, on the leeward side of the island prevents the Kona (west side of the island) coast from receiving precipitation from the predominantly northeasterly trade winds (Wagner *et al.* 1999a, pp. 36–44). However, convection-driven onshore breezes create upslope showers most afternoons, resulting in greater than expected annual rainfall (50 to more than 100 inches (in) (1,270 to more than 2,540 millimeters (m)), which supports

a broad band of mesic forest on portions of leeward Hawaii (Mitchell *et al.* 2005a, pp. 6–71–6–91). Another major source of rainfall is provided by winter (Kona) storms, which develop south of the island, and impact the island when trade winds subside during the winter months. Kawaihae, in south Kohala (on the northwest side of the island), is effectively cut off from the northeasterly tradewinds by the Kohala Mountains, and from southerly and southwesterly winds of winter storms by Mauna Loa and Hualalai. It is the driest place in the main (Hawaii, Kauai, Kahoolawe, Lanai, Molokai, Maui, Niihau, and Oahu) Hawaiian Islands, receiving only about 8 in (200 mm) of rain per year (Wagner *et al.* 1999a, p. 39).

Due to its relatively young age (less than 1 million years old), the island of Hawaii is represented by fewer soil types than the older main Hawaiian Islands. Sizable areas of lava, cinder, and rubble occur in the saddle between Mauna Kea and Mauna Loa, and on recent lava flows originating from Hualalai, Mauna Loa, and Kilauea (Juvik and Juvik 1998, pp. 44–46; Mitchell *et al.* 2005a, pp. 6–71–6–72). Other soil types include: histosols, which are characterized by a thin, well-drained, organic layer and occur on younger lava flows common in the Hilo and Kau areas; andisols, which occur on substrates older than 3,000 years, are characterized by the ability to take up large amounts of phosphorous and are common on the east flank of Mauna Kea and above Hilo; aridosols, which are characterized by horizons with accumulations of carbonates, gypsum, or sodium chloride, and are found in the dry soils of deserts or the dry leeward sides of the island; and mollisols, which are characterized by a distinct dark-colored surface horizon enriched with organic matter, and are found under the grasslands on the dry leeward areas of the island (Gavenda *et al.* 1998, p. 94).

The vegetation on the island of Hawaii continues to experience extreme alterations due to ongoing volcanic activity, past and present land use, and other activities. Land with rich soils was altered by the early Hawaiians and, more recently, converted to agricultural use in the production of sugar, diversified agriculture, and pasture for cattle (*Bos taurus*) ranching. For example, large areas on the eastern slopes of the Kohala Mountains, Mauna Kea, and Mauna Loa were maintained in sugarcane production until the late 1960s (Juvik and Juvik 1998, p. 22). Intentional and inadvertent introduction of alien plant and animal species has also contributed to the reduction in range of native vegetation on the island of Hawaii (throughout this rule, the terms ''alien,'' ''feral,'' ''nonnative,'' and ''introduced'' all refer to species that are not naturally native to the Hawaiian Islands). Currently, most of the native vegetation on the island persists on upper elevation slopes, valleys, and ridges; steep slopes; precipitous cliffs; valley headwalls; and other regions where unsuitable topography has prevented urbanization and agricultural development, or where inaccessibility has limited encroachment by nonnative plant and animal species.

Hawaii Island Ecosystems

There are 12 different ecosystems (anchialine pool, coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, subalpine, alpine, dry cliff, and wet cliff) recognized on the island of Hawaii. The 15 species proposed for listing occur in 10 of these 12 ecosystems (none of the 15 species are reported in subalpine and alpine ecosystems). The lowland dry ecosystem supports the three species for which critical habitat is proposed. The 10 Hawaii Island ecosystems that support the 15 proposed species are described in the following section; see Table 2 (above) for a list of the species that occur in each ecosystem type.

Anchialine Pools

The anchialine pool ecosystem has been reported from Oahu, Molokai, Maui, Kahoolawe, and Hawaii Island. Anchialine pools are land-locked bodies of water that have indirect underground connections to the sea, contain varying levels of salinity, and show tidal fluctuations in water level. Because all anchialine pools occur within coastal areas, they are technically a part of the coastal ecosystem (see below) with many of the same applicable and overlapping habitat threats. However, in this proposal, we are addressing this unique ecosystem distinctly. Over 80 percent of the State's anchialine pools are found on the island of Hawaii, with a total of approximately 600 to 650 pools distributed over 130 sites along all but the island's northernmost and steeper northeastern shorelines. Characteristic animal species include crustaceans (*e.g.,* shrimps, prawns, amphipods, isopods, etc.), several fish species, molluscs, and other invertebrates adapted to the pools' surface and subterranean habitats (The Nature Conservancy (TNC) 2009, pp. 1–3). Generally, vegetation within the pools consists of various types of algal forms (blue-green, green, red, and golden-brown). The majority of Hawaii's anchialine pools occur in bare or sparsely vegetated lava fields, although some pools occur in areas with various groundcover, shrub, and tree species (Chai 1989, pp. 2–24; Brock 2004, p. 35). The anchialine pool shrimp, *Vetericaris chaceorum,* which is proposed for listing as an endangered species in this rule, occurs in this ecosystem (Kensley and Williams 1986, pp. 417–437).

Coastal

The coastal ecosystem is found on all of the main Hawaiian Islands, with the highest native species diversity occurring in the least populated coastal areas of Kauai, Oahu, Molokai, Maui, Kahoolawe, Hawaii Island, and their associated islets. On Hawaii Island, the coastal ecosystem includes mixed herblands, shrublands, and grasslands, from sea level to 1,000 ft (300 m) in elevation, generally within a narrow zone above the influence of waves to within 330 ft (100 m) inland, sometimes extending farther inland if strong prevailing onshore winds drive sea spray and sand dunes into the lowland zone (TNC 2006a, pp. 1–3). The coastal ecosystem is typically dry, with annual rainfall of less than 20 in (50 cm); however, windward rainfall may be high enough (up to 40 in (100 centimeters (cm)) to support mesic-associated and sometimes wet-associated vegetation (Gagne and Cuddihy 1999, pp. 54–66). Biological diversity is low to moderate in this ecosystem, but may include some specialized plants and animals such as nesting seabirds and the endangered plant *Sesbania tomentosa* (ohai) (TNC 2006a, pp. 1–3). The plant *Bidens hillebrandiana* ssp. *hillebrandiana,* which is proposed for listing as an endangered species in this rule, occurs in this ecosystem on Hawaii Island (Hawaii Biodiversity and Mapping Program Database (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; HBMP 2010a)).

Lowland Dry

The lowland dry ecosystem includes shrublands and forests generally below 3,300 ft (1,000 m) elevation that receive less than 50 in (130 cm) annual rainfall, or are in otherwise prevailingly dry substrate conditions that range from weathered reddish silty loams to stony clay soils, rocky ledges with very shallow soil, or relatively recent little-weathered lava (Gagne and Cuddihy 1999, p. 67). Areas consisting of predominantly native species in the lowland dry ecosystem are now rare; however, this ecosystem is found on the islands of Kauai, Oahu, Molokai, Lanai, Maui, Kahoolawe and Hawaii, and is

best represented on the leeward sides of the islands (Gagne and Cuddihy 1999, p. 67). On leeward Hawaii Island, this ecosystem occurs on the northwest flank of Hualalai in north Kona and on Mauna Loa in south Kona, but also occurs on the eastern Hawaii Island in Puna and Kau (within and adjacent to Hawaii Volcanoes National Park (HVNP)) (Gagne and Cuddihy 1999, p. 67; TNC 2006b, pp. 1–2). Overall native biological diversity is low to moderate in this ecosystem; however, tree species exhibit a higher rate of diversity and endemism (Pau *et al.* 2009, p. 3,167). The lowland dry ecosystem includes specialized animals and plants such as the Hawaiian owl or pueo (*Asio flammeus sandwichensis*) and *Santalum ellipticum* (iliahialoe or coast sandalwood) (Gagne and Cuddihy 1999, pp. 45–114; TNC 2006b, pp. 1–2). The plant *Bidens micrantha* ssp. *ctenophylla,* which is proposed for listing as an endangered species in this rule, occurs in this ecosystem on Hawaii Island (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; HBMP 2010b).

Lowland Mesic

The lowland mesic ecosystem includes a variety of grasslands, shrublands, and forests, generally below 3,300 ft (1,000 m) elevation, that receive between 50 and 75 in (130 and 190 cm) annual rainfall (TNC 2006c, pp. 1–2). In the Hawaiian Islands, this ecosystem is found on Oahu, Kauai, Molokai, Lanai, Maui, and Hawaii, on both windward and leeward sides of the islands. On Hawaii Island, this ecosystem is often reduced to remnant occurrences, but can be found in north Kohala, on the southwest and southeast flanks of Mauna Loa and Kilauea (Gagne and Cuddihy 1999, p. 75; TNC 2006c, pp. 1–2). Native biological diversity is high in this system (TNC 2006c, pp. 1–2). The plants, *Pittosporum hawaiiense* and *Pritchardia lanigera,* and the picture-wing fly *Drosophila digressa,* which are proposed for listing as endangered species in this rule, occur in this ecosystem on Hawaii Island (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; Benitez *et al.* 2008, p. 58; HBMP 2010c; HBMP 2010d).

Lowland Wet

The lowland wet ecosystem is generally found below 3,300 ft (1,000 m) elevation on the windward sides of the main Hawaiian Islands, except Niihau and Kahoolawe (Gagne and Cuddihy 1999, p. 85; TNC 2006d, pp. 1–2). These areas include a variety of wet grasslands, shrublands, and forests that receive greater than 75 in (190 cm) annual precipitation, or are in otherwise wet substrate conditions (TNC 2006d, pp. 1–2). On the island of Hawaii, this system is best developed in north Kohala, on the lower windward flanks of Mauna Kea and Mauna Loa, as well as leeward areas benefiting from convection-driven upslope showers on leeward Mauna Loa and Hualalai (TNC 2006d, pp. 1–2). Native biological diversity is high in this system (TNC 2006d, pp. 1–2). The plants *Cyanea marksii, Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Phyllostegia floribunda, Platydesma remyi,* and *Pritchardia lanigera,* which are proposed for listing as endangered species in this rule, occur in this ecosystem on Hawaii Island (Lorence and Perlman 2007, pp. 357–361; TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; HBMP 2010c; HBMP 2010e; HBMP 2010f; HBMP 2010g; HBMP 2010h; HBMP 2010i).

Montane Dry

The montane dry ecosystem includes grasslands, shrublands, and forests at elevations between 3,300 and 6,600 ft (1,000 and 2,000 m), that receive less than 50 in (130 cm) of annual precipitation, or are in otherwise dry substrate conditions (TNC 2006e, pp. 1–2). In the Hawaiian Islands, this ecosystem is found on the islands of Maui and Hawaii (Gagne and Cuddihy 1999, pp. 93–97). On Hawaii Island, this ecosystem is best represented on the upper slopes of Hualalai and the Mauna Kea-Mauna Loa saddle area, and includes specialized animals and plants such as the elepaio (*Chasiempis sandwichensis*) and *Isodendrion hosakae* (aupaka) (Gagne and Cuddihy 1999, pp. 45–114; TNC 2006e, pp. 1–2). The plant *Schiedea hawaiiensis,* proposed for listing as an endangered species in this rule, is found in this ecosystem on Hawaii Island (U.S. Army Garrison 2006, pp. 1–55).

Montane Mesic

The montane mesic ecosystem is composed of natural communities (forests and shrublands) found at elevations between 3,300 and 6,600 ft (1,000 and 2,000 m), in areas where annual precipitation is between 50 and 75 in (130 and 190 cm), or areas in otherwise mesic substrate conditions (TNC 2006f, pp. 1–2). This system is found on Kauai, Molokai, Maui, and Hawaii Island (Gagne and Cuddihy 1999, pp. 97–99; TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished). Native biological diversity is moderate (Gagne and Cuddihy 1999, pp. 98–99; TNC 2006f, pp. 1–2). On Hawaii Island, specialized plants and animals such as io or Hawaiian hawk (*Buteo solitarius*) and *Pittosporum hosmeri* (hoawa) occur in the montane mesic ecosystem. The plants *Phyllostegia floribunda* and *Pittosporum hawaiiense,* and the picture-wing fly *Drosophila digressa,* which are proposed for listing as endangered species in this rule, are found in this ecosystem on Hawaii Island (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; Benitez *et al.* 2008, p. 58; HBMP 2010d; HBMP 2010h).

Montane Wet

The montane wet ecosystem is composed of natural communities (grasslands, shrublands, forests, and bogs) found at elevations between 3,300 and 6,600 ft (1,000 and 2,000 m), in areas where annual precipitation is greater than 75 in (191 cm) (TNC 2006g, pp. 1–2). This system is found on all of the main Hawaiian Islands except Niihau and Kahoolawe, and only the islands of Molokai, Maui, and Hawaii have areas above 4,020 ft (1,225 m) (TNC 2006g, pp. 1–2). On Hawaii Island, the montane wet ecosystem occurs in the Kohala Mountains, in the east flank of Mauna Kea, in the Kau Forest Reserve (FR) on windward Mauna Loa, and on the upper slopes of leeward Mauna Loa (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished). Native biological diversity is moderate to high (TNC 2006g, pp. 1–2). The plants *Cyanea marksii, C. tritomantha, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei,* and *Stenogyne cranwelliae,* and the picture-wing fly *Drosophila digressa,* which are proposed for listing as endangered species in this rule, occur in this ecosystem on Hawaii Island (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; Benitez *et al.* 2008, p. 58; HBMP 2010c; HBMP 2010d; HBMP 2010e; HBMP 2010f; HBMP 2010h; HBMP 2010i; HBMP 2010j; HBMP 2010k).

Dry Cliff

The dry cliff ecosystem is composed of vegetation communities occupying steep slopes (greater than 65 degrees) in areas that receive less than 75 in (190 cm) of rainfall annually, or that are in otherwise dry substrate conditions (TNC 2006h, pp. 1–2). This ecosystem is found on all of the main Hawaiian Islands except Niihau, and is best represented along portions of the eroded cliffs of east Kohala on Hawaii Island (TNC 2006h, pp. 1–2). A variety of

shrublands occur within this ecosystem (TNC 2006h, pp. 1–2). Native biological diversity is low to moderate (TNC 2006h, pp. 1–2). The plant *Bidens hillebrandiana* ssp. *hillebrandiana,* which is proposed for listing as an endangered species in this rule, occurs in this ecosystem on Hawaii Island (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; HBMP 2010a).

Wet Cliff

The wet cliff ecosystem is generally composed of shrublands on near-vertical slopes (greater than 65 degrees) in areas that receive more than 75 in (190 cm) of annual precipitation, or that are in otherwise wet substrate conditions (TNC 2006i, pp. 1–2). This system is found on the islands of Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii. On the island of Hawaii, this system is found in windward Kohala valleys and on the southeastern slope of Mauna Loa (TNC 2006i, pp. 1–2). Native biological diversity is low to moderate (TNC 2006i, pp. 1–2). The plants *Cyanea tritomantha, Pritchardia lanigera,* and *Stenogyne cranwelliae,* which are proposed for listing as endangered species in this rule, are found in this ecosystem on Hawaii Island (TNC 2007–*Ecosystem Database of ArcMap Shapefiles,* unpublished; HBMP 2010d; HBMP 2010f; HBMP 2010k).

Description of the 15 Species Proposed for Listing

Below is a brief description of each of the 15 species proposed for listing, presented in alphabetical order by genus. Plants are presented first, followed by animals.

Plants

In order to avoid confusion regarding the number of locations of each species (a location does not necessarily represent a viable population), we use the word ''occurrence'' instead of ''population.'' Each occurrence is composed only of wild (*i.e.,* not propagated and outplanted) individuals.

Bidens hillebrandiana ssp. *hillebrandiana* (kookoolau), a perennial herb in the sunflower family (Asteraceae), occurs only on the island of Hawaii (Ganders and Nagata 1999, pp. 275–276). Historically, *B. hillebrandiana* ssp. *hillebrandiana* was known from two locations along the windward Kohala coastline, in the coastal and dry cliff ecosystems, often along rocks just above the ocean (Degener and Wiebke 1926, in litt.; Flynn. 1988, in litt.). Currently, there are two known occurrences of *B. hillebrandiana* ssp. *hillebrandiana* totaling 40 or fewer individuals along the windward Kohala coast, in the coastal and dry cliff ecosystems. There are 30 individuals on the Pololu seacliffs, and 5 to 10 individuals on the seacliffs between Pololu and Honokane Nui (Perlman 1998, in litt.; Perlman 2006, in litt.). Biologists speculate that this species may total as many as 100 individuals with further surveys of potential habitat along the Kohala coast (Mitchell *et al.* 2005b; PEPP 2006, p. 3).

Bidens micrantha ssp. *ctenophylla* (kookoolau), a perennial herb in the sunflower family (Asteraceae), occurs only on the island of Hawaii (Ganders and Nagata 1999, pp. 271, 273). Historically, *B. micrantha* ssp. *ctenophylla* was known from the north Kona district, in the lowland dry ecosystem (HBMP 2010b). Currently, this subspecies is restricted to an area of less than 10 sq mi (26 sq km) on the leeward slopes of Hualalai volcano, in the lowland dry ecosystem in 6 occurrences totaling fewer than 1,000 individuals. The largest occurrence is found off Hina Lani Road with over 475 individuals widely dispersed throughout the area (Zimpfer 2011, in litt.). The occurrence at Kealakehe was reported to have been abundant and common in 1992, but by 2010 had declined to low numbers (Whister 2007, pp. 1–18; Bio 2008, in litt.; HBMP 2010b; Whister 2008, pp. 1–11). In addition, there are three individuals in Kaloko–Honokohau National Historical Park (NHP) (Beavers 2010, in litt.), and three occurrences are found within close proximity to each other to the northeast: five individuals in an exclosure at Puuwaawaa Wildlife Sanctuary (HBMP 2010b); a few scattered individuals at Kaupulehu; and a few individuals on private land at Palani Ranch (Whistler 2007, pp. 1–18; Whistler 2008, pp. 1–11). *Bidens micrantha* ssp. *ctenophylla* has also been outplanted within fenced exclosures at Kaloko–Honokohau NHP (49 individuals), Koaia Tree Sanctuary (1 individual), and Puuwaawaa (5 individuals) (Boston 2008, in litt.; HBMP 2010b).

Cyanea marksii (haha), a shrub in the bellflower family (Campanulaceae), is found only on the island of Hawaii. Historically, *C. marksii* was known from the Kona district, in the lowland wet and montane wet ecosystems (Lammers 1999, p. 457; HBMP 2010e). Currently, there are 27 individuals distributed among 3 occurrences in south Kona, in the lowland wet and montane wet ecosystems (PEPP 2007, p. 61). There is an adult and 20 to 30 juveniles (each approximately 1 in (2.54 cm tall)) in a lava tube in the Kona unit of the Hakalau National Wildlife Refuge (NWR) (PEPP 2007, p. 61), one individual in a pit crater in the South Kona FR, and 25 individuals on private land in south Kona (PEPP 2007, p. 61; Bio 2011, pers. comm.). Fruit has been collected from the individuals on private land, and 11 plants have been successfully propagated at the Volcano Rare Plant Facility (VRPF) (PEPP 2007, p. 61; Bio 2011, pers. comm.).

Cyanea tritomantha (aku), a palmlike shrub in the bellflower family (Campanulaceae), is known only from the island of Hawaii (Pratt and Abbott 1997, p. 13; Lammers 2004, p. 89). Historically, this species was known from the windward slopes of Mauna Kea, Mauna Loa, Kilauea, and the Kohala Mountains, in the lowland wet, montane wet, and wet cliff ecosystems (Pratt and Abbott 1997, p. 13). Currently, there are 16 occurrences of *Cyanea tritomantha* totaling fewer than 400 individuals in the lowland wet, montane wet, and wet cliff ecosystems: 10 occurrences (totaling fewer than 240 individuals) in the Kohala Mountains (Perlman 1993, in litt.; Perlman 1995a, in litt.; Perlman and Wood 1996, pp. 1–14; HBMP 2010f; PEPP 2010, p. 60); 2 occurrences (totaling fewer than 75 individuals) in the Laupahoehoe Natural Area Reserve (NAR) (HBMP 2010f; Bio 2011, pers. comm.); 1 occurrence (20 adults and 30 juveniles) at Puu Makaala NAR (Perlman and Bio 2008, in litt.; Agorastos 2010, in litt.; HBMP 2010f; Bio 2011, pers. comm.); 1 occurrence (a few scattered individuals) off Tom's Trail in the Upper Waiakea FR (Perlman and Bio 2008, in litt.); and 2 occurrences (totaling 11 individuals) in Olaa Tract in HVNP (Pratt 2007a, in litt.; Pratt 2008a, in litt). In 2003, over 75 individuals were outplanted in HVNP's Olaa Tract and Small Tract; however, by 2010, less than one third of these individuals remained (Pratt 2011a, in litt.). In addition, a few individuals have been outplanted at Puu Makaala NAR and Upper Waiakea FR (Hawaii Department of Land and Natural Resources (HDLNR) 2006; Belfield 2007, in litt.; Agorastos 2010, in litt.). *Cyanea tritomantha* produces few seeds, and their viability tends to be low (Moriyasu 2009, in litt.)

Cyrtandra nanawaleensis (haiwale), a shrub or small tree in the African violet family (Gesneriaceae), is known only from the island of Hawaii (Wagner and Herbst 2003, p. 29; Wagner *et al.* 2005a—*Flora of the Hawaiian Islands database*). Historically, *C. nanawaleensis* was known only from the Nanawale FR and the adjacent Malama Ki FR in the Puna district, in

the lowland wet ecosystem (St. John 1987, p. 500; Wagner *et al.* 1988, in litt.; HBMP 2010g; Pratt 2011b, in litt.). Currently, *C. nanawaleensis* is known from 4 occurrences with approximately 140 individuals in the lowland wet ecosystem: 2 occurrences in Malama Ki FR totaling 70 individuals (Lau 2011, pers. comm.); 1 occurrence in Keauohana FR (with 56 individuals) (Magnacca 2011a, in litt.); and 1 occurrence in the Halepuaa section of Nanawale FR (with 13 individuals) (Johansen 2012, in litt.; Kobsa 2012, in litt.). Conversion of areas within the Halepuaa section of Nanawale FR to papaya production over the past 25 years is thought to have contributed to the decline of the species in this area (Pratt 2011b, in litt.; Kobsa 2012, in litt.; Pratt 2012, in litt.). Biologists report that *C. nanawaleensis* is in decline throughout its already limited range (Bio 2011, pers. comm.; Kobsa 2012, in litt.).

Cyrtandra wagneri (haiwale), a shrub or small tree in the African violet family (Gesneriaceae), occurs only on the island of Hawaii (Lorence and Perlman 2007, p. 357). Historically, *C. wagneri* was known from a few individuals along the steep banks of the Kaiwilahilahi Stream in the Laupahoehoe NAR, in the lowland wet ecosystem (Perlman *et al.* 1998, in litt.). In 2002, there were 2 known occurrences totaling fewer than 175 individuals in the Laupahoehoe NAR: one occurrence (totaling 150 individuals (50 adults and 100 juveniles)) along the steep banks of the Kilau Stream (Lorence *et al.* 2002, in litt.; Perlman and Perry 2003, in litt.; Lorence and Perlman 2007, p. 359), and a second occurrence (with approximately 10 sterile individuals) along the slopes of the Kaiwilahilahi stream banks (Lorence and Perlman 2007, p. 359). Currently, there are no individuals remaining at Kaiwilahilahi Stream, and the individuals at Kilau Stream appear to be hybridizing with the endangered *Cyrtandra tintinnabula.* Biologists have identified only eight individuals at Kilau Stream that express the true phenotype of *Cyrtandra wagneri,* and only three of these individuals are reproducing successfully (PEPP 2010, p. 102; Bio 2011, pers. comm.).

Phyllostegia floribunda (NCN), a perennial herb in the mint family (Lamiaceae), is found only on the island of Hawaii (Wagner 1999, p. 268; Wagner *et al.* 1999b, p. 815). Historically, *P. floribunda* was reported in the lowland wet, montane mesic, and montane wet ecosystems at scattered sites along the slopes of the Kohala Mountains; southeast through Hamakua, Laupahoehoe NAR, Waiakea FR, and Upper Waiakea FR; and southward into Hilo, HVNP, and Puna. One report exists of the species occurring from north Kona and a few occurrences in south Kona (Cuddihy *et al.* 1982, in litt.; Wagner *et al.* 2005b—*Flora of the Hawaiian Islands database;* Perlman *et al.* 2008, in litt.; HBMP 2010h; Bishop Museum 2011—*Herbarium Database*). Currently, there are 12 known occurrences of *P. floribunda* totaling fewer than 100 individuals, in the lowland wet, montane mesic, and montane wet ecosystems (Bruegmann 1998, in litt.; Giffin 2009, in litt.; HBMP 2010h): 2 occurrences within HVNP, at Kamoamoa (1 individual) (HBMP 2010h) and near Napau Crater (4 individuals) (Pratt 2005, in litt.; Pratt 2007b, in litt.; HBMP 2010h); 1 occurrence behind the Volcano solid waste transfer station (10 to 50 individuals) (Flynn 1984, in litt.; Perlman and Wood 1993–*Hawaii Plant Conservation Maps database;* Pratt 2007b, in litt.; HBMP 2010h); 1 occurrence (with an unknown number individuals) in the Wao Kele O Puna NAR (HBMP 2010h); at least 1 occurrence each (with a few individuals each) in the Puu Makaala NAR, Waiakea FR, Upper Waiakea FR, and TNC's Kona Hema Preserve (PR) (Perry 2006, in litt.; Perlman 2007, in litt.; Giffin 2009, in litt.; PEPP 2008, pp. 106–107; Perlman *et al.* 2008, in litt.; Pratt 2008a, in litt.; Pratt 2008b, in litt.; Agorastos 2010, in litt.); 2 occurrences (each with an unknown number of individuals) from the South Kona FR; 1 occurrence (one individual) in the Kipahoehoe NAR; and, 1 occurrence (with an unknown number of individuals) in the Lapauhoehoe NAR (Moriyasu 2009, in litt.; HBMP 2010h; Agorastos 2010, in litt.). Since 2003, over 400 individuals have been outplanted at HVNP, Waiakea FR, Puu Makaala NAR, Honomalino in TNC's Kona Hema PR, and Kipahoehoe NAR (Bruegmann 2006, in litt.; HDLNR 2006, p. 38; Tangalin 2006, in litt.; Belfield 2007, in litt.; Pratt 2007b, in litt.; VRPF 2008, in litt.; VRPF 2010, in litt.; Bio 2008, in litt.; Agorastos 2010, in litt.). However, for reasons unknown, approximately 90 percent of the outplantings experience high seedling mortality (Pratt 2007b, in litt.; Van DeMark *et al.* 2010, pp. 24–43).

Pittosporum hawaiiense (hoawa, haawa), a small tree in the pittosporum family (Pittosporaceae), is known only from the island of Hawaii (Wagner *et al.* 1999c, p. 1,044). Historically, *P. hawaiiense* was known from the leeward side of the island, from the Kohala Mountains south to Kau, in the lowland mesic, montane mesic, and montane wet ecosystems (Wagner *et al.*1999c, p. 1,044). Currently, there are 14 known occurrences totaling fewer than 75 individuals, from HVNP to Puu O Umi NAR, and south Kona, in the lowland mesic, montane mesic, and montane wet ecosystems: 1 occurrence in Puu O Umi NAR (several scattered individuals) (Perlman 1995b, in litt.); 1 occurrence (with a least one individual) in TNC's Kona Hema PR (Oppenheimer *et al.* 1998, in litt.); 1 occurrence (with several individuals) at Kukuiopae (Perlman and Perry 2002, in litt.); 1 occurrence (with a few individuals) in the Manuka NAR (Perry 2011, in litt.); 8 occurrences (totaling fewer than 58 individuals) scattered within the Kahuku unit of HVNP; 1 occurrence in the Olaa FR (at least one individual), just adjacent to the Olaa Tract in HVNP; and 1 occurrence (with fewer than 6 individuals) at the Volcano solid waste transfer station (Wood and Perlman 1991, in litt.; McDaniel 2011a, in litt.; McDaniel 2011b, in litt.; Pratt 2011d, in litt.). Biologists have observed very low regeneration in these occurrences, which is believed to be caused, in part, by rat predation on the seeds (Bio 2011, pers. comm.).

Platydesma remyi (NCN), a shrub or shrubby tree in the rue family (Rutaceae), occurs only on the island of Hawaii (Stone *et al.* 1999, p. 1210; USFWS 2010, pp. 4-66–4-67, A–11, A–74). Historically, *P. remyi* was known from a few scattered individuals on the windward slopes of the Kohala Mountains and several small populations on the windward slopes of Mauna Kea, in the lowland wet and montane wet ecosystems (Stone *et al.* 1999, p. 1210; HBMP 2010i). Currently, *P. remyi* is known from 8 occurrences totaling fewer than 40 individuals, all of which are found in the Laupahoehoe NAR or in closely surrounding areas, in the lowland wet and montane wet ecosystems: along the banks of Kaiwilahilahi Stream in the Laupahoehoe NAR (unknown number of individuals) (Perlman and Perry 2001, in litt.; Bio 2008, in litt.; HBMP 2010i); near the Spencer Hunter Trail in the Laupahoehoe NAR (fewer than 17 individuals) (PEPP 2010, p. 102); the central part of the Laupahoehoe NAR (5 to 6 scattered individuals) (HBMP 2010i); near Kilau (1 to 3 individuals) and Pahale (1 to 3 individuals) Streams in Laupahoehoe NAR; southeastern region of Laupahoehoe NAR (1 individual); Hakalau unit of the Hakalau NWR (1 individual) (USFWS 2010, p. 4-74–4-75); and the Humuula region of the Hilo FR (2 individuals) (Bruegmann

1998, in litt.; Bio 2008, in litt.; PEPP 2008, p. 107; HBMP 2010i). According to field biologists, this species appears to be declining with no regeneration believed to be caused, in part, by rat predation on the seeds (Bio 2011, pers. comm.). In 2009, 29 individuals of *P. remyi* were outplanted in Laupahoehoe NAR (Bio 2008, in litt.). Their current status is unknown.

Pritchardia lanigera (loulu), a medium-sized tree in the palm family (Arecaceae), is found only on the island of Hawaii (Read and Hodel 1999, p. 1,371; Hodel 2007, pp. 10, 24–25). Historically, *P. lanigera* was known from the Kohala Mountains, Hamakua district, windward slopes of Mauna Kea, and southern slopes of Mauna Loa, in the lowland mesic, lowland wet, montane wet, and wet cliff ecosystems (Read and Hodel 1999, p. 1,371; HBMP 2010c). Currently, *P. lanigera* is known from 2 occurrences totaling fewer than 220 individuals scattered along the windward side of the Kohala Mountains, in the lowland mesic, lowland wet, montane wet, and wet cliff ecosystems. Approximately 100 to 200 individuals are scattered over 1 sq mi (3 sq km) in Waimanu Valley and surrounding areas (Wood 1995, in litt.; Perlman and Wood 1996, p. 6; Wood 1998, in litt.; Perlman *et al.* 2004, in litt.; HBMP 2010c). There are at least five individuals in the back rim of Alakahi Gulch in Waipio Valley (HBMP 2010c). According to field biologists, pollination rates appear to be low for this species, and the absence of seedlings and juveniles at known locations suggests that regeneration is not occurring believed to be caused, in part, by beetle and rat predation on the fruits and seeds (Bio 2011, pers. comm.).

Schiedea diffusa ssp. *macraei* (NCN), a perennial climbing herb in the pink family (Caryophyllaceae), is reported only from the island of Hawaii (Wagner *et al.* 2005c—*Flowering Plants of the Hawaiian Islands database;* Wagner *et al.* 2005d, p. 106). Historically, *S. diffusa* ssp. *macraei* was known from the Kohala Mountains, the windward slopes of Mauna Loa, and the Olaa Tract of HVNP, in the montane wet ecosystem (Perlman *et al.* 2001, in litt.; Wagner *et al.* 2005d, p. 106; HBMP 2010j). Currently, there is one individual of *S. diffusa* ssp. *macraei* on the slopes of Eke in the Kohala Mountains, in the montane wet ecosystem (Wagner *et al.* 2005d, p. 106; Bio 2011, pers. comm.).

Schiedea hawaiiensis (NCN), a perennial herb or subshrub in the pink family (Caryophyllaceae), is known only from the island of Hawaii (Wagner *et al.* 2005d, pp. 92–96). Historically, *S. hawaiiensis* was known from a single collection by Hillebrand (1888, p. 33) from the Waimea region, in the montane dry ecosystem (Wagner *et al.* 2005d, pp. 92–96). Currently, *S. hawaiiensis* is known from 25 to 40 individuals on the U.S. Army's Pohakuloa Training Area (PTA) in the montane dry ecosystem, in the saddle area between Moana Loa and Mauna Kea (Gon III and Tierney 1996 in Wagner *et al.* 2005d, p. 92; Wagner *et al.* 2005d, p. 92; Evans 2011, in litt.). In addition, there are over 150 individuals outplanted at PTA (Kipuka Alala and Kalawamauna), Puu Huluhulu, Puu Waawaa, and Kipuka Oweowe (Evans 2011, in litt.).

Stenogyne cranwelliae (NCN), a vine in the mint family (Lamiaceae), is known only from the island of Hawaii. Historically, *S. cranwelliae* was known from the Kohala Mountains, in the montane wet and wet cliff ecosystems (Weller and Sakai 1999, p. 837). Currently, there are 6 occurrences of *S. cranwelliae* totaling fewer than 160 individuals in the Kohala Mountains, in the montane wet and wet cliff ecosystems: roughly 1.5 sq mi (2.5 sq km) around the border between the Puu O Umi NAR and Kohala FR, near streams and bogs (ranging from 3 to 100 scattered individuals) (Perlman and Wood 1996, pp. 1–14; HBMP 2010k); Opaeloa, in the Puu O Umi NAR (3 individuals) (Perlman and Wood 1996, pp. 1–14; HBMP 2010k); Puukapu, in the Puu O Umi NAR (6-by 6-ft (2-by 2-m) ''patch'' of individuals) (HBMP 2010k); the rim of Kawainui Gulch (1 individual) (Perlman and Wood 1996, pp. 1–14; HBMP 2010k); along Kohakohau Stream, in the Puu O Umi NAR (a few individuals) (Perlman and Wood 1996, pp. 1–14; HBMP 2010k); and Waimanu Bog Unit in the Puu O Umi NAR (a ''patch'' of individuals) (Agorastos 2010, in litt.)

Animals

Drosophila digressa (picture-wing fly), a member of the family Drosophilidae, was described in 1968 by Hardy and Kaneshiro and is found only on the island of Hawaii (Hardy and Kaneshiro 1968, pp. 180–1882; Carson 1986, p. 3–9). This species is small, with adults ranging in size from 0.15 to 0.19 in (4.0 to 5.0 mm) in length. Adults are brownish yellow in color and have yellow-colored legs and hyaline (shiny-clear) wings with prominent brown spots. Breeding generally occurs year round, but egg laying and larval development increase following the rainy season as the availability of decaying matter, which picture-wing flies feed on, increases in response to heavy rains. In contrast to most continental Drosophilidae, many endemic Hawaiian species are highly host-plant-specific (Magnacca *et al.* 2008, p. 1). *Drosophila digressa* relies solely on the decaying stems of *Charpentiera* spp. for oviposition (to deposit or lay eggs) and larval substrate (Magnacca *et al.* 2008, pp. 11, 13). The larvae complete development in the decaying tissue before dropping to the soil to pupate (Montgomery 1975, pp. 65–103; Spieth 1986, p. 105). Pupae develop into adults in approximately 1 month, and adults sexually mature 1 month later. Adults live for 1 to 2 months. The adult flies are generalist microbivores (microbe eating) and feed upon a variety of decomposing plant material. *Drosophila digressa* occurs in elevations ranging from approximately 2,000 to 4,500 ft (610 to 1,370 m), in the lowland mesic, montane mesic, and montane wet ecosystems (Magnacca 2011a, pers. comm.). Historically, *Drosophila digressa* was known from five sites: Moanuiahea pit crater on Hualalai, Manuka FR, Kipuka 9 and Bird Park in HVNP, and Olaa FR (Montgomery 1975, p. 98; Magnacca 2006, pers. comm.; HBMP 2010d; Magnacca 2011b, in litt.). Currently, *D. digressa* is known from only two locations, one population in the Manuka NAR within the Manuka FR, in the lowland mesic and montane mesic ecosystems, and a second population in the Olaa FR in the montane wet ecosystem (Magnacca 2011b, in litt.). The current number of individuals at each of these locations is unknown (Magnacca 2011b, in litt.).

Vetericaris chaceorum (anchialine pool shrimp) is a member of the family Procarididae and is considered one of the most primitive shrimp species in the world (Kensley and Williams 1986, pp. 428–429). Known only from the island of Hawaii, the species is one of seven known species of hypogeal (underground) shrimp found in the Hawaiian Islands that occur in anchialine pools (Brock 2004, p. 6). Anchialine pool habitats can be distinguished from similar systems (*i.e.,* tidal pools) in that they are land-locked with no surface connections to water sources either saline or fresh, but have subterranean hydrologic connections where water flows through cracks and crevices, and yet remain tidally influenced (Holthuis 1973, p. 3; Stock 1986, p. 91). Anchialine habitats are ecologically distinct and unique, and while widely distributed throughout the world, they only occur in the United States in the Hawaiian Islands (Brock 2004, p. i, 2, and 12). In the Hawaiian Islands, there are estimated to be 600 to 700 anchialine pools, with the majority

occurring on the island of Hawaii (Brock 2004, p. i).

Relatively large in size for a hypogeal shrimp species, adult *Vetericaris chaceorum* measure approximately 2.0 in (5.0 cm) in total body length, excluding the primary antennae, which are approximately the same length as the adult's body length (Kensley and Williams 1986,
p. 419). The species lacks large chelapeds (claws) (Kensley and Williams 1986, p. 426), which are a key diagnostic characteristic of all other known shrimp species. *Vetericaris chaceorum* is largely devoid of pigment and lacks eyes, although eyestalks are present (Kensley and Williams 1986, p. 419).

Observations of *V. chaceorum* indicate the species is a strong swimmer and propels its body forward in an upright manner with its appendages held in a basket formation below the body. Forward movement is produced by a rhythmic movement of the thoracic and abdominal appendages, and during capture of some specimens, *V. chaceorum* escape tactics included only forward movement and a notable lack of tail flicking, which would allow backward movement and which is common to other shrimp species (Kensley and Williams 1986, p. 426). No response was observed when the species was exposed to light (Kensley and Williams 1986, p. 418).

The feeding habits of *V. chaceorum* are unknown, although Kensley and Williams (1986, p. 426) reported that the gut contents of a captured specimen included large quantities of an orange-colored oil and fragments of other crustaceans (including *Procaris hawaiana,* a co-occurring anchialine pool shrimp), indicating that the species may be carnivorous upon its associated anchialine pool shrimp species. In general, hypogeal shrimp occur within both the illuminated part of their anchialine pool habitat as well as within the cracks and crevices in the water table below the surface (Brock 2004,
p. 6), and relative abundance of some Hawaii species is directly tied to food abundance (Brock 2004, p. 10). Furthermore, studies indicate that the lighted environment of anchialine pools offers refugia of high benthic productivity, resulting in higher population levels for the shrimp compared to the surrounding interstitial spaces occupied by these species, albeit in lower numbers (Brock 2004, p. 10).

Although over 400 anchialine pool habitats have been surveyed on the island of Hawaii, *Vetericaris chaceorum* has to date only been documented from Lua O Palahemo, which is a submerged lava tube located on the southernmost point of Hawaii Island in an area known as Ka Lae (South Point) (Kensley and Williams 1986, pp. 417–418; Brock 2004, p. 2; HBMP 2010). Age estimates for Lua O Palahemo range from as young as 11,780 years to a maximum of age of 25,000 years based upon radio carbon data (Kensley and Williams 1986, pp. 417–418). Brock (2004, p. 18) states this lava tube is the second most important anchialine pool habitat in the State because of its unique connection to the ocean, the vertical size (*i.e.,* depth), and the presence of a total of five different species including *Halocaridina palahemo, Halocaridina rubra, Procaris hawaiiana, Calliasmata pholidota,* and *Vetericaris chaceorum.*

Lua O Palahemo itself is actually a naturally occurring opening (surface collapse) into a large lava tube below. The opening measures approximately 33 ft (10 m) in diameter and is directly exposed to sunlight. Unlike most anchialine pools in the Hawaiian Islands, which have depths less than 4.9 ft (1.5 m) (Brock 2004, p. 3), Lua O Palahemo's deep pool includes a deep shaft with vertical sides extending downward about 46 ft (14 m) into the lava tube below, which then splits off into two directions, both ending in blockages (Holthuis 1974, p.11; Kensley and Williams 1986, p. 418). The tube runs generally north and south, extending northward for 282 ft (86 m) and southward for 718 ft (219 m) to a depth of 108 ft (33 m) below sea level (Kensley and Williams 1986, p. 418).

We have information pertaining to three distinct survey efforts at Lua O Palahemo. The first survey occurred in 1972–1973 (Holthius 1973, pp. 10–12; 22; Maciolek and Brock 1974, pp. 1–2; 17; 50); a second survey in May 1985 (Kensley and Williams 1986, pp. 417–426; Bozanic 2004, p. 1); and a third survey in July 2010 (Wada 2012, pers. comm.). Descriptions of each survey follow and are considered relevant because each survey sheds light on the decline of habitat available to *Vetericaris chaceorum.*

Lua O Palahemo was first formally surveyed as anchialine pool habitat sometime between 1972–1973 (Maciolek and Brock 1974, pp. 1–2; 17). During this survey, which did not include SCUBA methods, the following physical characteristics and measurements of the pond were noted: salinity ranged between 18 to 22 parts per thousand (ppt); the pool depth was recorded as deep; the pool bottom was described as rocky with a large accumulation of sediment; and surrounding flora was noted as minimal, but included vines and succulents, grasses, and small trees or shrubs (Maciolek and Brock 1974, p. 50). According to Maciolek and Brock's (1974, pp. 17, 50) report, hypogeal shrimp species found at Lua O Palahemo at that time included *Procaris hawaiiana* (then, only the second known location), *Calliasmata pholidota, Antecaridina lauensis,* and *Halocaridina rubra.* Maciolek and Brock (1974, pp. 50) reported that Lua O Palahemo was inhabited by the greatest concentration of *H. rubra* ever observed up to that time period (1972–1973), and indeed, Holthius (1973, p. 22) reported that the density of *H. rubra* swimming in a swarm near the pool surface was sufficiently high enough to cause the water to appear blood red in color. Although neither scientific article written about this survey explicitly describes water clarity at Lua O Palahemo, both imply that the water was clear enough to see the various shrimp species from distances of several meters within the pool and the area directly below the pool.

In May of 1985, a second, more thorough survey of Lua O Palahemo was conducted by local biologists, a world-renowned cave diver, and hypogeal shrimp specialists (Kensley and Williams 1986, pp. 417–426; Bozanic 2004, p. 1–2). Because this survey included SCUBA methods, the full extent of the submerged system was explored, and physical characteristics, dimensions, and water measurements were completed for the pool as well as the water column directly below and the main lava tube. Pool surface measurements revealed a temperature of 75.2 degrees Fahrenheit (24 degrees Centigrade), salinity of 20 ppt, and dissolved oxygen of 6.0 parts per million (ppm) (Kensley and Williams 1986, p. 418). At a depth of 108 ft (33 m) (or 590 ft (180 m) from the pool surface) in the southward or seaward portion of the submerged lava tube where *Vetericaris chaceorum* was discovered and observed, measurements revealed a salinity of 30 ppt and dissolved oxygen at 0.3 ppm (Kensley and Williams 1986, p. 418).

The 1985 survey team completed a total of three dives within the Lua o Palahemo lava tube during their 1985 exploration of the site (Kensley and Williams 1986, pp. 417, 426). During those dives, researchers made five observations of *Vetericaris chaceorum* in total darkness at a depth of 108 ft (33 m) and 590 ft (180 m) from the opening, collecting two specimens. Kensley and Williams (1986, p. 418) noted, however, that the area surveyed directly beneath the surface of the pool contained the highest density of animals (*e.g.,* shrimps and crustaceans). In addition to the

discovery of *V. chaceorum,* a second new species was discovered, *Halocaridina palahemo,* and two known species were observed including *Procaris hawaiiana* and *Calliasmata pholidota. Calliasmata pholidota* was collected within the water column below the pool at a depth of 15 m (49 ft), and its population was estimated at less than 100. Both *P. hawaiiana,* numbering in the thousands and *H. palahemo,* numbering in the tens of thousands of individuals, were collected in the water column near the opening into the lava tube below the pool surface (Kensley and Williams 1986, p. 418). During their 1985 survey, Kensley and Williams (1986 entire) did not observe nonnative fish species within Lua O Palahemo.

Regarding water clarity and observation of sedimentation within Lua O Palahemo during the 1985 survey, both Kensley and Williams (1986, pp. 417–418) and Bozanic (2004, p. 1), noted that water clarity was good with visibility as great as 66 ft (20 m) during initial entry into the water column and the lateral lava tube below. However, during the exit phase of the dive, visibility diminished to a few centimeters as exhalation bubbles from the divers' expired air tanks disturbed sediment accumulated upon the ceiling of the lava tube and clouded the water. At the bottom of the water column below the pool and within both stretches of the lava tube, all surfaces were observed to be covered in sediment, which sometimes reached a depth of 3.3 ft (1 m). The survey team described the large mound located at the bottom of the water column below the pool opening as comprised of rock and silty sediment reaching at a total height of approximately 50 ft (15 m) (Kensley and Williams 1986, pp. 417–418; Bozanic 2004, p. 1). Foreign objects discovered and removed from the mound included bicycles, barbed wire, random trash, and assorted cables and lines (presumably fishing line) (Bozanic 2004, p. 1).

In July 2010, a team comprised of Service and Hawaii State Division of Aquatic Resources (DAR) biologists conducted a third survey of Lua O Palahemo. The survey team used snorkeling techniques and an underwater video camera as well as numerous trapping devices to take measurements, survey for shrimp species, and record data within the underwater site (Wada 2010, in litt., pp. 1–2). As noted during a brief 2005 U.S. Fish and Wildlife Service visit to the site, the team described the immediate area surrounding the depression above the pool opening as greatly eroded, creating a large soil funnel with the pool opening in the center of the funnel (Wada 2010, in litt., p. 1). The area was also described as dry and largely barren with a few clumps of nonnative grass species scattered throughout. The water immediately within the pool area was described as extremely low in clarity with visibility estimated at 3 in (8 cm) (Wada 2010, in litt., p. 1).

Snorkeling within the pool revealed that a partial collapse of the pool walls may have occurred in the past few years as the team experienced difficulty in locating an opening large enough for a person to explore. Wada (2010, in litt. p. 1) hypothesized that the collapse of the lava tube rock walls above the pool followed an earthquake of 6.7 magnitude (USGS 2010, in litt.) in October 2006 on Hawaii Island. Despite the blockages encountered, an underwater video camera was successfully deployed through a small opening and dropped to a depth of just over 100 ft (30 m) (Wada 2010, in litt., p. 1). The video footage showed a continuous thick cloud of sediment and detritus through the entire depth of the water column (Wada 2010, in litt., p. 1). After viewing photographs taken in 2005 of the pool and surrounding area at Lua O Palahemo, anchialine pool expert, Richard Brock (Brock 2012, pers. comm.), stated that a very obvious increase of sedimentation was occurring at the site and within the pool compared to conditions at the pool during the 1985 survey and other visits in the 1980s.

Of the five species of hypogeal shrimp known from Lua O Palahemo, only *Procaris hawaiiana* was observed. One specimen was captured within the pool and the underwater video camera captured footage of seven individuals, which were tentatively identified as *P. hawaiiana,* based upon their bright orange coloration (Wada 2010, in litt., p. 1). The survey team used standard and accepted methods while attempting to capture and survey for shrimp species. Specific trap types used included soft traps (*i.e.,* traps using netting), bottle traps, cylindrical traps, and specially designed traps devised by State DAR staff. Within the water column below the pool opening, trapping measures were employed at depths of 10 ft (3.04 m), 15 ft (4.57 m), 25 ft (7.62 m), 50 ft (15.24 m), and 100 ft (30.48 m) (Wada 2010, in litt., p. 1). According to the same report, no nonnative fish were observed. Hypogeal shrimp species known from Lua O Palahemo and notably absent during the survey included *Calliasmata pholidota, Antecaridina lauensis, Halocaridina rubra,* and *Vetericaris chaceorum.* Regarding the latter species, it is important to note that the survey team did not survey as deeply (108 ft (33 m) below sea level or 590 ft (180 m)) from the pool surface) as was done during 1985 survey, in which the species was first and last observed. Accordingly, it is uncertain whether surveys conducted after the 1985 effort would have detected *V. chaceorum,* given the different methods that were used. For the other species, based on what is known about the species' behavior, their presence would have been expected at the depths and locations where trapping was conducted; however, these species were notably absent during this survey.

In June 2012, Service biologists briefly revisited Lua O Palahemo to assess current conditions there (Richardson 2012, in litt., pp. 1–2). During this visit, we took measurements of the depression surrounding the opening to the pool. Roughly oval in shape, the depression measured approximately 195 ft (65 m) wide by 210 ft (70 m) long. We noted that there is no outlet for runoff from rain out of the depression other than into the anchialine pool itself. A total of 7 distinct off-road vehicle tracks into the depression surrounding the pool were counted and photographed. Snorkeling within the pool revealed no hypogeal shrimp species, although a common marine species, *Palaemonella burnsi,* was abundant and numbered approximately 1,000 individuals. No nonnative fish were observed; however, we noted approximately 10 mature and young native Hawaiian gobies. Gobies (family Gobiidae) are distinguished by their fused pelvic fins that form a disc-shaped sucker. Hawaii has several indigenous goby species, including the species observed at Lua O Palahemo, *Bathygobius coalitus* (Smith 2012, in litt.). Visibility in the water was estimated at approximately 4 ft (1.2 m), and no trash or debris was seen in the pool other than a large amount of grass seeds floating on the surface of the water. We did not dive deep enough to ascertain the condition of the pool bottom, however all submerged rock surfaces were covered in a 1-in (2.54-cm) thick layer of algae and mud, and the water smelled strongly of soil, similar to a smell encountered in wet caves (Richardson 2012, in litt., pp. 1–2). Lastly, the sign previously posted above the opening of the pool, and which included a warning and fine against disturbance of the site, was gone.

Our best understanding of hypogeal shrimp population dynamics in Hawaii and elsewhere is based upon studies of the comparatively common species, *Halocaridina rubra.* Studies and

anecdotal observations of that species and others indicate shrimp density may be very low in the water table (*i.e.,* greater than 1 individual per 3,500 cubic ft (approximately 100 cubic m)), compared to the anchialine pool areas, where abundance may reach many hundreds per square meter of bottom (Brock and Bailey-Brock 1998, p. 65; Brock 2004, p. 10).

Because of the ability of hypogeal shrimp species to inhabit the interstitial and crevicular spaces in the water table bedrock surrounding anchialine pools, it is very difficult to estimate population size of a given species within a given area (Brock 2004, pp. 10–11). Therefore, based upon these considerations and the fact that a total of five individuals have been observed on three occasions during one survey in 1985, we are unable to estimate the population size of *Vetericaris chaceorum.* Furthermore, the methods used and depths explored between the three surveys (in 1973, 1985, and 2010) of Lua O Palahemo were not sufficiently comparable for us to determine that there has been a decline in *V. chaceorum* abundance.

Brock (2004, p. 7) estimated that there are likely no more than a couple of dozen individuals of this species remaining in this pool; however, he provided no basis for this statement. Therefore, it is our opinion that *Vetericaris chaceorum* is extant, albeit in low numbers, and that additional surveys using SCUBA methods and conducted at the same depths explored in 1985 are warranted. Despite the lack of information regarding *V. chaceorum* biology and population demographics, the Service believes information from the three surveys presents compelling evidence of habitat decline at Lua O Palahemo. The other four hypogeal shrimp species formerly known from the site are either entirely absent or present in very low numbers, and at least three of those species are considered likely food sources for *V. chaceorum.* It is our opinion that these shrimp species have experienced drastic population decline due to degradation of the water quality at Lua O Palahemo. This degradation is a result of excessive siltation and sedimentation of the anchialine pool system at Lua O Palahemo, combined with the diminished ability of the system to flush, which Brock (2004, pp. 11, 35–36) described as necessary for a functioning anchialine pool system.

Summary of Factors Affecting the 15 Species Proposed for Listing

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

In considering what factors might constitute threats to a species; we must look beyond the exposure of the species to a particular factor to evaluate whether the species may respond to that factor in a way that causes actual impacts to the species. If there is exposure to a factor and the species responds negatively, the factor may be a threat and, during the status review, we attempt to determine how significant a threat it is. The threat is significant if it drives, or contributes to, the risk of extinction of the species such that the species warrants listing as endangered or threatened as those terms are defined in the Act. However, the identification of factors that could impact a species negatively may not be sufficient to warrant listing the species under the Act. The information must include evidence sufficient to show that these factors are operative threats that act on the species to the point that the species meets the definition of endangered or threatened under the Act.

If we determine that the level of threat posed to a species by one or more of the five listing factors is such that the species meets the definition of either endangered or threatened under section 3 of the Act, that species may then be proposed for listing. The Act defines an endangered species as ''in danger of extinction throughout all or a significant portion of its range,'' and a threatened species as ''likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' The threats to each of the individual 15 species proposed for listing in this document are summarized in Table 3, and discussed in detail below.

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Table 3. Summary of primary threats identified for each of the 15 Hawaii Island species.

Species	Ecosystem	Factor A						Factor B	Factor C				Factor D	Factor E
		Agriculture and urban development	Ungulates	Non native plants	Fire	Stochastic Events	Climate Change	Over-utilization	Disease	Predation/ Herbivory by ungulates	Predation/ Herbivory by other NN vertebrates	Predation/ Herbivory by NN invertebrates	Inadequate existing regulatory mechanisms	Other species-specific threats
Plants														
Bidens hillebrandiana ssp. *hillebrandiana*	CO, DC		P, G	X		H, RF, L	X			P, G	R		X	LN
Bidens micrantha ssp. *ctenophylla*	LD	X	P, G	X	X	H, DR	X			P, G	R		X	HY
Cyanea marksii	LW, MW		P, C, M	X		H, RF, L	X			P, C, M	R	S	X	LN
Cyanea tritomantha	LW, MW, WC		P, C	X		H, TF	X			P, C	R	S	X	NR
Cyrtandra nanawaleensis	LW		P	X		H	X			P	R	S	X	HY
Cyrtandra wagneri	LW		P	X		H, HR, E	X			P	R	S	X	LN, HY
Phyllostegia floribunda	LW, MM, MW		P	X	X	H	X			P			X	
Pittosporum hawaiiense	LM, MM,		P, C, M	X		H	X			P, C, M	R		X	NR

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	MW													
Platydesma remyi	LW, MW		P	X		H	X			P			X	LN, NR
Pritchardia lanigera	LM, LW, MW, WC		P, G, M	X		H	X	X		P, G, M	R	LH, B	X	NR
Schiedea diffusa ssp. *macraei*	MW		P, C	X		H	X			P, C	R		X	LN
Schiedea hawaiiensis	MD		P, G, SH, M	X	X	H, DR	X			P, G, SH, M	R		X	LN
Stenogyne cranwelliae	MW, WC		P	X		H	X			P	R	S	X	
Animals														
Drosophila digressa (Picture-wing fly)	LM, MM, MW		P, G, C, M	X	X	H, DR	X					W, A	X	LN, LOH, F

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Vetericaris chaceorum (Anchialine pool shrimp)	AP		G, C			-	X						X	REC, SD, D

Factor A = Habitat Modification

Factor B = Overutilization

Factor C = Disease or Predation

Factor D = Inadequacy of Regulatory Mechanisms

Factor E = Other Species-Specific Threats

AP = Anchialine Pools

CO = Coastal

LD = Lowland Dry

LM = Lowland Mesic

LW = Lowland Wet

MD = Montane Dry

MM = Montane Mesic

MW = Montane Wet

DC = Dry Cliff

WC = Wet Cliff

P = Pigs

G = Goats

C = Cattle

SH = Sheep

M = Mouflon

R = Rats

S = Slugs

W = Wasps

A = Ants

LH = Leafhopper

B = Beetles

H = Hurricane

DR = Drought

RF = Rockfalls

L = Landslides

HR = Heavy Rain

E = Erosion

TF = Tree Fall

D = Dumping (*i.e.*, Human dumping of nonnative fish and trash)

LN = Limited Numbers

HY = Hybridization

NR = No Regeneration

F = Flies

LOH = Loss of Host

REC = Recreational vehicles

SD = Sedimentation

BILLING CODE 4310–55–C

Assumptions

We acknowledge that the specific nature of the threats to the individual species being proposed for listing are not completely understood. Scientific research directed toward each of the species proposed for listing is limited because of their rarity and the challenging logistics associated with conducting field work in Hawaii (*e.g.,* areas are typically remote, difficult to access and work in, and expensive to survey in a comprehensive manner). However, there is information available on many of the threats that act on Hawaiian ecosystems, and, for some ecosystems, these threats are well studied and understood. Each of the native species that occur in Hawaiian ecosystems suffers from exposure to those threats to differing degrees. For the purposes of our listing determination, our assumption is that the threats that act at the ecosystem level also act on each of the species that occur in those ecosystems, although in some cases we have additionally identified species-specific threats, such as predation by nonnative invertebrates. Similarly, for the purposes of our critical habitat determinations, our assumption is that the physical or biological features that support an adequately functioning ecosystem represent the physical or biological features required by the species that occur in those ecosystems (see Critical Habitat section, below). The species discussed in this proposed rule are the components of the native ecosystems that have shown declines in number of individuals, number of occurrences, or changes in species abundance and species composition that can be reasonably attributed to the threats discussed below.

The following constitutes a list of ecosystem-scale threats that affect the species proposed for listing in 10 of the described ecosystems on Hawaii Island:

(1) Foraging and trampling of native plants by feral pigs (*Sus scrofa*), goats (*Capra hircus*), cattle (*Bos taurus*), sheep (*Ovis aries*), or mouflon sheep (*Ovis gmelini musimon*), which can result in severe erosion of watersheds because these mammals inhabit terrain that is often steep and remote (Cuddihy and Stone 1990, p. 63). Foraging and trampling events destabilize soils that support native plant communities, bury or damage native plants, and have adverse water quality effects due to runoff over exposed soils.

(2) Ungulate destruction of seeds and seedlings of native plant species via foraging and trampling (Cuddihy and Stone 1990, pp. 63, 65) facilitates the conversion of disturbed areas from native to nonnative vegetative communities.

(3) Disturbance of soils by feral pigs from rooting can create fertile seedbeds for alien plants (Cuddihy and Stone 1990, p. 65), some of them spread by ingestion and excretion by pigs.

(4) Increased nutrient availability as a result of pigs rooting in nitrogen-poor soils, which facilitates establishment of alien weeds. Introduced vertebrates are known to enhance the germination of alien plants through seed scarification in digestive tracts or through rooting and fertilization with feces of potential seedbeds (Stone 1985, p, 253). In addition, alien weeds are more adapted to nutrient-rich soils than native plants (Cuddihy and Stone 1990, p. 65), and rooting activity creates open areas in forests allowing alien species to completely replace native stands.

(5) Rodent damage to plant propagules, seedlings, or native trees, which changes forest composition and structure (Cuddihy and Stone 1990, p. 67).

(6) Feeding or defoliation of native plants from alien insects, which can reduce geographic ranges of some species because of damage (Cuddihy and Stone 1990, p. 71).

(7) Alien insect predation on native insects, which affects pollination of native plant species (Cuddihy and Stone 1990, p. 71).

(8) Significant changes in nutrient cycling processes because of large numbers of alien invertebrates such as earthworms, ants, slugs, isopods, millipedes, and snails, resulting in changes to the composition and structure of plant communities (Cuddihy and Stone 1990, p. 73).

Each of the above threats is discussed in more detail below, and summarized in Table 3. The most-often cited effects of nonnative plants on native plant species are competition and displacement. Competition may be for water, light, or nutrients, or it may involve allelopathy (chemical inhibition of other plants). Alien plants may displace native species of plants by preventing their reproduction, usually by shading and taking up available sites for seedling establishment. Alien plant invasions may also alter entire ecosystems by forming monotypic stands, changing fire characteristics of native communities, altering soil-water regimes, changing nutrient cycling, or encouraging other nonnative organisms (Smith 1989, pp. 61–69; Vitousek *et al.* 1987, pp. 224–227).

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

The Hawaiian Islands are located over 2,000 mi (3,200 km) from the nearest continent. This isolation has allowed the few plants and animals that arrived in the Hawaiian Islands to evolve into many highly varied and endemic species (species that occur nowhere else in the world). The only native terrestrial mammals in the Hawaiian Islands are two bat taxa, the extant Hawaiian hoary bat (*Lasiurus cinereus semotus*) and an extinct, unnamed insectivorous bat (Ziegler 2002, p. 245). The native plants of the Hawaiian Islands, therefore, evolved in the absence of mammalian predators, browsers, or grazers. As a result, many of the native species have lost unneeded defenses against threats such as mammalian predation and competition with aggressive, weedy plant species that are typical of continental environments (Loope 1992, p. 11; Gagne and Cuddihy 1999, p. 45; Wagner *et al.* 1999d, pp. 3–6). For example, Carlquist (in Carlquist and Cole 1974, p. 29) notes that ''Hawaiian plants are notably free from many characteristics thought to be deterrents to herbivores (toxins, oils, resins, stinging hairs, coarse texture).''

Native Hawaiian plants are therefore highly vulnerable to the impacts of introduced mammals and alien plants. In addition, species restricted and adapted to highly specialized locations (*e.g., Bidens hillebrandiana* ssp. *hillebrandiana*) are particularly vulnerable to changes (*e.g.,* nonnative species, hurricanes, fire, and climate change) in their habitat (Carlquist and Cole 1974, pp. 28–29; Loope 1992, pp. 3–6; Stone 1992, pp. 88–102).

Habitat Destruction and Modification by Agriculture and Urban Development

The consequences of past land use practices, such as agricultural or urban development, have resulted in little or no native vegetation below 2,000 ft (600 m) throughout the Hawaiian Islands (TNC 2007—*Ecosystem Database of ArcMap Shapefiles,* unpublished), largely impacting the coastal, lowland dry, lowland mesic, and lowland wet ecosystems. Although agriculture has been declining in importance, large tracts of former agricultural lands are being converted into residential areas or left fallow (TNC 2007—*Ecosystem Database of ArcMap Shapefiles,* unpublished). In addition, Hawaii's population has increased almost 7 percent in the past 10 years, further increasing demands on limited land and water resources in the islands (Hawaii

Department of Business, Economic Development and Tourism (HDBEDT) 2010).

Development and urbanization of the lowland dry ecosystem on Hawaii Island is a threat to one species proposed for listing in this rule, *Bidens micrantha* ssp. *ctenophylla,* which is dependent on this ecosystem. *Bidens micrantha* ssp. *ctenophylla* is currently found in an area less than 10 sq mi (26 sq km) on the leeward slopes of Hualalai volcano in the lowland dry ecosystem. The leeward slopes of Hualalai volcano encompass the increasingly urbanized region of north Kona, where there is very little undisturbed habitat (Pratt and Abbott 1997, p. 25). Approximately 25 percent (119 individuals of 475) of the largest of the 6 occurrences of this species is in the right-of-way of the proposed Ane Keohokalole Highway Project (USFWS 2010, in litt.) and Kaloko Makai Development, although 154 ac (62 ha) will be set aside as a lowland dry forest preserve (Kaloko Makai Dryland Forest Preserve) (see Kaloko Makai Development, below) to compensate for the loss of these individuals as a result of highway construction and prior to the Kaloko Makai Development. In addition, individuals of *Bidens micrantha* ssp. *ctenophylla* occur in areas where the development of the Villages of Laiopua Development at Kealakehe (see Department of Hawaiian Home Lands (DHHL), below) and of the Keahuolu affordable housing project (Whistler 2007, pp. 1–18; DHHL 2009, p. 15) is a threat to the species.

Habitat Destruction and Modification by Introduced Ungulates

Introduced mammals have greatly impacted the native vegetation, as well as the native fauna, of the Hawaiian Islands. Impacts to the native species and ecosystems of Hawaii accelerated following the arrival of Captain James Cook in 1778. The Cook expedition and subsequent explorers intentionally introduced a European race of pigs or boars and other livestock, such as goats, to serve as food sources for seagoing explorers (Tomich 1986, p. 120–121; Loope 1998, p. 752). The mild climate of the islands, combined with the lack of competitors or predators, led to the successful establishment of large populations of these introduced mammals, to the detriment of native Hawaiian species and ecosystems. The presence of introduced alien mammals is considered one of the primary factors underlying the alteration and degradation of native plant communities and habitats on the island of Hawaii. The destruction or degradation of habitat due to nonnative ungulates (hoofed mammals), including pigs, goats, cattle, sheep, and mouflon, is currently a threat to the ten ecosystems (lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, coastal, anchialine pool, dry cliff, and wet cliff) on Hawaii Island and their associated species. Habitat degradation or destruction by ungulates is also a threat to all 13 plant species (*Bidens hillebrandiana* ssp. *hillebrandiana, B. micrantha* ssp. *ctenophylla, Cyanea marksii, C. tritomantha, Cyrtandra nanawaleensis, C. wagneri, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei, S. hawaiiensis,* and *Stenogyne cranwelliae*), the picture-wing fly *Drosophila digressa,* and the anchialine pool shrimp *Vetericaris chaceorum,* which are proposed for listing in this rule (Table 3).

The destruction or degradation of habitat due to pigs is currently a threat to nine of the Hawaii Island ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) and their associated species. Feral pigs are known to cause deleterious impacts to ecosystem processes and functions throughout their worldwide distribution (Campbell and Long 2009, p. 2319). In Hawaii, pigs have been described as the most pervasive and disruptive nonnative influence on the unique native forests of the Hawaiian Islands, and are widely recognized as one of the greatest current threats to forest ecosystems (Aplet *et al.* 1991, p. 56; Anderson and Stone 1993, p. 195). European pigs, introduced to Hawaii by Captain James Cook in 1778, hybridized with domesticated Polynesian pigs, became feral, and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. The Hawaii Territorial Board of Agriculture and Forestry started a feral pig eradication project in the early 1900s that continued through 1958, removing 170,000 pigs from forests Statewide (Diong 1982, p. 63). Feral pigs are currently present on Niihau, Kauai, Oahu, Molokai, Maui, and Hawaii.

These feral animals are extremely destructive and have both direct and indirect impacts on native plant communities. While rooting in the earth in search of invertebrates and plant material, pigs directly impact native plants by disturbing and destroying vegetative cover, and trampling plants and seedlings. It has been estimated that at a conservative rooting rate of 2 sq yards (yd) (1.7 sq m) per minute, with only 4 hours of foraging a day, a single pig could disturb over 1,600 sq yd (1,340 sq m) (or approximately 0.3 ac, or 0.12 ha) of groundcover per week (Anderson *et al.* 2007, p. 2).

Pigs may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings (further discussion of predation by nonnative ungulates is provided under *Factor C. Disease or Predation,* below). Pigs are a major vector for the establishment and spread of competing invasive, nonnative plant species by dispersing plant seeds on their hooves and fur, and in their feces (Diong 1982, pp. 169–170), which also serves to fertilize disturbed soil (Matson 1990, p. 245; Siemann *et al.* 2009, p. 547). Pigs feed on the fruits of many nonnative plants, such as *Passiflora tarminiana* (banana poka) and *Psidium cattleianum* (strawberry guava), spreading the seeds of these invasive species through their feces as they travel in search of food. Pigs also feed on native plants, such as Hawaiian tree ferns that they root up to eat the core of the trunk (Baker 1975, p. 79). In addition, rooting pigs contribute to erosion by clearing vegetation and creating large areas of disturbed soil, especially on slopes (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Medeiros *et al.* 1986, pp. 27–28; Scott *et al.* 1986, pp. 360–361; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet *et al.* 1991, p. 56; Loope *et al.* 1991, pp. 1–21; Gagne and Cuddihy 1999, p. 52; Nogueira-Filho *et al.* 2009, pp. 3,677–3,682; Dunkell *et al.* 2011, pp. 175–177). Erosion impacts native plant communities by watershed degradation and alteration of plant nutrient status, as well as damage to individual plants from landslides (Vitousek *et al.* 2009, pp. 3074–3086; Chan-Halbrendt *et al.* 2010, p. 252).

Pigs have been cited as one of the greatest threats to the public and private lands within the Olaa Kilauea Partnership (an area of land that includes approximately 32,000 ac (12,950 ha) in the upper sections of the Olaa and Waiakea forests above Volcano village) that comprise the lowland mesic, lowland wet, montane mesic, and montane wet ecosystems that support individuals of three of the plant species proposed for listing (*Cyanea tritomantha, Phyllostegia floribunda,* and *Pittosporum hawaiiense*) (Olaa Kilauea Partnership Area Feral Animal Monitoring Report 2005, pp. 1–4; Perlman 2007, in litt.; Pratt 2007a, in litt.; Pratt 2007b, in litt.; Benitez *et al.* 2008, p. 58; HBMP 2010f; HBMP 2010h; PEPP 2010, p. 60, TNC 2012, in litt.). Impacts from feral pigs are also a threat to the coastal, lowland mesic, lowland

wet, montane wet, dry cliff, and wet cliff ecosystems in the northern Kohala Mountains and adjacent coastline. These ecosystems support occurrences of seven of the plant species proposed for listing (*Bidens hillebrandiana* ssp. *hillebrandiana, Cyanea tritomantha, Cyrtandra wagneri, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei,* and *Stenogyne cranwelliae*) (Wood 1995, in litt.; Wood 1998, in litt.; Perlman *et al.* 2001, in litt.; Wagner *et al.* 2005d, pp. 31–33; Kohala Mountain Watershed Partnership (KMWP) 2007, pp. 54–56; Lorence and Perlman 2007, pp. 357–361; HBMP 2010a; HBMP 2010c; HBMP 2010f; HBMP 2010i; HBMP 2010j; HBMP 2010k; PEPP 2010, pp. 63, 101, 106; Bio 2011, pers. comm.). In addition, feral pigs are a threat to the lowland wet and montane wet ecosystems in south Kona and the Puna district that support the plants *Cyanea marksii* and *Cyrtandra nanawaleensis* (Bio 2011, pers. comm.; Magnacca 2011b, pers. comm.; Maui Forest Bird Recovery Project 2011, in litt.). Feral pigs have also been reported in the lowland dry ecosystem that supports the plants *Bidens micrantha* ssp. *ctenophylla* (Bio 2011, pers. comm.) and the montane dry ecosystem that supports habitat for the only known occurrence of the plant *Schiedea hawaiiensis* (Mitchell *et al.* 2005c; U.S. Army Garrison 2006, pp. 27, 34, 95–97, 100–107, 112.). Although we do not have direct evidence of feral pigs threatening the particular species on Hawaii Island that are proposed for listing in this proposed rule, those threats have been documented on other islands where pigs have been introduced (Mitchell *et al.* 2005c; U.S. Army Garrison 2006, pp. 27, 34, 95–97, 100–107, 112). We believe it is reasonable to infer that feral pig threats to these species that have been observed on other Hawaiian islands would act in a similar manner on Hawaii Island, where those species interact.

Many of the most important host plants of Hawaiian picture-wing flies (*Charpentiera, Pleomele, Reynoldsia, Tetraplasandra, Urera,* and the lobelioids (*e.g., Cyanea* spp.)) are also among the most susceptible to damage from feral ungulates, such as pigs (Foote and Carson 1995, p. 370; Kaneshiro and Kaneshiro 1995, pp. 8, 39; Magnacca *et al.* 2008, p. 32). Feral pig browsing alters the essential microclimate in picture-wing fly habitat by opening up the canopy, leading to increased desiccation of soil and host plants, which disrupts the host plant life cycle and decay processes, resulting in disruption of the picture-wing fly life cycle, particularly oviposition and larvae substrate (Magnacca *et al.* 2008, pp. 1, 32). Foote and Carson (1995, p. 369) have experimentally demonstrated the above detrimental effects of feral pigs on *Drosophila* spp. in wet forest habitat on the island of Hawaii. In addition, Montgomery (2005, in litt.; 2007, in litt.) and Foote (2005, pers. comm.) have observed feral pig damage to host plants (*e.g., Charpentiera* sp., *Cheirodendron* sp., *Pleomele* sp., *Tetraplasandra* sp., *Urera kaalae*) of Hawaiian picture-wing flies on the island of Hawaii (Foote 2005, pers. comm.) and throughout the main Hawaiian Islands (Montgomery 2005, in litt.; 2007, in litt.). Magnacca (2012, pers. comm.) has observed the lack of regeneration of picture-wing fly host plants due to destruction of seedlings caused by pig rooting and herbivory.

The destruction or degradation of habitat due to goats is currently a threat to all 10 of the described ecosystems on Hawaii Island (anchialine pool, coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) and their associated species. Goats, native to the Middle East and India, were also successfully introduced to the Hawaiian Islands in the late 1700s. Actions to control feral goat populations began in the 1920s (Tomich 1986, pp. 152–153); however, goats still occupy a wide variety of habitats on Hawaii Island, where they consume native vegetation, trample roots and seedlings, accelerate erosion, and promote the invasion of alien plants (van Riper and van Riper 1982, pp. 34–35; Stone 1985, p. 261; Kessler 2011, pers. comm.). Goats are able to access, and forage in, extremely rugged terrain, and they have a high reproductive capacity (Clarke and Cuddihy 1980, pp. C–19, C–20; Culliney 1988, p. 336; Cuddihy and Stone 1990, p. 64). Because of these factors, goats are believed to have completely eliminated some plant species from islands (Atkinson and Atkinson 2000, p. 21).

Goats can be highly destructive to native vegetation, and contribute to erosion by eating young trees and young shoots of plants before they can become established, creating trails that damage native vegetative cover, promoting erosion by destabilizing substrate and creating gullies that convey water, and dislodging stones from ledges that can cause rockfalls and landslides and damage vegetation below (Cuddihy and Stone 1990, pp. 63–64). A recent study by Chynoweth *et al.* (2011, in litt.), which deployed GPS (global positioning system) satellite collars on 12 feral goats to track movement patterns every 2 hours for 1 year in Pohakuloa Training Area, found that goats prefer native-dominated shrublands in the montane dry ecosystem during the day and barren lava at night. Pohakuloa Training Area supports one of the few montane dry forest ecosystems on Hawaii Island that supports native plants in the montane dry ecosystem, including the only occurrence of the plant *Schiedea hawaiiensis* (U.S. Army Garrison 2006, pp. 27, 34; Evans 2011, in litt.). In addition, one of the two occurrences of the proposed plant species *Pritchardia lanigera* is known from an unfenced area of the Kohala Mountains, where herds of wild goats and other ungulates occur (Maly and Maly 2004 *in* KMWP 2007, p. 55; KMWP 2007, pp. 54–55; Warshauer *et al.* 2009, pp. 10, 24; Laws *et al.* 2010, in litt.; Ikagawa 2011, in litt.). Maly and Maly (2004 *in* KMWP 2007, p. 55) report that ''herds of wild goats roam throughout this region, trampling, grubbing, and rending, grinding the bark of old trees and eat the young ones * * * which will destroy the beauty and alter the climate of the mountainous region of Hawaii.'' There are direct observations that goats are also altering the coastal ecosystem along the Kohala Mountains, the location of the only known wild individuals of the plant *Bidens hillebrandiana* ssp. *hillebrandiana* (Warshauer *et al.* 2009, p. 24; Bio 2011, pers. comm.). Goats are also found in North Kona and have been observed browsing in the lowland dry ecosystem that supports the plant *B. micrantha* ssp. *ctenophylla* (Bio 2011, pers. comm.; Knoche 2011, in litt.). Fresh seedlings from native plants attract goats to the dry and rough lava (Bio 2011, pers. comm.). Further, the host plant (*Charpentiera* spp.) of the proposed picture-wing fly appears to be decreasing throughout its range due to impacts from browsing goats (Foote and Carson 1995, p. 369; Science Panel 2005, pp. 1–23; Magnacca *et al.* 2008, p. 32). Feral goat browsing alters the picture-wing fly's essential microclimate by opening up the canopy leading to increased desiccation of soil and host plants, which disrupts the host plant life cycle and decay processes, resulting in the disruption of the picture-wing fly life cycle, particularly oviposition and larvae substrate (Magnacca *et al.* 2008, pp. 1, 32). Based on observations of goats and their scat (Magnacca 2012, pers. comm.) within the Ka Lae region where the Lua O Palahemo anchialine pool is located, the Service believes that goats contribute to the degradation of the anchialine pool habitat and, thus, are a threat to *Vetericaris chaceorum.* Feral goats trample and forage on both native and

nonnative plants around and near the pool opening at Lua O Palahemo, and increase erosion around the pool and sediment entering the pool.

The destruction or degradation of habitat due to cattle is currently a threat to five of the described ecosystems (anchialine pool, lowland mesic, lowland wet, montane mesic, and montane wet) on Hawaii Island and their associated species. Cattle, the wild progenitors of which were native to Europe, northern Africa, and southwestern Asia, were introduced to the Hawaiian Islands in 1793. Large feral herds (as many as 12,000 on the island of Hawaii) developed as a result of restrictions on killing cattle decreed by King Kamehameha I (Cuddihy and Stone 1990, p. 40). While small cattle ranches were developed on Kauai, Oahu, Molokai, west Maui, and Kahoolawe, very large ranches of tens of thousands of acres (thousands of hectares) were created on east Maui and Hawaii Island (Stone 1985, pp. 256, 260; Broadbent 2010, in litt.). Logging of native *Acacia koa* was combined with establishment of cattle ranches, quickly converting native forest to grassland (Tomich 1986, p. 140; Cuddihy and Stone 1990, p. 47). Feral cattle can presently be found on the islands of Maui and Hawaii, where ranching is still a major commercial activity.

Feral cattle eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas into which alien plants invade, and spread seeds of alien plants in their feces and on their bodies. The forest in areas grazed by cattle degrades to grassland pasture, and plant cover is reduced for many years following removal of cattle from an area. In addition, several alien grasses and legumes purposely introduced for cattle forage have become noxious weeds (Tomich 1986, pp. 140–150; Cuddihy and Stone 1990, p. 29).

The wet forests of the Kohala Mountains are reported to have a feral cattle population of at least 100 individuals that are causing forest degradation by trampling and browsing, which leads to subsequent increased nitrogen availability through deposition of feces (Stone 1985, p. 253), all of which contribute to the influx of nonnative plant and animal species (KMWP 2007, pp. 54–55; Laws 2010, in litt.). Feral cattle are reported from remote regions on Hawaii Island, including the back of both Pololu and Waipio Valleys (KMWP 2007, p. 55). Feral cattle are a threat to the lowland wet and montane wet ecosystems in the Kohala Mountains where individuals of *Cyanea tritomantha* and *Pritchardia lanigera,* and the last wild individual of *Schiedea diffusa* ssp. *macraei,* are reported (PEPP 2010, pp. 59–60; Bio 2011, pers. comm.). According to a 2010 Service report (USFWS 2010, pp. 3–15, 4–86), a herd of 200 to 300 feral cattle roams the Kona unit of the Hakalau Forest NWR (USFWS 2010, p. 3–15, 4–86). Field biologists have observed cattle-induced habitat degradation at all elevations in this refuge unit, including within the montane wet ecosystem that supports individuals of *Cyanea marksii* (PEPP 2007, p. 61; USFWS 2010, pp. 1–15, 2–13, 4–10, 4–58–4–59, 4–82, 4–86; Bio 2011, pers. comm.; Krauss 2012, pers. comm.). In addition, the host plant (*Charpentiera* spp.) of the proposed picture-wing fly species (*Drosophila digressa*) appears to be decreasing throughout its range due to impacts from cattle browsing in the lowland mesic and montane mesic ecosystems (Science Panel 2005, pp. 1–23; Magnacca 2011b, in litt.). Feral cattle browsing alters the picture-wing fly's essential microclimate by opening up the canopy, leading to increased desiccation of soil and host plants, which disrupts the host plant life cycle and decay processes, resulting in the disruption of the picture-wing fly life cycle, particularly oviposition and larvae substrate (Magnacca *et al.* 2008, pp. 1, 32). According to Palikapu Dedman with the Pele Defense Fund, observations of feral cattle in the Ka Lae region where the Lua O Palahemo anchialine pool is located contribute to the degradation of the anchialine pool habitat. We therefore conclude that feral cattle are a threat to *Vetericaris chaceorum* (Richardson 2012, in litt., pp. 1–2). Feral cattle trample and forage on both native and nonnative plants around and near the pool opening at Lua O Palahemo, and increase erosion around the pool and sediment entering the pool.

The destruction or degradation of habitat due to feral sheep is currently a threat to the montane dry ecosystem on Hawaii Island and its associated species. Sheep were introduced to Hawaii Island in 1791, when Captain Vancouver brought five rams and two ewes from California (Tomich 1986, pp. 156–163). Soon after, stock was brought from Australia, Germany, and the Mediterranean for sheep production (Tomich 1986, pp. 156–163; Cuddihy and Stone 1990, p. 65–66). Feral sheep became established on leeward Mauna Kea by 1876 (Cuddihy and Stone 1990, p. 65–66), and by the early 1930s, reached close to 40,000 individuals (Scowcroft and Conrad 1992, p. 627). Acquiring the majority of their water needs by consuming vegetation, sheep inhabited dry forests in remote regions of Mauna Kea and Mauna Loa, including the saddle between the two volcanoes. Feral sheep browse and trample native vegetation and have decimated large areas of native forest and shrubland on Hawaii Island (Tomich 1986, pp. 156–163; Cuddihy and Stone 1990, p. 65–66). Browsing erodes top soil, which alters moisture regimes and micro-environments and results in the loss of native plant and animal taxa (Tomich 1986, pp. 156–163; Cuddihy and Stone 1990, p. 65–66). In addition, nonnative opportunistic plant seeds get dispersed to disturbed forest sites by adhering to sheep wool coats (Hawaii Division of Forestry and Wildlife (HDOFAW) 2002, p. 3).

In 1962, game hunters intentionally crossbred feral sheep with mouflon sheep and released them on Mauna Kea (Tomich 1986, pp. 156–163). In *Palila* v. *Hawaii Department of Land and Natural Resources* (471 F. Supp. 985 (Haw. 1979)), the Federal court ordered complete removal of feral sheep from Mauna Kea in 1979, because they were harming the endangered palila (*Loxioides bailleui*) by degrading and destroying palila habitat in the montane dry ecosystem. Throughout the past 30 years, attempts to protect the vegetation of Mauna Kea and the saddle from sheep have only been sporadically effective (Scowcroft and Conrad 1992, p. 628). Currently, a large feral population surrounds Mauna Kea and extends into the saddle and northern part of Mauna Loa, including the State forest reserves where they trample and browse endangered plants (Hess 2008, p. 1). At the U.S. Army's Pohakuloa Training Area, located in the saddle area of the island, biologists have reported that feral sheep are a threat to the last occurrence of the plant species *Schiedea hawaiiensis,* which occurs in the montane dry ecosystem (Mitchell *et al.* 2005a; U.S. Army Garrison 2006, pp. 27, 34).

Five of the described ecosystems (lowland mesic, lowland wet, montane dry, montane mesic, and montane wet) on Hawaii Island, and their associated species are currently threatened by the destruction or degradation of habitat due to mouflon sheep. The mouflon sheep (mouflon), native to Asia Minor, was introduced to the islands of Lanai and Hawaii in the 1950s, as a managed game species, and has become widely established on these islands (Tomich 1986, pp. 163–168; Cuddihy and Stone 1990, p. 66; Hess 2008, p. 1). In 1968, mouflon were introduced to Kahuku Ranch (now a unit of HVNP) on Mauna Loa for trophy hunting. By 2008, mouflon ranged over the southern part

of Mauna Loa in the Kahuku area on adjacent public and private lands (Hess 2008, p. 1). According to Ikagawa (2011, in litt.), mouflon are found on the slopes of both Mauna Loa and Mauna Kea. Ikagawa (2011, in litt.) also notes that mouflon and mouflon-sheep hybrids are found from sea level to over 3,280 ft (1,000 m) elevation. Mouflon have high reproduction rates; for example, the original population of 11 individuals on the island of Hawaii has increased to more than 2,500 in 36 years, even though mouflon are hunted as a game animal (Hess 2008, p. 3). Mouflon only gather in herds when breeding, thus limiting control techniques and hunting efficiency (Hess 2008, p. 3; Ikagawa 2011, in litt.). Mouflon are both grazers and browsers, and have decimated vast areas of native forest and shrubland through browsing and bark stripping (Stone 1985, p. 271; Cuddihy and Stone 1990, pp. 63, 66; Hess 2008, p. 3). Mouflon also create trails and pathways through thick vegetation, leading to increased runoff and erosion through soil compaction. In some areas, the interaction of browsing and soil compaction has led to a change from native rainforest to grassy scrublands (Hess 2008, p. 3). Field biologists have observed habitat degradation in five of the described ecosystems (lowland mesic, lowland wet, montane dry, montane mesic, and montane wet) that support four plants proposed for listing (*Cyanea marksii, Pittosporum hawaiiense, Pritchardia lanigera,* and *Schiedea hawaiiensis*) (Bio 2011, pers. comm.; Ikagawa 2011, in litt.; Pratt 2011d, in litt.), and the picture-wing fly (*Drosophila digressa*) (Magnacca 2011b, pers. comm.). Many of the current and proposed fenced exclosures on Hawaii Island are only 4 ft (1.3 m) in height, as they are designed to exclude feral pigs, goats, and sheep. However, a fence height of at least 6 ft (2 m) is required to exclude mouflon sheep, as they can easily jump a 4-ft (1.3-m) fence (Ikagawa 2011, in litt.). The increased range of mouflon, as well as the lack of adequately protected habitat, increase the threat of mouflon sheep to additional ecosystems on Hawaii Island.

Axis deer (*Axis axis*) were first introduced to Molokai in 1868, Lanai in 1920, and Maui in 1959 (Hobdy 1993, p. 207; Erdman 1996, pers. comm. cited in Waring 1996, in litt., p. 2; Hess 2008, p. 2). Recently (2010–2011), unauthorized introduction of axis deer to the island of Hawaii as a game animal has occurred (Kessler 2011, in litt.; Aila 2012a, in litt.). They have been observed in the regions of Kohala, Kau, Kona, and Mauna Kea (HDLNR 2011, in litt.). The HDLNR–HDOFAW has developed a response-and-removal plan, including a partnership now underway between HDLNR, Hawaii Department of Agriculture (HDOA), the Big Island Invasive Species Committee (BIISC), Federal natural resource management agencies, ranchers, farmers, private landowners, and concerned citizens (Big Island-Big Island.com, June 6, 2011). The partnership is working with animal trackers and game cameras to survey locations where axis deer have been observed in an effort to eradicate them on the island (Big Island-Big Island.com, June 6, 2011; Osher 2012, in litt.). There is a high level of concern by the partnership due to the negative impacts of axis deer on agriculture and native ecosystems on neighboring islands (*e.g.,* Maui) (Aila 2011, in litt.; Schipper 2011, in litt.; Aila 2012b, in litt.). In response to the presence of axis deer on Hawaii Island, the Hawaii Invasive Species Council drafted House Bill 2593 (Draft 2), to amend House Revised Statutes (Haw. Rev. Stat.) 91, which allowed agencies to adopt emergency rules in instances of imminent peril to the public health, safety, or morals, or to livestock and poultry health (Aila 2012a, in litt.). House Bill 2593 (Draft 2) addresses the gap in the current emergency rules authority, expanding the ability of State agencies to adopt emergency rules to address situations that impose imminent threats to natural resources (Aila 2012a, in litt.; Martin 2012, in litt.) (see *Factor D. The Inadequacy of Existing Regulatory Mechanisms,* below). Emergency rules are valid for 120 days after they are registered and approved, and after 6 months a permanent rule can be enacted (Cravalho 2012, pers. comm). On June 21, 2012, House Bill 2593 was enacted into law as Act 149 (''Relating to Emergency Rules for Threats to Natural Resources or the Health of the Environment'').

Axis deer are primarily grazers, but also browse numerous palatable plant species, including those grown as commercial crops (Waring 1996, in litt., p. 3; Simpson 2001, in litt.). They prefer the lower, more openly vegetated areas for browsing and grazing; however, during episodes of drought (*e.g.,* from 1998–2001 on Maui (Medeiros 2010, pers. comm.)), axis deer move into urban and forested areas in search of food (Waring 1996, in litt., p. 5; Nishibayashi 2001, in litt.). Like goats, axis deer can be highly destructive to native vegetation and contribute to erosion by eating young trees and young shoots of plants before they can become established, creating trails that can damage native vegetative cover, promoting erosion by destabilizing substrate and creating gullies that convey water, and by dislodging stones from ledges that can cause rockfalls and landslides and damage vegetation below (Cuddihy and Stone 1990, pp. 63–64). The unauthorized introduction of axis deer on Hawaii Island is a concern due to the devastating impacts of habitat destruction by axis deer in nine ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) on the islands of Kahoolawe, Lanai, and Maui (Mehrhoff 1993, p. 11; Anderson 2002, poster; Swedberg and Walker 1978, cited in Anderson 2003, pp. 124–125 Perlman 2009, in litt., pp. 4–5; Hess 2008, p. 3; Hess 2010, pers. comm.; Kessler 2010, pers. comm.; Medeiros 2010, pers. comm.). As reported on the islands of Kahoolawe, Lanai, and Maui, the spread of axis deer into nine of the described ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) on Hawaii Island is expected to lead to similar habitat degradation and destruction if the deer are not controlled. The results from the studies above, in addition to the confirmed sightings of axis deer on Hawaii Island, suggest that axis deer can significantly alter these ecosystems and directly damage or destroy native plants. Although habitat degradation due to axis deer has not yet been observed on Hawaii Island, we believe it is reasonable to assume similar habitat effects on this island. Based on the prevailing evidence of the documented impacts to native ecosystems and individual plants on the other islands, we determine that the expanding population of axis deer on the Island of Hawaii, while not currently resulting in population-level effects to native plants, is expected to do so in the future if the deer are not managed or controlled. As a result, we currently do not believe that the existing population of axis deer on Hawaii Island is a threat; however, we expect that as the population of axis deer expands, axis deer will become a significant threat to the native plants and ecosystems on Hawaii Island in the future.

In summary, all of the 15 species proposed for listing and that are dependent upon the 10 ecosystems (anchialine pool, coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) identified in this proposed rule are exposed to the ongoing threat of feral ungulates (pigs,

goats, cattle, sheep, and mouflon sheep). Additionally, if not adequately managed or controlled, impacts from axis deer may also become a significant threat to these ecosystems in the future. These negative impacts result in the destruction and degradation of habitat for the native species on Hawaii Island. The effects of these nonnative animals include the destruction of vegetative cover; trampling of plants and seedlings; direct consumption of native vegetation; soil disturbance and sedimentation; dispersal of alien plant seeds on hooves and coats, and through the spread of seeds in feces; alteration of soil nitrogen availability; and creation of open, disturbed areas conducive to further invasion by nonnative pest plant species. All of these impacts lead to the subsequent conversion of a plant community dominated by native species to one dominated by nonnative species (see Habitat Destruction and Modification by Nonnative Plants below). In addition, because these mammals inhabit terrain that is often steep and remote (Cuddihy and Stone 1990, p. 59), foraging and trampling contributes to severe erosion of watersheds and degradation of streams (Dunkell *et al.* 2011, pp. 175–194). As early as 1900, there was increasing concern expressed about the integrity of island watersheds, due to effects of ungulates and other factors, leading to the establishment of a professional forestry program emphasizing soil and water conservation (Nelson 1989, p. 3).

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, the deliberate introduction of nonnative plants and animals, and agricultural development (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). Of these 100 nonnative pest plant species, over 35 species have altered the habitat of 14 of the 15 species proposed for listing (only the proposed anchialine pool shrimp is not directly impacted by nonnative plants (see Table 3)). Some of the nonnative plants were brought to Hawaii by various groups of people, including the Polynesians, for food or cultural reasons. 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. Ranchers intentionally introduced pasture grasses and other nonnative plants for agriculture, and sometimes inadvertently introduced weeds 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 impact native habitat in Hawaii, including 9 of the described Hawaii Island ecosystems that support 14 of the 15 proposed species (all except the anchialine pool shrimp), and directly adversely impact the 13 proposed plant species, by: (1) Modifying the availability of light through alterations of the canopy structure; (2) altering soil-water regimes; (3) modifying nutrient cycling; (4) altering the fire regime affecting native plant communities (*e.g.,* successive fires that burn farther and farther into native habitat, destroying native plants and removing habitat for native species by altering microclimatic conditions to favor alien species); and (5) ultimately converting native-dominated plant communities to nonnative plant communities (Smith 1985, pp. 180–181; Cuddihy and Stone, 1990, p. 74; D'Antonio and Vitousek 1992, p. 73; Vitousek *et al.* 1997, p. 6). Below, we have organized a list of nonnative plants by their ecosystems, followed by a discussion of the specific negative effects of those nonnative plants on the species proposed for listing here.

Nonnative Plants in the Coastal Ecosystem

Nonnative plant species that threaten *Bidens hillebrandiana* ssp. *hillebrandiana,* the only plant species proposed for listing in this rule that inhabits the coastal ecosystem on Hawaii Island, include the understory and subcanopy species *Pluchea carolinensis* (sourbush), *P. indica* (Indian fleabane), *Lantana camara* (lantana), and *Melastoma* spp. (Perlman and Wood 2006, in litt.; Bio 2011, pers. comm.). Nonnative canopy species that threaten *B. hillebrandiana* ssp. *hillebrandiana* include *Casuarina equisetifolia* (ironwood) (Perlman and Wood 2006, in litt.). In addition, *B. hillebrandiana* ssp. *hillebrandiana* is threatened by the nonnative grass *Pennisetum setaceum* (fountain grass) (Perlman and Wood 2006, in litt.; Bio 2011, pers. comm.). These nonnative plant species pose serious and ongoing threats to the species *B. hillebrandiana* ssp. *hillebrandiana,* which depends on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Nonnative Plants in the Lowland Dry Ecosystem

Nonnative plant species that threaten *Bidens micrantha* ssp. *ctenophylla,* the only plant species proposed for listing in this rule that inhabits the lowland dry ecosystem on Hawaii Island include the understory and subcanopy species *Lantana camara, Leucana leucocephala* (koa haole), *Pluchea carolinensis,* and *P. indica* (HBMP 2010b). Nonnative canopy species that are a threat to *B. micrantha* ssp. *ctenophylla* include *Grevillea* spp., *Prosopis pallida* (kiawe), and *Schinus terebinthifolius* (christmasberry) (HBMP 2010b). In addition, *B. micrantha* ssp. *ctenophylla* is threatened by the nonnative grasses *Melinis repens* (natal redtop) and *Pennisetum setaceum* (HBMP 2010b). See *Specific Nonnative Plant Species Impacts* below for specific threats each of these nonnative plant species pose to the species *Bidens micrantha* ssp. *ctenophylla,* which depends on this ecosystem.

Nonnative Plants in the Lowland Mesic Ecosystem

Nonnative plant species that threaten two plant species (*Pittosporum hawaiiense* and *Pritchardia lanigera*) and the picture-wing fly proposed for listing in this rule that inhabit the lowland mesic ecosystem on Hawaii Island include the understory and subcanopy species *Delairea odorata* (cape ivy), *Hedychium gardnerianum* (kahili ginger), *Lantana camara,* and *Rubus rosifolius* (thimbleberry) (HDOFAW 1992, p. 11–22; Benitez *et al.* 2008, pp. 24–52; Pacific Islands Ecosystems at Risk (PIER) 2012a). Nonnative canopy species that are a threat to the three species include *Omalanthus populifolius* (Queensland poplar), *Psidium cattleianum,* and *Schinus terebinthifolius* (Benitez *et al.* 2008, pp. 24–58). Additional species that are a threat to the three species are the nonnative grasses *Ehrharta stipoides* (meadow rice grass) and *Paspalum conjugatum* (Hilo grass) (Denslow *et al.* 2006, p. 118). These nonnative plant species pose serious and ongoing threats to the three species that depend on this ecosystem (see *Specific Nonnative Species Impacts* below).

Nonnative Plants in the Lowland Wet Ecosystem

Nonnative plant species that are a threat to the 7 of the 13 plant species (*Cyanea marksii, Cyaneatritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Phyllostegia floribunda, Platydesma remyi, and Pritchardia lanigera*) proposed for listing in this rule that inhabit the lowland wet ecosystem on Hawaii Island include the understory and subcanopy species *Clidemia hirta* (Koster's curse), *Erigeron karvinskianus* (daisy fleabane), *Hedychium gardnerianum, Juncus effusus* (Japanese mat rush), *J. ensifolius* (dagger-leaved rush), *J. planifolius* (bog rush), *Melastoma* spp., *Passiflora edulis* (passion fruit), *P. tarminiana* (banana poka), *Polygonum punctatum* (water smartweed), *Rubus argutus* (prickly Florida blackberry), *R. ellipticus* (yellow Himalayan raspberry), *R. rosifolius, Sphaeropteris cooperi* (Australian tree fern), *Tibouchina herbacea* (glorybush), and *T. urvilleana* (princess flower) (Wood 1995, in litt.; Perlman *et al.* 2001, in litt.; Perlman and Wood 2006, in litt.; Perlman and Perry 2003, in litt.; Lorence and Perlman 2007, pp. 357–361; PEPP 2007, pp. 1–65; PEPP 2008, pp. 87–111; Perlman and Bio 2008, in litt.; Perlman *et al.* 2008, in litt.; HBMP 2010c; HBMP 2010e; HBMP 2010f; HBMP 2010g; HBMP 2010h; HBMP 2010i; PEPP 2010, pp. 33–121). Nonnative canopy species that are a threat to the seven species include *Angiopteris evecta* (mule's foot fern), *Falcataria moluccana* (albizia), *Miconia calvescens* (miconia), *Psidium cattleianum, Schefflera actinophylla* (octopus tree) (Palmer 2003, p. 48; HBMP 2010c; HBMP 2010e; HBMP 2010f; HBMP 2010g; HBMP 2010h; HBMP 2010i; PEPP 2010, p. 62; Lau 2011, in litt.; Magnacca 2011b, pers. comm.; Pratt 2011a, in litt.; Price 2011, in litt.). Nonnative grasses that threaten this ecosystem are *Ehrharta stipoides* and *Setaria palmifolia* (palmgrass) (Lorence and Perlman 2007, pp. 357–361; PEPP 2007, pp. 1–65; HBMP 2010c; HBMP 2010f; HBMP 2010g). These nonnative plant species pose serious and ongoing threats to the seven species that depend on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Nonnative Plants in the Montane Dry Ecosystem

Nonnative plant species that threaten the plant species *Schiedea hawaiiensis* in the montane dry ecosystem on Hawaii Island include the understory and subcanopy species *Heterotheca grandiflora* (telegraph weed) and *Senecio madagascariensis* (Madagascar fireweed) (Herbst *et al.* 2004, p. 4; Le Roux *et al.* 2006, pp. 694–702; U.S. Army Garrison 2009, p. 5; Bio 2011, pers. comm.; Evans 2011, pers. comm.; HISC 2012; Jepson eFlora 2012–*Jepson Herbarium Database*). The nonnative grass *Pennisetum setaceum* also threatens *Schiedea hawaiiensis* (U.S. Army Garrison 2009, p. 5; Bio 2011, pers. comm.; Evans 2011, pers. comm.). These nonnative plant species pose serious and ongoing threats to the proposed species *Schiedea hawaiiensis,* which depends on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Nonnative Plants in the Montane Mesic Ecosystem

Nonnative plant species that threaten two plant species (*Phyllostegia floribunda* and *Pittosporum hawaiiense*) and the picture-wing fly proposed for listing in this rule that inhabit the montane mesic ecosystem on Hawaii Island include the understory and subcanopy species *Anemone hupehensis* var. *japonica* (Japanese anemone), *Buddleia asiatica* (dog tail), *Clidemia hirta, Hedychium gardnerianum, Rubus argutus,* and *Rubus rosifolius* (HDOFAW 1992, p. 17; Benitez *et al.* 2008, pp. 24–53; PEPP 2008, pp. 106–107; Perlman *et al.* 2008, in litt.; HBMP 2010h; PIER 2011a). Canopy species that threaten the three species include *Psidium cattleianum* and *Schinus terebinthifolius* (Benitez *et al.* 2008, pp. 29–30; Perlman *et al.* 2008, in litt.). Nonnative grasses that threaten this ecosystem are *Andropogon virginicus* (broomsedge), *Ehrharta stipoides, Pennisetum setaceum,* and *Setaria palmifolia* (HDOFAW 1992, p. 17; Benitez *et al.* 2008, pp. 24–53; PEPP 2008, pp. 106–107; HBMP 2010c). These nonnative plant species pose serious and ongoing threats to the species that depend on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Nonnative Plants in the Montane Wet Ecosystem

Nonnative plant species that threaten 8 of the 13 plant species (*Cyanea marksii, C. tritomantha, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei,* and *Stenogyne cranwelliae*), and the picture-wing fly proposed for listing in this rule that inhabit the montane wet ecosystem on Hawaii Island include the understory and subcanopy species *Clidemia hirta, Erigeron karvinskianus, Hedychium coronarium* (white ginger), *H. gardnerianum, Juncus* spp., *Lantana camara, Passiflora edulis, P. tarminiana, Polygonum punctatum, Rubus argutus, R. ellipticus, R. rosifolius, Tibouchina herbacea, T. urvilleana,* and *Ulex europaeus* (gorse) (Wood 1995, in litt.; Benitez *et al.* 2008, pp. 1–118; Perlman and Bio 2008, in litt.; HBMP 2010c; HBMP 2010d; HBMPe; HBMP 2010f; HBMP 2010h; HBMPi; HMBP 2010j; HBMP 2010k; USFWS 2010, pp. 4–74—4–75). Nonnative canopy species that threaten the nine proposed species include *Sphaeropteris cooperi* and *Psidium cattleianum* (HBMP 2010c; HBMP 2010h; HBMP 2010i). Nonnative grasses that threaten this ecosystem are *Andropogon* ssp., *Axonopus fissifolius* (carpetgrass), *Ehrharta stipoides, Paspalum conjugatum,* and *Setaria palmifolia* (Wood 1995, in litt.; Perlman and Bio 2008, in litt.; HBMP 2010c; HBMP 2010h; HBMP 2010i). These nonnative plant species pose serious and ongoing threats to nine proposed species that depend on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Nonnative Plants in the Dry Cliff Ecosystem

Nonnative plant species that threaten *Bidens hillebrandiana* ssp. *hillebrandiana,* the only plant species proposed for listing in this rule that inhabits the dry cliff ecosystem on Hawaii Island, include the understory and subcanopy species *Lantana camara, Melastoma* spp., and *Pluchea carolinensis* (Perlman and Wood 2006, in litt.; Bio 2011, pers. comm.). Nonnative canopy species that threaten *B. hillebrandiana* ssp. *hillebrandiana* include *Casuarina equisetifolia* and *Psidium cattleianum* (Perlman and Wood 2006, in litt.; Bio 2011, pers. comm.). Nonnative grasses that threaten this ecosystem include *Digitaria setigera* and *Pennisetum setaceum* (Perlman and Wood 2006, in litt.; Bio 2011, pers. comm.). These nonnative plant species pose serious and ongoing threats to all three of the species proposed for listing that depend on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Nonnative Plants in the Wet Cliff Ecosystem

Nonnative plant species that threaten the three plant species (*Cyanea tritomantha, Pritchardia lanigera,* and *Stenogyne cranwelliae*) proposed for listing in this rule that inhabit the wet cliff ecosystem on Hawaii Island include the understory and subcanopy species *Hedychium coronarium, H. gardnerianum, Juncus effusus, Passiflora tarminiana, Rubus rosifolius, Tibouchina herbacea,* and *T. urvilleana*

(HBMP 2010c; HBMP 2010f; HBMP 2010k). The three species in this ecosystem are also threatened by the nonnative grasses *Axonopus fissifolius, Ehrharta stipoides, Paspalum conjugatum,* and *Setaria palmifolia* (HBMP 2010c; HBMP 2010f; HBMP 2010k). These nonnative plant species pose serious and ongoing threats to the three species that depend on this ecosystem (see *Specific Nonnative Plant Species Impacts* below).

Specific Nonnative Plant Species Impacts

Nonnative plants pose serious and ongoing threats to 14 of the 15 species proposed for listing (all except the anchialine pool shrimp) in this rule throughout their ranges by destroying and modifying habitat. They can adversely impact microhabitat by modifying the availability of light and nutrient cycling processes, and by altering soil-water regimes. They can also alter fire regimes affecting native plant habitat, leading to incursions of fire-tolerant nonnative plant species into native habitat. Alteration of fire regimes clearly represents an ecosystem-level change caused by the invasion of nonnative grasses (D'Antonio and Vitousek 1992, p. 73). The grass life form supports standing dead material that burns readily, and grass tissues have large surface-to-volume ratios and can dry out quickly (D'Antonio and Vitousek 1992, p. 73). The flammability of biological materials is determined primarily by their surface-to-volume ratio and moisture content, and secondarily by mineral content and tissue chemistry (D'Antonio and Vitousek 1992, p. 73). The finest size classes of material (mainly grasses) ignite and spread fires under a broader range of conditions than do woody fuels or even surface litter (D'Antonio and Vitousek 1992, p. 73). The grass life form allows rapid recovery following fire; there is little above-ground structural tissue, so almost all new tissue fixes carbon and contributes to growth (D'Antonio and Vitousek 1992, p. 73). Grass canopies also support a microclimate in which surface temperatures are hotter, vapor pressure deficits are larger, and the drying of tissues more rapid than in forests or woodlands (D'Antonio and Vitousek 1992, p. 73). Thus, conditions that favor fire are much more frequent in grasslands (D'Antonio and Vitousek 1992, p. 73).

Nonnative plants outcompete native plants by growing faster, and some may release chemicals that inhibit the growth of other plants. Nonnative plants may also displace native species by preventing their reproduction, usually by shading and taking up available sites for seedling establishment (Vitousek *et al.* 1987, pp. 224–227). These competitive advantages allow nonnative plants to convert native-dominated plant communities to nonnative plant communities (Cuddihy and Stone 1990, p. 74; Vitousek 1992, pp. 33–35). The following list provides a brief description of the nonnative plants that pose a threat to 14 of the 15 species (all except the anchialine pool shrimp) proposed for listing here. The Hawaii-Pacific Weed Risk Assessment is cited in many of the brief descriptions of the nonnative plants below. This assessment was created as a research collaboration between the University of Hawaii and the U.S. Forest Service for use in Hawaii and other high Pacific islands (*i.e.,* volcanic in origin, as opposed to low-lying atolls) and is an adaptation of the Australian-New Zealand Weed Risk Assessment protocol developed in the 1990s (Denslow and Daehler 2004, p. 1). The Australian-New Zealand protocol was developed to screen plants proposed for introduction into those countries, while the Hawaii-Pacific Weed Risk Assessment was developed to evaluate species already used in landscaping, gardening, and forestry, and is used to predict whether or not a nonnative plant species is likely to become invasive. Not all nonnative plant species present in Hawaii have been assessed, and information on species invasiveness is lacking or absent from some of the descriptions below. In general, all nonnative plant species displace native Hawaiian plants; here we describe other specific negative impacts of individual alien plant species when known.

- *Andropogon virginicus* (broomsedge) is a perennial bunchgrass native to northeastern America, now naturalized along roadsides and in disturbed dry to mesic forest and shrubland (O'Connor 1999, p. 1,497). Seeds are easily distributed by wind, clothing, vehicles, and feral animals (Smith 1989, pp. 60–69). *Andropogon virginicus* may release allelopathic substances that dramatically decrease native plant reestablishment (Rice 1972, pp. 752–755). This species has become dominant in areas subjected to natural or human-induced fires (Gagne and Cuddihy 1999, p. 77). *Andropogon virginicus* is on the Hawaii State noxious weed list (Hawaii Administrative Rules (H.A.R.) Title 4, Subtitle 6, Chapter 68).
- *Anemone hupehensis* var. *japonica* (Japanese anemone) is native to China, and is naturalized and locally common in open, wet, disturbed areas along roadsides and in wet forest in Hawaii. The species has wind-distributed seeds, and resists grazing because of toxic chemicals that induce vomiting when ingested. It was designated as a high risk invasive species in the Pacific Islands Ecosystems at Risk (PIER) project.
- *Angiopteris evecta* (mule's foot fern) is native throughout much of the South Pacific, including Australia and New Guinea, and has established invasive populations throughout the Hawaiian Islands (Global Invasive Species Database (GISD) 2011a). Rhizomes form a massive, almost spherical trunk, 5 in (12 cm) high and 39 in (100 cm) in diameter, and fronds may grow up to 20 ft (6 m) long and 8 to 10 ft (2.5 to 3 m) broad, allowing this species to form dense stands that displace and shade out native plants (GISD 2011a).
- *Axonopus fissifolius* (carpetgrass) is a pasture grass that forms dense mats with tall foliage. This species does well in soils with low nitrogen levels, and can outcompete other grasses in wet forests and bogs. In addition, *A. fissifolius* outcompetes native plants for moisture, an impact accentuated by drought (Olaa Kilauea Partnership 2007, p. 3). This species is not subject to any major diseases or insect pests, and recovers quickly from fire. The seeds are readily spread by water, vehicles, and grazing animals (O'Connor 1999, pp. 1,500–1,502; Cook *et al.* 2005, p. 4).
- *Buddleia asiatica* (dog tail) is a shrub or small tree that can tolerate a wide range of habitats, forms dense thickets, and is rapidly spreading into wet forest and lava and cinder substrate areas in Hawaii, displacing native vegetation (Wagner *et al.* 1999e, p. 415; PIER 2011a).
- *Casuarina equisetifolia* (ironwood), native to Australia (Wagner *et al.* 1999f, p. 528–529), is a tree 33 to 66 ft (10 to 20 m) tall (Cronk & Fuller 2001, p. 144 *in* PIER 2011b). This species is a pioneer, salt-resistant tree that forms monotypic stands under which little else grows (PIER 2011b). It is thought that the roots and needle litter exude a chemical that kills other plants. Ironwood trees are fire resistant, and the seeds of this species are wind- and water-dispersed, further contributing to its advantage over native species (Staples & Herbst, 2005, p. 229).
- *Clidemia hirta* (Koster's curse), a noxious shrub in the Melastoma family, forms a dense understory, shades out native plants, and prevents their regeneration (Wagner *et al.* 1985, p. 41; Smith 1989, p. 64). All plants in the Melastoma family are on the Hawaii State noxious weed list (H.A.R. Title 4, Subtitle 6, Chapter 68).

• *Delairea odorata* (cape ivy), a rapidly growing perennial bushy vine native to South Africa, covers and suppresses growth and germination of native species by carpeting the ground and rooting down at leaf nodes. This species can also grow in the canopy, where it smothers native trees, often to the point of death (Benitez *et al.* 2008, pp. 1–115; PIER 2012a; Weeds of Blue Mountain Bushlands 2011).

• *Digitaria setigera* (East Indian crabgrass) is native to tropical Asia from India to Sri Lanka, and the Pacific Islands. The species propagates by seeds and runners, a single flowering stem produces hundreds of seeds. This species is a serious weed, which was accidently introduced to Hawaii and first collected around 1864.

• *Ehrharta stipoides* (meadow rice grass) is a grass that creates a thick mat in which other species cannot regenerate; its seeds are easily dispersed by awns (slender, terminal bristle-like process found at the spikelette in many grasses) that attach to fur or clothing (U.S. Army Garrison 2006, p. 2–1–20).

• *Erigeron karvinskianus* (daisy fleabane) is a sprawling, perennial herb that reproduces and spreads rapidly by stem layering and regrowth of broken roots to form dense mats. This species crowds out and displaces ground-level plants (Weeds of Blue Mountains Bushland 2008).

• *Falcataria moluccana* (albizia), native to Moluccas, New Guinea, New Britain, and the Solomon Islands, is a tree that can reach up to 131 ft (40 m) tall with wide-spreading branches. Albizia is commonly used as a shade plant for coffee plants in plantations in many parts of the world. This species grows very rapidly. Albizia can quickly establish in disturbed and nondisturbed mesic to wet areas (PIER 2011c; GISD 2011b). Its rapid growth habit enables it to outcompete slow-growing native trees by reducing light availability, and its abundant, high-quality litter alters nutrient dynamics in the soil (GISD 2011b). Increased nitrogen in the soil may favor nonnative plant species (GISD 2011b).

• *Grevillea* spp. are medium to large evergreen trees native to Australia. Over two million *Grevillea robusta* trees were planted in the Hawaii Islands between 1919 and 1959, in an effort to reduce erosion and to provide timber. The leaves produce an allelopathic substance that inhibits the establishment of all other plant species underneath the canopy (Smith 1985, p. 191). This species has been documented in dry and moist forests, and open areas in Hawaii (Smith 1985, p. 191). *Grevillea banksii* is similar to *G. robusta* in most features and is considered a major infestation in the Kau district on Hawaii Island.

• *Hedychium* spp. (ginger) are native to India and the Himalayas (Nagata 1999, p. 1,623; Motooka *et al.* 2003a). *Hedychium gardnerianum* (kahili ginger) and *H. coronarium* (white ginger) are both showy gingers introduced for ornamental purposes. *Hedychium gardnerianum* was first collected in 1954, at HVNP (Wester 1992, pp. 99–154; Nagata 1999, p. 1,623). This species grows over 3 ft (1 m) tall in open, light environments; however it will readily grow in full shade beneath a forest canopy (Smith 1985, pp. 191–192). It forms vast, dense colonies, displacing other plant species, and reproduces by rhizomes where already established. The conspicuous, fleshy, red seeds are dispersed by fruit-eating birds as well as humans. *Hedychium coronarium* is a herbaceous perennial that grows 3 to 7 ft (1 to 2 m) tall and favors wet habitats (GISD 2011c; PIER 2012b). This species is shade tolerant but can grow in exposed full sun (Csurhes and Hannan-Jones 2008, p. 7). Similar to *H. gardnerianum,* the creeping growth habit of *H. coronarium* overwhelms low-growing native plants, and this species is difficult to control due to the presence of rhizomes (Csurhes and Hannan-Jones 2008, p. 7; GISD 2011c). In addition to outcompeting native plants, *Hedychium* spp. reduce the amount of nitrogen in the *Metrosideros* forest canopy in Hawaii, thus impacting the availability of nutrients for native plants (Asner and Vitousek 2005, in litt.; Jordan *et al.* 2008, pp. 177–190). It may also block stream edges, altering water flow (GISD 2011c), which can subsequently lead to watershed degradation and decline in moisture regimes that are necessary to support native plants.

• *Heterotheca grandiflora* (telegraph weed) is an annual or biennial herb native to California and Mexico, as well as a common weed of dry, disturbed areas on Hawaii Island (PIER 2011d). This species is an opportunistic colonizer that grows quickly, forms dense stands, and inhibits recruitment of native plants (Csurhes 2009, p. 2; PIER 2011d).

• *Juncus effusus* (Japanese mat rush) is a perennial herb widely distributed in temperate regions and naturalized in Hawaii in ponds, streams, and open boggy sites. It was brought to Hawaii as a source of matting material, but grew too slowly to be of commercial value (Coffey 1999, p. 1,453). This plant spreads by seeds and rhizomes, and forms dense mats that crowd-out native plants (United States Department of Agriculture—Agricultural Research Division—National Genetic Resources Program (USDA–ARS–NGRP) 2011—*Germplasm Resources Information Network (GRIN) Online Database;* USDA–Natural Resources Conservation Service (NRCS) 2012a—*Plants database*).

• *Juncus ensifolius* (dagger-leaved rush), a perennial herb native to the western United States, is naturalized in Hawaii and occurs in standing water of marshy areas (Coffey 1999, p. 1,453). This weedy colonizer can tolerate environmental stress and outcompete native species (USDA–NRCS 2012b—*Plants Database*).

• *Juncus planifolius* (bog rush) is a perennial herb that is naturalized in Hawaii in moist, open, disturbed depressions on margins of forests and in bogs (Coffey 1999, pp. 1,453–1,454). This species forms dense mats and has the potential to displace native plants by preventing establishment of native seedlings (Medeiros *et al.* 1991, pp. 22–23).

• *Lantana camara* (lantana), a malodorous, branched shrub up to 10 ft (3 m) tall, was brought to Hawaii as an ornamental plant. Lantana is aggressive, thorny, and forms thickets, crowding out and preventing the establishment of native plants (Davis *et al.* 1992, p. 412; Wagner *et al.* 1999g, p. 1,320).

• *Leucana leucocephala* (koa haole), a shrub native to the neotropics, is a nitrogen-fixer and an aggressive competitor that often forms the dominant element of the vegetation in low-elevation, dry, disturbed areas in Hawaii (Geesink *et al.* 1999, pp. 679–680).

• Plants in the genus *Melastoma* are ornamental shrubs native to southeast Asia and all species are on the Hawaii State noxious weed list (H.A.R. Title 4, Subtitle 6, Chapter 68). *Melastoma* species have high germination rates, rapid growth, early maturity, ability of fragments to root, possible asexual reproduction, and efficient seed dispersal (especially by birds that are attracted by copious production of berries) (Smith 1985, p. 194; University of Florida Herbarium 2008, pp. 1–2). These characteristics enable the plants to be aggressive competitors in Hawaiian ecosystems.

• *Melinis repens* (natal redtop), a perennial grass native to Africa, is now widely naturalized in the tropics and in Hawaii. It invades disturbed dry areas from coastal regions to subalpine forest (Gould 1977–*Desert Museum database;* O'Connor 1999, p. 1,588). Dense stands of this species can contribute to recurrent fires (Gould 1977–*Desert Museum database*).

• *Miconia calvescens* (miconia), a tree native to the neotropics, first appeared on Oahu and the island of Hawaii as an introduced garden plant, and has escaped from cultivation (Almeda 1999, p. 903). Miconia is remarkable for its 2- to 3-ft (70-cm) long, dark purple leaves. It reproduces in dense shade, eventually shading out all other plants to form a monoculture. A single mature plant produces millions of seeds per year, which are spread by birds, ungulates, and humans (Motooka *et al.* 2003b). According to the Hawaii Weed Risk Assessment for *M. calvescens,* this species has a high risk of invasiveness or a high risk of becoming a serious pest (PIER 2010). This species, as well all plants in the Melastoma family, are on the Hawaii State noxious weed list (H.A.R. Title 4, Subtitle 6, Chapter 68).

• *Omalanthus populifolius* (Queensland poplar) is a large shrub native to Australia that is now naturalized in disturbed mesic forests up to 3,280 ft (1,000 m) elevation on Hawaii Island (Starr *et al.* 2003, in litt.). Seeds of this species are spread by birds, water, and machinery-such as roadside mowers (PIER 2011e). *Omalanthus populifolius* has the potential to colonize entire gulches, displacing and inhibiting the regeneration of native plants (Oppenheimer 2004, p. 11).

• *Paspalum conjugatum* (Hilo grass) is a perennial grass that is found in wet habitats and forms a dense ground cover. Its small, hairy seeds are easily transported on humans and animals, or are carried by the wind through native forests, where it establishes and displaces native vegetation (Tomich 1986, p. 125; Cuddihy and Stone 1990, p. 83; Motooka *et. al.* 2003c; PIER 2008a).

• *Passiflora edulis* (passion fruit), native to South America, is a vigorous vine that can reach up to 49 ft (15 m) in length. In Hawaii, its seeds are spread by feral pigs, and it can be found in agricultural areas, natural forests, disturbed sites, and shrublands (GISD 2012a). *Passiflora edulis* overgrows and smothers the forest canopy, and its fruit encourages rooting and trampling by feral pigs.

• *Passiflora tarminiana* (banana poka), a vine native to South America, is widely cultivated for its fruit (Escobar 1999, pp. 1,010–1,012). First introduced to Hawaii in the 1920s, it is now a serious pest in mesic forest, where it overgrows and smothers the forest canopy. Seeds are readily dispersed by humans, birds, and feral pigs (La Rosa 1992, pp. 281–282). Fallen fruit encourage rooting and trampling by pigs (Diong 1982, pp. 157–158). Field releases of biocontrol agents to control the spread of this species have not been successful to date.

• *Pennisetum setaceum* (fountain grass) is a grass that is an aggressive colonizer that outcompetes most native species by forming widespread, dense, thick mats. This species is also fire-adapted and burns swiftly and hot, causing extensive damage to the surrounding habitat (O'Connor 1999, p. 1,581). Fountain grass occurs in dry, open places; barren lava flows; and cinder fields, and it is estimated to cover hundreds of thousands of acres on the island of Hawaii (O'Connor 1999, p. 1,578; Fox 2011, in litt.).

• *Pluchea* spp. are 3- to 6-ft (1- to 2-m) tall, fast-growing shrubs that form thickets in dry habitats and can tolerate saline conditions. *Pluchea carolinensis* (sourbush) is native to Mexico, the West Indies, and South America (Wagner *et al.* 1999h, p. 351), and *Pluchea indica* (Indian fleabane), is native to southern Asia (Wagner *et al.* 1999h, p. 351). The seeds are wind-dispersed (Francis 2004, pp. 577–579). Both species are adapted to a wide variety of soils and sites, tolerate excessively well-drained to poorly-drained soil conditions, the full range of soil textures, acid and alkaline reactions, salt and salt spray, and compaction. They quickly invade burned areas, but being early successional, they are soon replaced by other species. These adaptive capabilities increase the species' competitive abilities over native plants.

• *Polygonum punctatum* (water smartweed), native to North America, South America, and the West Indies, is a naturalized, aquatic species found along streambeds, in wet areas, in running or standing water, and in disturbed forest sites on Hawaii Island (Wagner *et al.* 1999i, p. 1064). This species is fast-growing but short-lived, and has long-lived seeds and allelopathic properties (Gutscher 2007, in litt.). Loh and Tunison (1998, p. 5) found that in pig-disturbed sites, *P. punctatum* expanded from 25 percent to 62.5 percent cover in 2 years. The combination of rapid growth, long-lived seeds, and allelopathic properties allows this species to form dense patches that prohibit the establishment of native plants after disturbance events.

• *Prosopis pallida* (kiawe), a large tree up to 30 ft (9 m) tall, was introduced to Hawaii from northwestern South America in 1828, and its seeds were used as fodder for ranch animals (Motooka *et al.* 2003d). This species is now a dominant component of the vegetation in low-elevation disturbed sites, and it is well adapted to dry habitats. It overshadows other vegetation and has deep tap roots that significantly reduce available water for native dryland plants. This plant fixes nitrogen and can outcompete native species (Geesink *et al.* 1999, pp. 692–693; Obiri 2011, p. 421). This species is on the U.S. Federal noxious weed list (USDA–NRCS 2012c–*Plants database*).

• *Psidium cattleianum* (strawberry guava) is a tall shrub or tree that forms dense stands in which few other plants can grow, displacing native vegetation through competition. The fruit is eaten by feral pigs and birds that disperse the seeds throughout the forest (Smith 1985, p. 200; Wagner *et al.* 1985, p. 24).

• *Rubus argutus* (prickly Florida blackberry) is a prickly bramble with long-arching stems, and reproduces both vegetatively and by seed. It readily sprouts from underground runners, and is quickly spread by frugivorous (fruit-eating) birds (Tunison 1991, p. 2; Wagner *et al.* 1999j, p. 1,107; U.S. Army Garrison 2006, pp. 2–1–21–2–1–22). This species, which displaces native vegetation through competition, is on the Hawaii State noxious weed list (H.A.R. Title 4, subtitle 6, Chapter 68).

• *Rubus ellipticus* (yellow Himalayan raspberry), native to India, is a prickly bramble with long arching stems up to 13 ft (4 m) long that smother smaller plants, including native species. This species occurs in wet areas in the Volcano and Laupahoehoe areas on Hawaii Island (Motooka *et al.* 2003e).

• *Rubus rosifolius* (thimbleberry) is an erect to trailing shrub that forms dense thickets and outcompetes native plant species. It easily reproduces from roots left in the ground, and seeds are spread by birds and feral animals (GISD 2008; PIER 2008b).

• *Schefflera actinophylla* (octopus tree) is a tree native to Australia and New Guinea, is found in low-elevation, disturbed and undisturbed, mesic and wet habitats in Hawaii (Lowry 1999, p. 232; Motooka *et al.* 2003f). This species is shade tolerant and can spread deep into undisturbed forests, forming dense thickets, as its numerous seeds are readily dispersed by birds (Motooka *et al.* 2003f; PIER 2012c). *Schefflera actinophylla* grows epiphytically, strangling its host tree (PIER 2012c).

• *Schinus terebinthifolius* (christmasberry, also known as Brazilian pepper), native to South America, forms dense thickets in all habitats, and its red berries are attractive to and dispersed by birds (Smith 1989, p. 63). *Schinus* seedlings grow very slowly and can survive in dense shade, exhibiting vigorous growth when the canopy is opened after a disturbance (Brazilian Pepper Task Force 1997). Because of these attributes, *S. terebinthifolius* is

able to displace native vegetation through competition.

• *Senecio madagascariensis* (Madagascar fireweed), native to Madagascar and South Africa, is a short-lived perennial plant that is on the State of Hawaii's noxious weed list (PIER 2011f). Each *S. madagascariensis* plant can produce abundant seeds each year that are easily distributed by wind (The State of Queensland, Department of Employment, Economic Development and Innovation 2011, pp. 1–4). This combination of long-range dispersal of its seeds and its allelopathic properties enables this species to successfully outcompete native plants (Daehler 2011, in litt.)

• *Setaria palmifolia* (palmgrass), native to tropical Asia, was first collected on Hawaii Island in 1903 (O'Connor 1999, p. 1,592). A large-leafed perennial herb, this species reaches approximately 6.5 ft (2 m) in height at maturity, and shades out native vegetation. Palmgrass is resistant to fire and recovers quickly after being burned (Cuddihy and Stone 1990, p. 83).

• *Sphaeropteris cooperi* (Australian tree fern) is a tree fern native to Australia that was brought to Hawaii for use in landscaping (Medeiros *et al.* 1992, p. 27). It can achieve high densities in native Hawaiian forests, grows up to 1 ft (0.3 m) in height per year (Jones and Clemesha 1976, p. 56), and can displace native species. Understory disturbance by feral pigs facilitates the establishment of this species (Medeiros *et al.* 1992, p. 30), and it has been known to spread over 7 mi (12 km) through windblown dispersal of spores from plant nurseries (Medeiros *et al.* 1992, p. 29).

• *Tibouchina* species are herbs, shrubs, or trees native to South America. All members of this genus are on the Hawaii State noxious weed list (H.A.R. Title 4, Subtitle 6, Chapter 68). *Tibouchina herbacea* (glorybush), an herb or shrub up to 3 ft (1 m) tall, is native to southern Brazil, Uruguay, and Paraguay. In Hawaii, it is naturalized and abundant in disturbed mesic to wet forest on the islands of Molokai, Lanai, Maui, and Hawaii (Almeda 1999, p. 915). It forms dense thickets, crowding out all other plant species and inhibits regeneration of native plants (Motooka *et al.* 2003g). *Tibouchina urvilleana* (princess flower), a shrub or small tree up to 3-to 14-ft (1-to 4-m) tall, is native to southern Brazil (Almeda 1999, p. 916). Naturalized on Kauai, Oahu, Maui, and Hawaii, this species forms dense thickets in disturbed areas of wet forest, crowding out all other plant species and inhibiting regeneration of native plants.

• *Ulex europaeus* (gorse), a woody legume up to 12 ft (4 m) tall and covered with spines, is native to Western Europe (Geesink *et al.* 1999, pp. 715–716). It is cultivated as a hedge and fodder plant, and was inadvertently introduced to Hawaii before 1910, with the establishment of the wood industry (Tulang 1992, pp. 577–583; Geesink *et al.* 1999, pp. 715–716). Gorse spreads numerous seeds by explosive opening of the pods (Mallinson 2011, pp. 1–2). It can rapidly form extensive dense and impenetrable infestations, and competes with native plants, preventing their establishment. Dense patches can also present a fire hazard (Mallinson 2011, pp. 1–2). Over 20,000 ac (8,094 ha) are infested by gorse on the island of Hawaii, and over 15,000 ac (6,070 ha) are infested on Maui (Tulang 1992, pp. 577–583). Gorse is on the Hawaii State noxious weed list (H.A.R. Title 4, Subtitle 6, Chapter 68).

Habitat Destruction and Modification by Fire

Fire is an increasing, human-exacerbated threat to native species and native ecosystems 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). It is believed that prior to human colonization, fuel was sparse and inflammable in wet plant communities and seasonally flammable in mesic and dry plant communities. The primary ignition sources were volcanism and lightning (Baker *et al.* 2009, p. 43). Natural fuel beds were often discontinuous, and rainfall in many areas on most islands was, and is, moderate to high. 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. Pasturage and ranching, in particular, created high fire-prone areas of nonnative grasses and shrubs (D'Antonio and Vitousek 1992, p. 67). Although fires were historically infrequent in mountainous regions, extensive fires have recently occurred in lowland dry and lowland mesic areas, leading to grass-fire cycles that convert forest to grasslands (D'Antonio and Vitousek 1992, p. 77).

Because several Hawaiian plants show some tolerance of fire, Vogl proposed that naturally occurring fires may have been important in the development of the original Hawaiian flora (Vogl 1969 in Cuddihy and Stone 1990, p. 91; Smith and Tunison 1992, p. 394). However, Mueller-Dombois (1981 in Cuddihy and Stone 1990, p. 91) points out that most natural vegetation types in Hawaii would not carry fire before the introduction of alien grasses, and Smith and Tunison (1992, p. 396) state that native plant fuels typically have low flammability. Because of the greater frequency, intensity, and duration of fires that have resulted from the introduction of nonnative plants (especially grasses), fires are now 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 (D'Antonio and Vitousek 1992, p. 74).

Fire represents a threat to four of the species proposed for listing (the plants *Bidens micrantha* ssp. *ctenophylla, Phyllostegia floribunda,* and *Schiedea hawaiiensis;* and the picture-wing fly) found in the lowland dry, lowland mesic, lowland wet, montane dry, and montane mesic ecosystems addressed in this proposed rule (see Table 3). Fire can destroy dormant seeds of these species as well as plants themselves, even in steep or inaccessible areas. Successive fires that burn farther and farther into native habitat destroy native plants and remove habitat for native species by altering microclimate conditions favorable to alien plants. Alien plant species most likely to be spread as a consequence of fire are those that produce a high fuel load, are adapted to survive and regenerate after fire, and 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 (Fujioka and Fujii 1980 in Cuddihy and Stone 1990, p. 93; D'Antonio 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 shifts the competitive balance toward alien species (National Park Service (NPS) 1989, in Cuddihy and Stone 1990, p. 93). On a post-burn survey at Puuwaawaa on Hawaii Island, an area of native *Diospyros* forest with undergrowth of the nonnative grass *Pennisetum setaceum,* Takeuchi noted

that ''no regeneration of native canopy is occurring within the Puuwaawaa burn area'' (Takeuchi 1991, p. 2). Takeuchi (1991, pp. 4, 6) also stated that ''burn events served to accelerate a decline process already in place, compressing into days a sequence that would ordinarily take decades,'' and concluded that in addition to increasing the number of fires, the nonnative *Pennisetum* acted to suppress the establishment of native plants after a fire.

For decades, fires have impacted rare or endangered species and areas previously designated or proposed for critical habitat designation in this rule (HDOFAW 2002, pp. 1, 4–6; Dayton 2007, in litt.; Joint Fire Science Program (JFSP) 2009, pp. 1–12; Weise *et al.* 2010, pp. 199–220; Kakesako 2011, in litt.). On the island of Hawaii, wildfires are caused primarily by lava flows, humans, and lightning, all of which are exacerbated by severe drought and nonnative grasses (*e.g., Pennisetum setaceum*) (Dayton 2007, in litt.; JFSP 2009, pp. 1–6; Armstrong and Media 2010, in litt.; Weise *et al.* 2010, pp. 199–216; Adkins *et al.* 2011, p. 17; Hawaii County Major.com–accessed September 7, 2011; Burnett 2010, in litt.; KHON2, June 6, 2011). Between 2002 and 2003, three successive lava-ignited wildfires in the east rift zone of HVNP affected native forests in lowland dry, lowland mesic, and lowland wet ecosystems (JFSP 2009, p. 3), cumulatively burning an estimated 11,225 ac (4,543 ha) (Wildfire News, June 9, 2003; JFSP 2009, p. 3). These fires destroyed over 95 percent of the canopy cover in the burned areas and encroached upon rainforests (*i.e.,* forests in the lowland wet ecosystem) that were previously thought to have low susceptibility or even be relatively immune to wildfires (JFSP 2009, pp. 2–3; Wildfire News, June 9, 2003). After the fires, nonnative ferns were reported in the higher elevation rainforests where they had not previously been observed, and were believed to inhibit the ability of the dominant native *Metrosideros polymorpha* (ohia) trees to recover (JFSP 2003, pp. 1–2). Nonnative flammable grasses also spread in the area, under the dead ohia trees (Ainsworth 2011, in litt.), increasing the risk of fire in surrounding native forested areas. In 2011, the Napau Crater wildfire, ignited by an eruption at the Kamoamoa fissure in HVNP, consumed over 2,076 ac (840 ha), including 100 ac (40 ha) of the 2,750 ac (1,113 ha*)* east rift zone's special ecological area (Ainsworth 2011, in litt.; Kakesako 2011, in litt.). Special ecological areas (SEA) are HVNP's most intact and intensively managed natural systems (Tunison and Stone 1992, pp. 781–798). The plant *Phyllostegia floribunda,* proposed for listing in this rule, is known from the east rift zone's Napau Crater, in the lowland wet ecosystem (Belfield 1998, pp. 9, 11–13, 23; Pratt 2007b, in litt.; HBMP 2010h). In addition, historical records report that the plant *Cyanea tritomantha,* proposed for listing in this rule, also occurred in this area, in the same ecosystem; however the last survey that reported this occurrence was over 25 years ago (Lamoureux *et al.* 1985, pp. 105, 107–108; HBMP 2010h).

Fire is a threat to the Kona (leeward) side of Hawaii Island. In the past 50 years, there have been three wildfires that burned 20,000 ac (8,094 ha) or more: (1) 20,000 ac (8,094 ha) burned at Puuwaawaa Ranch in 1985; (2) 20,000 acres (8,094 ha) burned at PTA in 1994; and (3) 25,000 ac (10,117 ha) burned in Waikoloa in 2005 (Thompson 2005, in litt.). The only known occurrence (25 to 40 individuals) of the plant *Schiedea hawaiiensis,* proposed for listing in this rule, is found on the U.S. Army's Pohakuloa Training Area (PTA), and the 1994 fire burned to within 2 mi (4 km) of this species (U.S. Army Garrison 2006, p. 34; Evans 2011, in litt.). Although this fire may seem relatively distant from *S. hawaiiensis,* wildfires can travel from 4 to 8 miles per hour (mph) (6.5 to 13 kilometers per hour (kph)), and burn 2.5 ac (1 ha) to 6 ac (2.5 ha) per minute (the equivalent of 6 to 8 football fields per minute), depending on the fuel type, wind, and slope of land (Burn Institute 2009, p. 4). In 2011, a 500-ac (202-ha) wildfire ignited by lightning and fueled by nonnative *Pennisetum setaceum* burned within the State's Puu Anahulu Game Management Area (GMA) and encroached within a quarter-mile (0.5 km) of PTA (KHON2, June 6, 2011). The Puu Anahulu GMA lies just 3 mi (5 km) northwest of the only known occurrence of *S. hawaiiensis* in the montane dry ecosystem. Also in 2011, a 120-ac (49-ha) wildfire broke out near Kaiminani Street (Jensen 2011, in litt.), just north of Hina Lani Road, in the lowland dry ecosystem, where the largest occurrence of the plant species *Bidens micrantha* ssp. *ctenophylla,* proposed for listing in this rule, is found. In addition, the threat of fire to this species is increased by its occurrence in areas bordered by residential developments, schools, and roads, which provide numerous ignition sources from the high volume of human traffic. A recent fire at the Villages of Laiopua subdivision at Kealakehe, known to have been intentionally set, threatened to burn an area that supports *B. micrantha* ssp. *ctenophylla* (Knoche 2012, in litt.). Although no *B. micrantha* ssp. *ctenophylla* individuals were burned, the immediate proximity of the fire to occupied and unoccupied habitat for this species demonstrates the threat of fire to *B. micrantha* ssp. *ctenophylla* in the lowland dry ecosystem at Kealakehe.

Fire is also a threat to the picture-wing fly, proposed for listing in this rule, at one of its two known locations (the Manuka NAR) due to the ongoing extreme drought conditions in this region and the resulting accumulation of dead trees (*i.e.,* fuel load), in the lowland mesic and montane mesic ecosystems (Magnacca 2011b, pers. comm.).

Throughout the Hawaiian Islands, increased fuel loads and human-ignited fires caused the average acreage burned to increase five-fold from the early 1900s (1904 to 1939) to the mid-1900s (1940 to 1976) (La Rosa *et al.* 2008, p. 231). In HVNP, fires were three times more frequent and 60 times larger, on average, from the late 1960s to 1995, when compared to data spanning 1934 to the late 1960s (Tunison *et al.* 2001 *in* La Rosa *et al.* 2008, p. 231). The historical fire regimes have been altered from typically rare events to more frequent events, largely a result of continuous fine fuel loads associated with the presence of the fire-tolerant, nonnative fountain grass and the grass-fire feedback cycle that promotes its establishment (La Rosa *et al.* 2008, pp. 240–241; Pau 2009, in litt.). Extreme drought conditions are also contributing to the number and intensity of the wildfires on Hawaii Island (Armstrong and Media 2010, in litt.; Loh 2010, in litt.). In addition, the combination of El Niño conditions (see ''Habitat Destruction and Modification by Climate Change,'' below) in the Pacific, a half-century decline in annual rainfall, and intermittent dry spells have fueled wildfires throughout all of the main Hawaiian Islands (Marcus 2010, in litt.). The entire State is experiencing dry conditions, but Hawaii Island appears to be significantly impacted (Kodama 2010, in litt.; USDA–FSA 2012, in litt.).

Fire is a threat to three plant species (*Bidens micrantha* ssp. *ctenophylla, Phyllostegia floribunda,* and *Schiedea hawaiiensis*), and the picture-wing fly (*Drosophila digressa*), reported from Hawaii Island's lowland dry, lowland mesic, lowland wet, montane dry, and montane mesic ecosystems, because individuals of these species or their habitat are located in or near areas that were burned in previous fires or in areas at risk for fire due to volcanic activity,

drought, or the presence of highly flammable nonnative grasses and shrubs.

Habitat Destruction and Modification by Hurricanes

Hurricanes adversely impact native Hawaiian terrestrial habitat and exacerbate the impacts resulting from other threats such as habitat degradation by ungulates and competition with nonnative plants. They do this by destroying native vegetation, opening the canopy and thus modifying the availability of light, and creating disturbed areas conducive to invasion by nonnative pest species (see ''*Specific Nonnative Plant Species Impacts,*'' above) (Asner and Goldstein 1997, p. 148; Harrington *et al.* 1997, pp. 539–540). Because many Hawaiian plant and animal species persist in low numbers and in restricted ranges, natural disasters, such as hurricanes, can be particularly devastating (Mitchell *et al.* 2005a, pp. 3–4).

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 mph (161 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). Competition with nonnative plants is a threat to 9 of the 10 ecosystems that support all 13 plant species and the picture-wing fly (*Drosophila digressa*), proposed for listing in this rule, as described above in ''*Habitat Destruction and Modification by Nonnative Plants.*'' Nonnative plants also compete with the native host plants of the picture-wing fly.

In addition to the habitat destruction and nonnative plant introduction resulting from hurricanes, high winds and intense rains from hurricanes can directly kill individual picture-wing flies to the point of decimating an entire population (Carson 1986, p. 7; Foote and Carson 1995, pp. 369–370). High winds can also dislodge fly larvae from their host plants, destroy host plants, and expose the fly larvae to predation by nonnative yellowjacket wasps (see ''*Factor C. Disease or Predation,*'' below) (Carson 1986, p. 7; Foote and Carson 1995, p. 371).

Since 1950, 13 hurricanes have passed near but not over Hawaii Island. Eleven of these hurricanes brought heavy rain, strong wind, or high surf to the island, which caused erosion, flash floods, and other damage (Fletcher III *et al.* 2002, pp. 11–17; National Weather Service *et al.* 2010, pp. 1–22). In 1994, tropical depression 1C brought over 14 in (36 cm) of rain in just a few days to windward sections of Hawaii Island (National Oceanic Atmospheric Administration (NOAA) 1994, pp. 4–5; National Weather Service *et al.* 2010, pp. 4–5).

Although there is historical evidence of only one hurricane (1861) that approached from the east and impacted the islands of Maui and Hawaii (Businger 1998, p.3), damage from future hurricanes could further decrease the remaining native plant-dominated habitat areas that support the 13 plant species, and the picture-wing fly proposed for listing in this rule in 9 of the described ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff).

Habitat Destruction and Modification Due to Rockfalls, Treefalls, Landslides, Heavy Rain, Erosion, and Drought

Rockfalls, treefalls, landslides, heavy rain, and erosion damage and destroy individual plants, destabilize substrates, and alter hydrological patterns that result in changes to native plant and animal communities. In the open sea near Hawaii, rainfall averages 25 to 30 in (635 to 762 mm) per year, yet the islands may receive up to 15 times this amount in some places, caused by orographic features (physical geography of mountains) (Wagner *et al.* 1999a, pp. 36–44). During storms, rain may fall at 3 in (76 mm) per hour or more, and sometimes may reach nearly 40 in (1,000 mm) in 24 hours, causing destructive flash-flooding in streams and narrow gulches (Wagner *et al.* 1999a, pp. 36–44). Due to the steep topography of some areas on Hawaii Island where 4 of the 13 plants proposed for listing in this rule remain, erosion and disturbance caused by introduced ungulates exacerbates the potential for rockfalls, treefalls, and landslides, which in turn are a threat to native plants. Such events have the potential to eliminate all individuals of a population, or even all populations of a species, resulting in a greater likelihood of extinction due to the lack of redundancy and resilience of the species caused by their reduced numbers and geographic range.

Rockfalls, treefalls, landslides, heavy rain, and subsequent erosion are a threat to four of the plant species (*Bidens hillebrandiana* ssp. *hillebrandiana, Cyanea marksii, Cyanea tritomantha,* and *Cyrtandra wagneri*) addressed in this proposed rule (Lorence and Perlman 2007, p. 359; PEPP 2010, p. 52; Bio 2011, pers. comm.). Monitoring data from PEPP and other field biologists and surveyors suggest that these four species are threatened by these events as they are found in landscape settings susceptible to these events (*e.g.,* lava tubes, stream banks, steep slopes and cliffs). Field survey data presented by PEPP and other field biologists document that individuals of *Bidens hillebrandiana* ssp. *hillebrandiana* that occur on steep sea cliffs are threatened by rockfalls and landslides, 1 of the 27 known individuals of *Cyanea marksii* is threatened by falling rocks and landslides, and individuals of *Cyanea tritomantha* are threatened by treefalls (PEPP 2007, p. 52; Bio 2011, pers. comm.). Field survey data presented by Lorence and Perlman (2007, p. 359) suggest that heavy rains and subsequent erosion threaten the only known location of *Cyrtandra wagneri* on a stream bank in the Laupahoehoe NAR. Since *Cyrtandra wagneri* is currently only known from a total of eight individuals along the steep banks of Kilau Stream, heavy rains and erosion could lead to near extirpation or even extinction of this species by direct destruction of the individual plants, mechanical damage to individual plants that could lead to their death, or destabilization of the stream bank habitat leading to additional erosion.

Two plant species, *Bidens micrantha* ssp. *ctenophylla* and *Schiedea hawaiiensis,* and the picture-wing fly (*Drosophila digressa*), proposed for listing in this rule may also be affected by habitat loss or degradation associated with droughts, which are not uncommon in the Hawaiian Islands (HDLNR 2009, pp. 1–6; Hawaii State Civil Defense 2011, pp. 14–1–14–12; U.S. National Drought Mitigation Center (NDMC) 2012—*Online Archives*). Between 1901 and 2011, there have been at least 18 serious or severe droughts that have impacted Hawaii Island, including the current drought that began in 2008 and has led to the island's first ever drought exceptional designation (the highest drought level rating on the scale) (between March and December of 2010) (HDLNR 2009, pp. 1–6; Hawaii Civil Defense 2011, pp. 14–1–14–12). According to the NDMC's drought rating system, most of the island has been rated as in severe drought since 2008, with extreme drought ratings intermittently in some

portions of the island (NDMC 2012—*Online Archives*). Giambelluca *et al.* (1991, pp. 3–4) compiled descriptive accounts of drought throughout the Hawaiian Islands between 1860 and 1986, and found that 87 episodes of drought occurred on Hawaii Island between those years, although some of those episodes occurred for periods as short as one month. The 2011 winter weather system brought periods of heavy rain from Kauai to Maui; however these systems weakened or moved away from Hawaii Island, leaving the typically wet windward slopes of the island under moderate drought conditions (NOAA 2011—*Online Climate Data Center*). The entire windward side of Hawaii Island is currently in an abnormally dry state (NDMC 2011—*Online Archives;* NDMC 2012—*Online Archives*).

Pohakuloa Training Area (the location of the only known individuals of the plant *Schiedea hawaiiensis*) was rated as experiencing extreme drought during the spring of 2011 (Hawaii State Civil Defense 2011, pp. 14–1–14–12), and in 2010, as well as most of north and south Kona. North Kona, including the lowland dry ecosystem that supports the largest occurrence of the plant *Bidens micrantha* ssp. *ctenophylla,* has been experiencing conditions of extreme to severe drought over the past few years. One of the two known extant populations of the picture-wing fly (*Drosophila digressa*) is found in the lowland mesic ecosystem in south Kona, in an area that has also experienced extreme to severe drought over the past few years. Drought alters the decay processes of the picture-wing fly's host plants and the entire plant community on which the fly depends. Monitoring data collected in HVNP during a drought period between 1981 and 1982 suggest that drought was associated with a reduction in the number of picture-wing flies one year following the drought (Carson 1986, pp. 4, 7). In addition, the ongoing drought in south Kona has resulted in an increasing accumulation of dead trees in the Manuka NAR, which increases the fuel load and threat of wildfires in the area where one of the two known occurrences of the picture-wing fly occurs (Magnacca 2011b, pers. comm.).

Severe episodes of drought cannot only directly kill individuals of a species or entire populations, but drought frequently leads to an increase in the number and intensity of forest and brush fires (see ''Habitat Degradation and Modification by Fire,'' above), causing a reduction of native plant cover and habitat, an increase in nonnative plant and animal species, and a reduction in availability of host plants for the picture-wing fly (Giambelluca *et al.* 1991, p. v; D'Antonio and Vitousek 1992, pp. 77–79; HDLNR 2009, pp. 1–6; Hawaii Civil Defense 2011, pp. 14–1–14–12). Ecosystems altered by drought and subsequent fires are further altered by the introduction of nonnative species that outcompete native species for basic life-cycle requirements (see ''Habitat Destruction and Modification by Nonnative Plants,'' above). To further exacerbate the situation, nonnative ungulate patterns may be altered as observed on Maui, where recent episodes of drought have driven axis deer (*Axis axis*) farther into urban and forested areas for food, increasing their negative impacts to native vegetation from herbivory and trampling (Waring 1996, in litt., p. 5; Nishibayashi 2001, in litt.). Due to the recent widespread increase in frequency and intensity of drought on the island of Hawaii, even the wettest forests on the windward side of the island may be threatened by long-term drought (JFSP 2009, pp. 1–12). Prolonged periods of water deprivation caused by drought can also lead to the direct death of the remaining individuals of the plants *Schiedea hawaiiensis* and *Bidens micrantha* ssp. *ctenophylla,* and the picture-wing fly, possibly leading to extinction of one or more of these species. Drought is a direct threat to two of the plant species (*Bidens micrantha* ssp. *ctenophylla* and *Schiedea hawaiiensis*), and the picture-wing fly (*Drosophila digressa*), proposed for listing in this rule, as discussed above.

Habitat Destruction and Modification by Climate Change

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (Le Treut *et al.* 2007, pp. 93–127). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (*e.g.,* temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (Le Treut *et al.* 2007, pp. 93–127). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (*e.g.,* habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Climate change will be a particular challenge for the conservation of biodiversity because the introduction and interaction of additional stressors may push species beyond their ability to survive (Lovejoy 2005, pp. 325–326). The synergistic implications of climate change and habitat fragmentation are the most threatening facet of climate change for biodiversity (Hannah *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. Currently, there are no climate change studies that specifically address impacts to the Hawaii Island ecosystems discussed here or the 15 species proposed for listing that are associated with these ecosystems. Based on the best available information, climate change impacts could lead to the loss of native species that comprise the communities in which the 15 species occur (Pounds *et al.* 1999, pp. 611–612; Still *et al.* 1999, p. 610; Benning *et al.* 2002, pp. 14,246–14,248; Allen *et al.* 2010, pp. 660–662; Sturrock *et al.* 2011, p. 144; Towsend *et al.* 2011, p. 15; Warren 2011, pp. 221–226). In addition, weather regime changes (droughts, floods) will likely result from increased annual average temperatures related to more frequent El Niño episodes in Hawaii (Giambelluca *et al.* 1991, p. v). Future changes in precipitation and the forecast of those changes are highly uncertain because they depend, in part, on how the El Niño-La Niña weather cycle (a disruption of the ocean atmospheric system in the tropical Pacific having important global consequences for weather and climate) might change (State of Hawaii 1998, pp. 2–10). The 15 species proposed for listing may be especially vulnerable to extinction due to anticipated environmental changes that may result from global climate change, due to their small population size and highly restricted ranges. Environmental changes that may affect these species are expected to include habitat loss or alteration and changes in disturbance regimes (*e.g.,* storms and hurricanes).

Climate Change and Ambient Temperature

The average ambient air temperature (at sea level) is projected to increase by about 4.1 degrees Fahrenheit (°F) (2.3 degrees Centigrade (°C)) with a range of 2.7 °F to 6.7 °F (1.5 °C to 3.7 °C) by 2100 worldwide (Trenberth *et al.* 2007, pp. 235–336). These changes would increase the monthly average temperature of the Hawaiian Islands from the current value of 74 °F (23.3 °C) to between 77 °F and 86 °F (25 °C and 30 °C). Historically, temperature has been rising over the last 100 years, with the greatest increase after 1975 (Alexander *et al.* 2006, pp. 1–22; Giambelluca *et al.* 2008, p. 1). The rate of increase at low elevation (0.16 °F; 0.09 °C) per decade is below the observed global temperature rise of 0.32 °F (0.18 °C) per decade (Trenberth *et al.* 2007, pp. 235–336). However, at high elevations, the rate of increase (0.48 °F (0.27 °C) per decade) greatly exceeds the global rate (Trenberth *et al.* 2007, pp. 235–336).

Overall, the daily temperature range in Hawaii is decreasing, resulting in a warmer environment, especially at higher elevations and at night. In the main Hawaiian Islands, predicted changes associated with increases in temperature include a shift in vegetation zones upslope, shift in animal species' ranges, changes in mean precipitation with unpredictable effects on local environments, increased occurrence of drought cycles, and increases in the intensity and number of hurricanes (Loope and Giambelluca 1998, pp. 514–515; U.S. Global Change Research Program (US–GCRP) 2009, pp. 1–188). In addition, weather regime changes (*e.g.,* droughts, floods) will likely result from increased annual average temperatures related to more frequent El Niño episodes in Hawaii (Giambelluca *et al.* 1991, p. v). However, despite considerable progress made by expert scientists toward understanding the impacts of climate change on many of the processes that contribute to El Niño variability, it is not possible to say whether or not El Niño activity will be affected by climate change (Collins *et al.* 2010, p. 391).

Globally, the warming atmosphere is creating a plethora of anticipated and unanticipated environmental changes such as melting ice caps, decline in annual snow mass, sea-level rise, ocean acidification, increase in storm frequency and intensity (*e.g.,* hurricanes, cyclones, and tornadoes), and altered precipitation patterns that contribute to regional increases in floods, heat waves, drought, and wildfires that also displace species and alter or destroy natural ecosystems (Pounds *et al.* 1999, pp. 611–612; IPCC AR4 2007, pp. 26–73; Marshall *et al.* 2008, p. 273; U.S. Climate Change Science Program 2008, pp. 1–164; Flannigan *et al.* 2009, p. 483; US–GCRP 2009, pp. 1–188; Allen *et al.* 2010, pp. 660–662; Warren 2011, pp. 221–226). These environmental changes are predicted to alter species migration patterns, lifecycles, and ecosystem processes such as nutrient cycles, water availability, and decomposition (IPCC AR4 2007, pp. 26–73; Pounds *et al.* 1999, pp. 611–612; Sturrock *et al.* 2011, p. 144; Townsend *et al.* 2011, p. 15; Warren 2011, pp. 221–226). The species extinction rate is predicted to increase congruent with ambient temperature increase (US–GCRP 2009, pp. 1–188). In Hawaii, these environmental changes associated with a rise in ambient temperature can directly and indirectly impact the survival of native plants and animals, including the 15 species proposed for listing in this rule, and the ecosystems that support them.

Climate Change and Precipitation

As global surface temperature rises, the evaporation of water vapor increases, resulting in higher concentrations of water vapor in the atmosphere, further resulting in altered global precipitation patterns (U.S. National Science and Technology Council (US–NSTC) 2008, pp. 69–94; US–GCRP 2009, pp. 1–188). While annual global precipitation has increased over the last 100 years, the combined effect of increases in evaporation and evapotranspiration is causing land surface drying in some regions leading to a greater incidence and severity of drought (US–NSTC 2008, pp. 69–94; US–GCRP 2009, pp. 1–188). Over the past 100 years, the Hawaiian Islands have experienced an annual decline in precipitation of just over 9 percent (US–NSTC 2008, p. 70). Other data on precipitation in Hawaii, which include sea-level precipitation and the added orographic effects, show a steady and significant decline of about 15 percent over the last 15 to 20 years (Chu and Chen 2005, p. 4,881–4,900; Diaz *et al.* 2005, pp. 1–3). Exact future changes in precipitation in Hawaii and the forecast of those changes are uncertain because they depend, in part, on how the El Niño-La Niña weather cycle might change (State of Hawaii 1998, pp. 2–10).

In the oceans around Hawaii, the average annual rainfall at sea level is about 25 in (63.5 cm). The orographic features of the islands increase this annual average to about 70 in (177.8 cm) but can exceed 240 in (609.6 cm) in the wettest mountain areas. Rainfall is distributed unevenly across each high island, and rainfall gradients are extreme (approximately 25 in (63.5 cm) per mile), creating both very dry and very wet areas. Global climate modeling predicts that, by 2100, net precipitation at sea level near the Hawaiian Islands will decrease in winter by about 4 to 6 percent, with no significant change during summer (IPCC AR4 2007, pp. 1–73). Downscaling of global climate models indicates that wet-season (winter) precipitation will decrease by 5 percent to 10 percent, while dry-season (summer) precipitation will increase by about 5 percent (Timm and Diaz 2009, pp. 4,261–4,280). These data are also supported by a steady decline in stream flow beginning in the early 1940s (Oki 2004, p. 1). Altered seasonal moisture regimes can have negative impacts on plant growth cycles and overall negative impacts on natural ecosystems (US–GCRP 2009, pp. 1–188). Long periods of decline in annual precipitation result in a reduction in moisture availability; an increase in drought frequency and intensity; and a self-perpetuating cycle of nonnative plants, fire, and erosion (US–GCRP 2009, pp. 1–188; Warren 2011, pp. 221–226) (see ''Habitat Destruction and Modification by Fire,'' above). These impacts may negatively affect the 15 species proposed for listing in this rule and the 10 ecosystems that support them.

Climate Change, and Tropical Cyclone Frequency and Intensity

A tropical cyclone is the generic term for a medium- to large-scale, low-pressure storm system over tropical or subtropical waters with organized convection (*i.e.*, thunderstorm activity) and definite cyclonic surface wind circulation (counterclockwise direction in the Northern Hemisphere) (Holland 1993, pp. 1–8). In the Northeast Pacific Ocean, east of the International Date Line, once a tropical cyclone reaches an intensity of winds of at least 74 mi per hour (33 m per second), it is considered a hurricane (Neumann 1993, pp. 1–2). Climate modeling has projected changes in tropical cyclone frequency and intensity due to global warming over the next 100 to 200 years (Vecchi and Soden 2007, pp. 1,068–1,069, Figures 2 and 3; Emanuel *et al.* 2008, p. 360, Figure 8; Yu *et al.* 2010, p. 1,371, Figure 14). The frequency of hurricanes generated by tropical cyclones is projected to decrease in the central Pacific (*e.g.*, the main and Northwestern Hawaiian Islands) while storm intensity (strength) is projected to increase by a few percent over this period (Vecchi and Soden

2007, pp. 1,068–1,069, Figures 2 and 3; Emanuel *et al.* 2008, p. 360, Figure 8; Yu *et al.* 2010, p. 1,371, Figure 14). There are no climate model predictions for a change in the duration of Pacific tropical cyclone storm season (which generally runs from May through November).

In general, tropical cyclones with the intensities of hurricanes have been a rare occurrence in the Hawaiian Islands. From the 1800s until 1949, hurricanes were only rarely reported from ships in the area. Between 1950 and 1997, 22 hurricanes passed near or over the Hawaiian Islands, 5 of which caused serious damage (Businger 1998, pp. 1–2). Hurricanes may cause destruction of native vegetation and open the native canopy, allowing for invasion by nonnative plant species that compete for space, water, and nutrients, and alter basic water and nutrient cycling processes leading to decreased growth and reproduction for all 13 plant species in this proposed rule (see Table 3, above) (Perlman 1992, pp. 1–9; Kitayama and Mueller-Dombois 1995, p. 671). Hurricanes also constitute a threat to the picture-wing fly proposed for listing as a result of their high winds that may dislodge larvae from their host plants, thereby increasing the likelihood of mortality caused by lack of essential nutrients for proper development or increased exposure to predators, such as nonnative yellowjacket wasps and ants, and destruction of host plants (see ''*Factor C. Disease or Predation,*'' below). Although there is historical evidence of only one hurricane that approached from the east and impacted the islands of Maui and Hawaii (Businger 1998, p.3), damage by future hurricanes could further decrease the remaining native plant-dominated habitat areas that support the 13 plant species and the picture-wing fly (*Drosophila digressa*) proposed for listing in this rule, in nine of the described ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff and wet cliff).

Climate Change, and Sea-Level Rise and Coastal Inundation

On a global scale, sea level is rising as a result of thermal expansion of warming ocean water; the melting of ice sheets, glaciers, and ice caps; and the addition of water from terrestrial systems (Climate Institute 2011, in litt.). Sea level rose at an average rate of 0.1 in (1.8 mm) per year between 1961 and 2003 (IPCC 2007, pp. 30–73), and the predicted increase by the end of this century, without accounting for ice sheet flow, ranges from 0.6 ft to 2.0 ft (0.18 m to 0.6 m) (IPCC AR4 2007, p. 30). When ice sheet and glacial melt are incorporated into models the average estimated increase in sea level by the year 2100 is approximately 3 to 4 ft (0.9 to 1.2 m), with some estimates as high as 6.6 ft (2.0 m) to 7.8 ft (2.4 m) (Rahmstorf 2007, pp. 368–370; Pfeffer *et al.* 2008, p. 1,340; Fletcher 2009, p. 7; US–GCRP 2009, p. 18). The species *Bidens hillebrandiana* ssp. *hillebrandiana* occurs within the coastal ecosystem. Although there is no specific data available on how sea-level rise and coastal inundation will impact this species, its occurrence in close proximity to the coastline places it at risk of the threat of sea level rise and coastal inundation due to climate change.

In summary, increased interannual variability of ambient temperature, precipitation, hurricanes, and sea-level rise and inundation would provide additional stresses on 9 of the 10 ecosystems (all except the anchialine pool ecosystem) and 14 of the 15 associated species (all except the anchialine pool shrimp) proposed for listing in this rule because they are highly vulnerable to disturbance and related invasion of nonnative species. The probability of a species going extinct as a result of such factors increases when its range is restricted, habitat decreases, and population numbers decline (IPCC 2007, pp. 8–11). In addition, these 14 species may be at a greater risk of extinction due to the loss of redundancy and resiliency created by their limited ranges, restricted habitat requirements, small population sizes, or low numbers of individuals. Therefore, we would expect these 14 species to be particularly vulnerable to projected environmental impacts that may result from changes in climate and subsequent impacts to their habitats (*e.g.*, Loope and Giambelluca 1998, pp. 504–505; Pounds *et al.* 1999, pp. 611–612; Still *et al.* 1999, p. 610; Benning *et al.* 2002, pp. 14,246–14,248; Giambelluca and Luke 2007, pp. 13–18). Based on the above information, we conclude that changes in environmental conditions that result from climate change are likely to negatively impact 14 of the 15 species (all except the anchialine pool shrimp) proposed for listing in this rule, and exacerbate other threats. This potential threat will increase in the near future.

Habitat Destruction and Modification by Sedimentation

Anchialine pool habitats can gradually disappear when organic and mineral deposits from aquatic production and wind-blown materials accumulate through a process known as senescence (Maciolek and Brock 1974, p. 3; Brock 2004, pp. 11, 35–36). Conditions promoting rapid senescence are known to include an increased amount of sediment deposition, good exposure to light, shallowness, and a weak connection with the water table, resulting in sediment and detritus accumulating within the pool instead of being flushed away with tidal exchanges and groundwater flow (Maciolek and Brock 1974, p. 3; Brock 2004, pp. 11, 35–36).

Based upon what we know about healthy anchialine pool systems (Brock 2004, pp. 11, 35–36), it is our understanding that one or more factors including increased sedimentation, may be synergistically degrading the health of the Lua O Palahemo pool system. Sedimentation is likely reducing the capacity of the pool to produce adequate cyanobacteria and algae to support some of the pool's 'herbivorous' hypogeal shrimp species. A decreased food supply (*i.e.*, a reduction in cyanobacteria and algae) would likely lead to a lower abundance of herbivorous hypogeal shrimp species as well as a lower abundance of the known carnivorous species, *Metabetaeus lohena,* and possibly *Vetericaris chaceorum,* whose gut contents contained fragments of other crustaceans (including *Procaris hawaiiana,* a co-occurring anchialine pool shrimp), indicating that the species may be carnivorous upon its associated anchialine pool shrimp species (see above, Description of the 15 Species Proposed for Listing).

A second factor is that increased sedimentation in Lua O Palahemo may be overloading the capacity of the pool and lava tube below to adequately flush water to maintain the water quality needed to support the micro-organisms that are fed upon by several of the pool's shrimp species (*e.g., Calliasmata pholidota, Halocaridina palahemo, Halocaridina rubra,* and *Procaris hawaiiana*) and their associated shrimp predators, *Antecaridina lauensis* and *Vetericaris chaceorum* (Brock 2004, pp. 10–11, 16).

A third factor that may be contributing to the degradation of the health of the Lua O Palahemo pool system is that increased sedimentation and an inability of the pool system to adequately flush its waters, are either diminishing or preventing migration and recolonization of the pool by the hypogeal shrimp species from the surrounding porous watertable bedrock. In other words, this lack of porosity may be affecting the movement of shrimp to and from food resources, and the

accumulating sedimentation and detritus reduce productivity within the pool. This reduction in productivity reduces the carrying capacity of the habitat to support hypogeal shrimp like *Vetericaris chaceorum* (Brock 2004, p. 10). Indeed, Brock (2004, p. 16) has established that pool productivity and shrimp presence are interdependent. In some cases, a pool that loses its shrimp populations due, for example, to the introduction of nonnative fish, more quickly loses its capacity to support shrimp in the future as a result of excessive buildup of algae and cyanobacterial mats that block and impede the pool's ability to flush and maintain necessary water quality (Brock 2004, p. 16).

As described above, in 1985, visibility within the lava tube portion of Lua O Palahemo was as great as 20 m (66 ft). During this dive survey, Kensley and Williams (1986, p. 418) estimated that other species of hypogeal shrimp co-occurring with *Vetericaris chaceorum* numbered in the tens of thousands for *Halocaridina* sp., in the thousands for *Procaris hawaiana,* and less than 100 for *Calliasmata* sp. By 2010, visibility had been reduced to 8 cm (3 in) within the pool itself, and underwater video taken during the survey shows continuous clouds of thick sediment and detritus within the water column below the pool. During this survey, only one *P. hawaiiana* individual was trapped, and seven others were observed in the video footage. No other species of shrimp, including *V. chaceorum,* were observed during the 2010 survey (Wada 2010, in litt.). Kensley and Williams (1986, p. 426) reported fragments of crustaceans, including *P. hawaiiana,* in gut contents of *V. chaceorum.* While *P. hawaiiana* occurs in other anchialine pool habitats on Hawaii Island and Maui, *V. chaceorum* is currently only known from Lua O Palahemo. A reduction in the abundance of *P. hawaiiana* may indicate a loss of food resources for *V. chaceorum,* although further research is needed to confirm this.

During the 2010 survey, it was discovered that a possible partial collapse of the interior rock walls of Lua O Palahemo pool may have occurred and caused the difficulty experienced by the survey team to bodily survey to any depth below the pool's surface (Wada 2010, in litt.). This collapse may also be contributing to reduced flushing in the pool portion of Lua O Palahemo, leading to an accumulation of sediment and detritus in the pool. This accumulation of sediment could certainly reduce both food productivity (*i.e.*, reduce the abundance and availability of other species of hypogeal shrimp co-occurring with *Vetericaris chaceorum*) and the ability of *V. chaceorum* and other species of hypogeal shrimp co-occurring with *V. chaceorum* to move between the pool and the water table, thus leading to a reduction of their numbers within the pool. The degradation of Lua O Palahemo by senescence from sedimentation is a threat to the continued existence of *V. chaceorum* by degrading the conditions of the only known anchialine pool that supports this species and by reducing available food resources (Brock 2004, pp. 10–11, 16).

Summary of Factor A

The threats to the habitats of the 15 species proposed for listing in this rule occur throughout the entire range of each of the species. These threats include land conversion by agriculture and urbanization, nonnative ungulates and plants, fire, natural disasters, environmental changes resulting from climate change, sedimentation, and the interaction of these threats.

Development and urbanization of lowland dry habitat on Hawaii Island represents a serious and ongoing threat to *Bidens micrantha* ssp. *ctenophylla* because of loss and degradation of habitat.

The effects from ungulates are serious and ongoing because ungulates currently occur in all of the 10 ecosystems that support the 15 species proposed for listing in this rule. Ungulates are a direct threat to the 13 plant species, the anchialine pool shrimp (*Vetericaris chaceorum*), and the picture-wing fly (*Drosophila digressa*) proposed for listing in this rule (see Table 3), because they cause: (1) Trampling and grazing that directly impact the plant communities, including the plant species proposed for listing, and impact the host plants used by the picture-wing fly for shelter, foraging, and reproduction; (2) increased soil disturbance, leading to mechanical damage to individuals of the plant species proposed for listing, and also plants used by the picture-wing fly for shelter, foraging, and reproduction; (3) creation of open, disturbed areas conducive to weedy plant invasion and establishment of alien plants from dispersed fruits and seeds, which results over time in the conversion of a community dominated by native vegetation to one dominated by nonnative vegetation (leading to all of the negative impacts associated with nonnative plants, listed below); and (4) increased erosion, followed by sedimentation affecting the anchialine pool habitat of *V. chaceorum.* These threats are expected to continue or increase without ungulate control or eradication.

Nonnative plants represent a serious and ongoing threat to 14 of the 15 species proposed for listing (all 13 plant species and the picture-wing fly (see Table 3)) through habitat destruction and modification, because they: (1) Adversely impact microhabitat by modifying the availability of light; (2) alter soil-water regimes; (3) modify nutrient cycling processes; (4) alter fire characteristics of native plant habitat, leading to incursions of fire-tolerant nonnative plant species into native habitat; (5) outcompete, and possibly directly inhibit the growth of, native plant species; and (6) create opportunities for subsequential establishment of nonnative vertebrates and invertebrates. Each of these threats can convert native-dominated plant communities to nonnative plant communities (Cuddihy and Stone 1990, p. 74; Vitousek 1992, pp. 33–35). This conversion has negative impacts on all 13 plant species addressed here, as well as the native plant species upon which the picture-wing fly depends for essential life-history needs.

The threat from fire to 4 of the 15 species in this proposed rule that depend on lowland dry, lowland mesic, lowland wet, montane dry, and montane mesic ecosystems (the plants *Bidens micrantha* ssp. *ctenophylla, Phyllostegia floribunda,* and *Schiedea hawaiiensis,* and the picture-wing fly; see Table 3) is serious and ongoing because fire damages and destroys native vegetation, including dormant seeds, seedlings, and juvenile and adult plants. Many nonnative, invasive plants, particularly fire-tolerant grasses, outcompete native plants and inhibit their regeneration (D'Antonio and Vitousek 1992, pp. 70, 73–74; Tunison *et al.* 2002, p. 122). Successive fires that burn farther and farther into native habitat destroy native plants and remove habitat for native species by altering microclimatic conditions and creating conditions favorable to alien plants. The threat from fire is unpredictable but increasing in frequency in ecosystems that have been invaded by nonnative fire-prone grasses, and that are experiencing abnormally dry to severe drought conditions.

Natural disasters such as hurricanes are a threat to native Hawaiian terrestrial habitat including 9 of the 10 ecosystems (all except the anchialine pool ecosystem) addressed here, and the 13 plant species identified in this rule, because they result in direct impacts to ecosystems and individual plants by opening the forest canopy, modifying

available light, and creating disturbed areas that are conducive to invasion by nonnative pest plants (Asner and Goldstein 1997, p. 148; Harrington *et al.* 1997, pp. 346–347). In addition, hurricanes threaten the picture-wing fly species proposed for listing in this rule because strong winds and intense rainfall can kill individual host plants, and can dislodge individual flies and their larvae from their host plants and deposit them on the ground where they may be crushed by falling debris or eaten by nonnative wasps and ants. The impacts of hurricanes and other stochastic natural events can be particularly devastating to 14 of the species (all except the anchialine pool shrimp) proposed for listing because, as a result of other threats, they now persist in low numbers or occur in restricted ranges and are therefore less resilient to such disturbances, rendering them highly vulnerable to extirpation. Furthermore, a particularly destructive hurricane holds the potential of driving a localized endemic species to extinction in a single event. Hurricanes pose an ongoing and ever-present threat because they are unpredictable and can happen at any time.

Rockfalls, treefalls, landsides, heavy rain, and erosion are a threat to four of the species proposed for listing (the plants *Bidens hillebrandiana* ssp. *hillebrandiana, Cyanea marksii, Cyanea tritomantha,* and *Cyrtandra wagneri;* see Table 3) by destabilizing substrates, damaging and destroying individual plants, and altering hydrological patterns, which result in habitat destruction or modification and changes to native plant and animal communities. Drought threatens two plant species (*Bidens micrantha* ssp. *ctenophylla* and *Schiedea hawaiiensis*) and the picture-wing fly (*Drosophila digressa*) by the loss or degradation of habitat due to death of individual native plants and host tree species, as well as an increase in forest and brush fires. These threats are serious and unpredictable, and have the potential to occur at any time.

Changes in environmental conditions that may result from global climate change include increasing temperatures, decreasing precipitation, increasing storm intensities, and sea-level rise and coastal inundation. The consequent impacts on the 15 species proposed for listing here are related to changes in microclimatic conditions in their habitats. These changes may lead to the loss of native species due to direct physiological stress, the loss or alteration of habitat, or changes in disturbance regimes (*e.g.,* droughts, fire, storms, and hurricanes). However, the specific and cumulative effects of climate change on the 15 species are presently unknown, and we are not able to determine the extent of this possible threat with confidence.

Erosion and resulting sedimentation of the Lua O Palahemo pool system is a threat to the anchialine pool shrimp (*Vetericaris chaceorum*). The sedimentation of the pool may also change the water chemistry (*i.e.*, salinity and dissolved oxygen) of the pool and the ability of the pool to support hypogeal anchialine pool shrimp such as *V. chaceorum,* although further research is needed. Accumulation of sediment and detritus reduces the abundance of food resources, such as *P. hawaiana* and other co-occurring hypogeal shrimp, for *V. chaceorum,* although further research is needed to confirm this. In addition, sedimentation degrades the conditions of the only anchialine pool known to support *V. chaceorum.*

Factor B. Overutilization for Commercial, Recreational, Scientific or Educational Purposes

The plant species *Pritchardia lanigera* is threatened by overcollection for commercial and recreational purposes (Hillebrand 1888, pp. 21–27; Chapin *et al.* 2004, pp. 273, 278). We are aware that some species of Hawaiian anchialine pool shrimp are sold and purchased on the Internet; however we do not believe that the proposed anchialine pool shrimp is threatened by overcollection for commercial or recreational purposes due to the remoteness of its currently known location and difficulty of accessing this species within the deeper lava tube portions of the Lua O Palahemo anchialine pool. We are not aware of any threats to the remaining 12 plant species or the picture-wing fly addressed in this proposed rule that would be attributed to overutilization for commercial, recreational, scientific or educational purposes.

Pritchardia lanigera

The genus *Pritchardia* has 28 known species, 14 of which are endemic to the Hawaiian Islands, and its range is restricted to the Pacific archipelagos of Hawaii, Fiji, the Cook Islands, Tonga, and Tuamotus (Chapin *et al.* 2004, p. 273). *Pritchardia* palms have been valued as collectibles for centuries (Hillebrand 1888, pp. 21–27; Chapin *et al.* 2004, pp. 273, 278). In 1888, botanist Wilhelm Hillebrand noted that, ''* * * one species of *Pritchardia* in Nuuanu, * * * was completely exterminated when natives found that the trees were saleable to amateurs of gardening in Honolulu.'' *Pritchardia* has become one of the most widely cultivated ornamental palm genera in the world (Maunder *et al.* 2001 in Chapin *et al.* 2004, p. 278). There is an international trade in *Pritchardia* seeds and seedlings that has created a market in which individual *Pritchardia* seeds sell for 5 to 35 dollars each (Chapin *et al.* 2004, p. 278; Clark 2010, in litt.; rarepalmseeds.com). Most seeds sold are cultivated; however, wild collection of some ''highly-threatened'' species does occur (Chapin *et al.* 2004, p. 278). There are over a dozen internet Web sites that offer Hawaiian *Pritchardi*a plants and seeds for sale, including *Pritchardia lanigera* (*e.g.*, eBay.com; google.com). Based on the history of collection of endemic Hawaiian *Pritchardia* plants and seeds, the market for Hawaiian *Pritchardia* plants and seeds, and the vulnerability of the small populations of *Pritchardia lanigera* to the negative impacts of any collection, we consider overcollection of *Pritchardia lanigera* to pose a serious and ongoing threat, because it can occur at any time, although its occurrence is not predictable.

Anchialine Pool Shrimp

While we are aware of only one collection of the anchialine pool shrimp *Vetericaris chaceorum* for scientific and educational purposes (Kensley and Williams, 1986, pp. 419–429), there is no information available that indicates this species has ever been collected for commercial or recreational purposes. Other Hawaiian anchialine pool shrimp (*e.g.,* opaeula (*Halocaridina rubra*)) and the candidate species *Metabetaeus lohena* (NCN) are collected for the aquarium market (*e.g.,* Fuku-Bonsai.com; ecosaqua.com; eBay.com; and, seahorse.com), including self-contained aquariums similar to those marketed by Ecosphere Associates, Inc. (Ecosphere Associates 2011, p. 1). Two of these companies are located in Hawaii (FukuBonsai and Stockly's Aquariums of Hawaii). However, we believe the anchialine pool shrimp proposed for listing in this rule is not likely to be among those species collected for commercial or recreational purposes given the species' limited distribution and generally inaccessible habitat. Therefore, we do not consider overcollection to pose a threat to *Vetericaris chaceorum.*

Summary of Overcollection for Commercial, Recreational, Scientific, or Educational Purposes

We have no evidence to suggest that overutilization for commercial, recreational, scientific, or educational purposes poses a threat to 12 of the 13

plant species, the picture-wing fly, or the anchialine pool shrimp proposed for listing in this rule. The plant species *Pritchardia lanigera* is vulnerable to the impacts of overutilization due to collection for trade or market. Based on the history of collection of endemic Hawaiian *Pritchardia* spp., the market for Hawaiian *Pritchardia* trees and seeds, and the inherent vulnerability of the small populations of *Pritcharidia lanigera* to the removal of individuals (seeds), we consider collection to pose a serious and ongoing threat to this species.

Factor C. Disease or Predation

Disease

We are not aware of any threats to the 13 plant species, anchialine pool shrimp, or picture-wing fly, proposed for listing in this rule that would be attributable to disease.

Predation and Herbivory

Hawaii's plants and animals evolved in nearly complete isolation from continental influences. Successful colonization of these remote volcanic islands was infrequent, and many organisms never succeeded in establishing populations. As an example, Hawaii lacks any native ants or conifers, has very few families of birds, and has only a single native land mammal—a bat (Loope 1998, p. 748). In the absence of any grazing or browsing mammals, plants that became established did not need mechanical or chemical defenses against mammalian herbivory such as thorns, prickles, and production of toxins. As the evolutionary pressure to either produce or maintain such defenses was lacking, Hawaiian plants either lost or never developed these adaptations (Carlquist 1980, p. 173). Likewise, native Hawaiian birds and insects experienced no evolutionary pressure to develop anti-predator mechanisms against mammals or invertebrates that were not historically present on the island. The native flora and fauna of the islands are thus particularly vulnerable to the impacts of introduced nonnative species, as discussed below.

Introduced Ungulates

In addition to the habitat impacts discussed above (see ''*Habitat Destruction and Modification by Introduced Ungulates''* under Factor A. *The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*), introduced ungulates and their resulting impacts are a threat to the 13 plant species in this proposal by grazing and browsing individual plants (this information is also presented in Table 3): *Bidens hillebrandiana* ssp. *hillebrandiana* (pigs and goats), *B. micrantha* ssp. *ctenophylla* (pigs and goats), *Cyanea marksii* (pigs, cattle, and mouflon), *Cyanea tritomantha* (pigs and cattle), *Cyrtandra nanawaleensis* (pigs), *Cyrtandra wagneri* (pigs), *Phyllostegia floribunda* (pigs), *Pittosporum hawaiiense* (pigs, cattle, and mouflon), *Platydesma remyi* (pigs), *Pritchardia lanigera* (pigs, goats, and mouflon), *Schiedea diffusa* ssp. *macraei* (pigs and cattle), *Schiedea hawaiiensis* (pigs, goats, sheep, and mouflon), and *Stenogyne cranwelliae* (pigs). In addition, introduced ungulates are a threat to the picture-wing fly proposed for listing by grazing and browsing individuals of its host plant, *Charpentiera* spp. (pigs, goats, cattle, and mouflon).

We have direct evidence of ungulate damage to some of these species, but for many, due to their remote locations or lack of study, ungulate damage is presumed based on the known presence of these introduced ungulates in the areas where these species occur and the results of studies conducted in Hawaii and elsewhere (Diong 1982, p. 160). Magnacca *et al.* (2008, p. 32) and others (Maui Forest Bird Recovery Project 2011, in litt.) found that native plant species such as the Hawaiian lobelioids (*e.g., Cyanea* spp.) and plants in the African violet family (*e.g., Cyrtandra* spp.) are particularly vulnerable to pig disturbance. In a study conducted by Diong (1982, p. 160) on Maui, feral pigs were observed browsing on young shoots, leaves, and fronds of a wide variety of plants, of which over 75 percent were endemic species. A stomach content analysis in this study showed that 60 percent of the pigs' food source consisted of the endemic *Cibotium* (hapuu, tree fern). Pigs were observed to fell plants and remove the bark from native plant species within the genera *Cibotium, Clermontia, Coprosma, Hedyotis, Psychotria,* and *Scaevola,* resulting in larger trees being killed over a few months of repeated feeding (Diong 1982, p. 144). Beach (1997, pp. 3–4) found that feral pigs in Texas spread disease and parasites, and their rooting and wallowing behavior led to spoilage of watering holes and loss of soil through leaching and erosion. Rooting activities also decreased the survivability of some plant species through disruption at root level of mature plants and seedlings (Beach 1997, pp. 3–4; Anderson *et al.* 2007, pp. 2–3). In Hawaii, pigs dig up forest ground cover consisting of delicate and rare species of orchids, ferns, mints, lobeliads, and other taxa, including roots, tubers and rhizomes (Stone and Anderson 1988, p. 137).

In addition, there are direct observations of pig herbivory, on either the fresh seedlings, fruits, seeds, or leaves, on each of the 13 plant species proposed for listing in this rule, including *Bidens hillebrandiana* ssp. *hillebrandiana* (Bio 2011, pers. comm.), *B. micrantha* ssp. *ctenophylla* (Bio 2011, pers. comm.), *Cyanea marksii* (PEPP 2010, p. 52; Bio 2011, pers. comm.), *Cyanea tritomantha* (HBMP 2010f; PEPP 2010, p. 60), *Cyrtandra nanawaleensis* (Bio 2011, pers. comm.), *Cyrtandra wagneri* (Lorence and Perlman 2007, p. 359; PEPP 2010, p. 63), *Phyllostegia floribunda* (Perlman and Wood 1993—*Hawaii Plant Conservation Maps database;* Perry 2006, in litt.; Pratt 2007b, in litt.; USFWS 2010, p. 4–66), *Pittosporum hawaiiense* (Bio 2011, pers. comm.), *Platydesma remyi* (PEPP 2008, p. 107), *Pritchardia lanigera* (Wood 1995, in litt.; HBMP 2010c), *Schiedea diffusa* ssp. *macraei* (Wagner *et al.* 2005d, p. 32), *Schiedea hawaiiensis* (Mitchell *et al.* 2005a; Wagner *et al.* 2005d, p. 32; Bio 2011, pers. comm.), and *Stenogyne cranwelliae* (HBMP 2010k). According to Magnacca *et al.* (2008, p. 32) several of the host plants of Hawaiian picture-wing flies, including the host plant of the picture-wing fly (*i.e., Charpentiera* sp.) proposed in this rule, are susceptible to damage from feral ungulates such as pigs. As pigs occur in 9 of the 10 ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) on Hawaii Island, the results of the studies described above suggest that pigs can also alter these ecosystems and directly damage or destroy native plants.

Feral goats thrive on a variety of food plants, and are instrumental in the decline of native vegetation in many areas (Cuddihy and Stone 1990, p. 64). Feral goats trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980, p. C–20; van Riper and van Riper 1982, pp. 34–35; Tomich 1986, pp. 153–156; Cuddihy and Stone 1990, p. 64). Goats were observed to browse on native plant species in the following genera: *Argyroxiphium, Canavalia, Plantago, Schiedea,* and *Stenogyne* (Cuddihy and Stone 1990, p. 64). A study on the island of Hawaii demonstrated that *Acacia koa* seedlings are unable to survive due to browsing and grazing by goats (Spatz and

Mueller-Dombois 1973, p. 874). If goats are maintained at constantly high numbers, mature *A. koa* trees will eventually die, and with them the root systems that support suckers and vegetative reproduction. One study demonstrated a positive height-growth response of *A. koa* suckers to the 3-year exclusion of goats (1968–1971) inside a fenced area, whereas suckers were similarly abundant but very small outside of the fenced area (Spatz and Mueller-Dombois 1973, p. 873). Another study at Puuwaawaa demonstrated that prior to management actions in 1985, regeneration of endemic shrubs and trees in the goat-grazed area was almost totally lacking, contributing to the invasion of the forest understory by exotic grasses and weeds. After the removal of grazing animals in 1985, *A. koa* and *Metrosideros* spp. seedlings were observed germinating by the thousands (HDOFAW 2002, p. 52). Based on a comparison of fenced and unfenced areas, it is clear that goats can devastate native ecosystems (Loope *et al.* 1988, p. 277).

Goats seek out seedlings and juveniles of *Bidens* spp. (Bio 2011, pers. comm.), and are known to indiscriminately graze on and eat the seeds of native Hawaiian *Pritchardia* species (Chapin *et al.* 2004, p. 274; Chapin *et al.* 2007, p. 20). The two known occurrences of the plant *Pritchardia lanigera* are found in an unfenced area of the Kohala Mountains, where they are impacted by browsing and grazing by goats and other ungulates (Warshauer *et al.* 2009, pp. 10, 24; Laws *et al.* 2010, in litt.). *Schiedea* spp. are favored by grazing goats, and goat browsing threatens the only known population of the plant species *Schiedea hawaiiensis* (Wagner *et al.* 2005d, p. 32; Chynoweth *et al.* 2011, in litt.). In addition, there are direct observations of goat herbivory, on either the fresh seedlings, fruit, seeds, or leaves, of four of the plant species proposed for listing in this rule, including *Bidens hillebrandiana* ssp. *hillebrandiana* (Bio 2011, pers. comm.), *B. micrantha* ssp. *ctenophylla* (Bio 2011, pers. comm.; Knoche 2011, in litt.), *Pritchardia lanigera* (Wood 1995, in litt.; Chapin *et al.* 2004, p. 274), and *Schiedea hawaiiensis* (Mitchell *et al.* 2005a). According to Magnacca *et al.* (2008, p. 32) several of the host plants of Hawaiian picture-wing flies, including the host plant of the picture-wing fly (*i.e., Charpentiera* sp.) proposed in this rule, are susceptible to damage from feral ungulates such as goats. As goats occur in nine of the ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) on Hawaii Island, the results of the studies described above suggest that goats can also alter these ecosystems and directly damage or destroy native plants.

Four of the plant species proposed for listing in this rule (*Cyanea marksii, C. tritomantha, Pittosporum hawaiiense,* and *Schiedea diffusa* ssp. *macraei*), and the host plant of the picture-wing fly (*Charpentiera sp.*), are impacted by browsing and grazing by feral cattle. Cattle, either feral or domestic, are considered one of the most significant factors in the destruction of Hawaiian forests (Baldwin and Fagerlund 1943, pp. 118–122). Captain George Vancouver of the British Royal Navy is attributed with introducing cattle to the Hawaiian Islands in 1793 (Fischer 2007, p. 350), by way of a gift to King Kamehameha I on the island of Hawaii. Over time, cattle became established on all of the main Hawaiian Islands, and historically feral cattle were found on the islands of Kauai, Oahu, Molokai, Maui, Kahoolawe, and Hawaii. Currently, feral cattle are found only on Maui and Hawaii, typically in accessible forests and certain coastal and lowland leeward habitats (Tomich 1986, pp. 140–144).

In HVNP, Cuddihy reported that there were twice as many native plant species as nonnatives found in areas that had been fenced to exclude feral cattle, whereas on the adjacent, nonfenced cattle ranch, there were twice as many nonnative plant species as natives (Cuddihy 1984, pp. 16, 34). Skolmen and Fujii (1980, pp. 301–310) found that *Acacia koa* seedlings were able to reestablish in a moist *A. koa–Metrosideros polymorpha* forest on Hawaii Island after the area was fenced to exclude feral cattle (Skolmen and Fujii 1980, pp. 301–310). Cattle eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas conducive to invasion by nonnative plants, and spread seeds of nonnative plants in their feces and on their bodies. Cattle have been observed accessing native plants in Hakalau NWR by breaking down ungulate exclosure fences (Tummons 2011, p. 4). In addition, there are direct observations of cattle herbivory on three of the plant species proposed in this rule, including *Cyanea marksii* (PEPP 2010, p. 52), *C. tritomantha* (PEPP 2010, p. 60), and *Pittosporum hawaiiense* (Bio 2011, pers. comm.). In addition, although we have no direct observations, we also consider the plant *Schiedea diffusa* ssp. *macraei* to be susceptible to herbivory by cattle because cattle are reported to favor plants in the genus *Schiedea* (Wagner *et al.* 2005d, pp. 31–32) and feral cattle still occur in the Kohala Mountains, the location of the only known individual of this species. Between 1987 and 1994, populations of *Schiedea salicaria* on West Maui were grazed so extensively by cattle, all of the individuals of this species in accessible areas disappeared by 1994 (Wagner *et al.* 2005d, p. 32). Cattle are also known to browse the host plant of the proposed picture-wing fly (*Charpentiera* spp.) (Magnacca *et al.* 2008, p. 32; Magnacca 2011b, pers. comm.). As feral cattle occur in five of the described ecosystems (anchialine pool, lowland mesic, lowland wet, montane mesic, and montane wet) on Hawaii Island, the results of the studies described above suggest that feral cattle can also alter these ecosystems and directly damage or destroy native plants.

Feral sheep browse and trample native vegetation and have decimated large areas of native forest and shrubland (Tomich 1986, pp. 156–163; Cuddihy and Stone 1990, p. 65–66). Large areas of Hawaii Island have been devastated by sheep. For example, sheep browsing reduced seedling establishment of *Sophora chrysophylla* (mamane) so severely that it resulted in a reduction of the tree line elevation on Mauna Kea (Warner 1960 in Juvik and Juvik 1984, pp. 191–202). Currently there is a large sheep-mouflon sheep hybrid population (see ''Habitat Destruction and Modification by Introduced Ungulates'' above) on Mauna Kea that extends into the saddle and northern part of Mauna Loa, and there are reports that these animals are destroying endangered plants (Hess 2008, p. 1). There are direct observations of feral sheep herbivory on individuals of the only known occurrence of the plant species *Schiedea hawaiiensis* at PTA (Mitchell *et al.* 2005a; U.S. Army Garrison 2006, p. 34). As feral sheep occur in one of the described ecosystems (montane dry) on Hawaii Island, the results of the studies described above suggest that sheep can also alter this ecosystem and directly damage or destroy native plants.

Mouflon sheep graze native vegetation, trample undergrowth, spread weeds, and cause erosion. On the island of Hawaii, mouflon sheep browsing led to the decline in the largest population of the endangered *Argyroxiphium kauense* (kau silversword, Mauna Loa silversword or ahinahina) located on the former Kahuku Ranch, reducing it from a ''magnificent population of several thousand'' (Degener *et al.* 1976, pp. 173–174) to fewer than 2,000 individuals (unpublished data in Powell 1992, in litt., p. 312) over a period of 10

years (1974–1984). The native tree *Sophora chrysophylla* is also a preferred browse species for mouflon. According to Scowcroft and Sakai (1983, p. 495), mouflon eat the shoots, leaves, flowers and bark of this species. Bark stripping on the thin bark of a young tree is potentially lethal. Mouflon are also reported to strip bark from *Acacia koa* trees (Hess 2008, p. 3) and to seek out the threatened plant *Silene hawaiiensis* (Benitez *et al.* 2008, p. 57). In the Kahuku section of HVNP, mouflon jumped the park boundary fence and reduced one population of *S. hawaiiensis* to half its original size over a 3-year period (Belfield and Pratt 2002, p. 8). Other native species browsed by mouflon include *Geranium cuneatum* ssp. *cuneatum* (hinahina, silver geranium), *G. cuneatum* ssp. *hypoleucum* (hinahina, silver geranium), and *Sanicula sandwicensis* (NCN) (Benitez *et al.* 2008, pp. 59, 61). On Lanai, mouflon were once cited as one of the greatest threats to the endangered *Gardenia brighamii* (Mehrhoff 1993, p. 11), although fencing has now proven to be an effective mechanism against mouflon herbivory on this plant (Mehrhoff 1993, pp. 22–23). Due to their high agility and reproductive rates, mouflon sheep have the potential to occupy most ecosystems found on Hawaii Island, from sea-level to very high elevations (Hess 2010, pers. comm.; Ikagawa 2011, in litt.). Further, *Ovis* spp. are known throughout the world for chewing vegetation right down to the dirt (Ikagawa 2011, in litt.).

Recent research by Ikagawa (2011, in litt.) suggests that the plant species *Pritchardia lanigera* occurs within the observed range of mouflon, and is potentially impacted by mouflon browsing. In addition, there are direct observations or reports that mouflon sheep browsing and grazing significantly impact the plant species *Cyanea marksii, Pittosporum hawaiiense,* and *Schiedea hawaiiensis* (Bio 2011, pers. comm.; Pratt 2011e, in litt.), which are proposed for listing. The host plant (*Charpentiera* spp.) for the picture-wing fly species appears to be decreasing throughout its range due to impacts from mouflon browsing (Science Panel 2005, pp. 1–23; Magnacca 2011b, pers. comm.). As mouflon occur in five of the described ecosystems (lowland wet, lowland mesic, montane dry, montane mesic, and montane wet) on Hawaii Island, the results of the studies described above suggest that mouflon sheep can also alter these ecosystems and directly damage or destroy native plants.

Axis deer were introduced as a game animal to Molokai in 1868, Oahu by 1898, Lanai in 1920, and Maui in 1959, and between 2010 and 2011, unauthorized releases occurred on Hawaii Island (Hess 2008, p. 2; Kessler 2011, in litt.; Aila 2012a, in litt.). This new introduction to Hawaii Island raises a significant concern due to the reported damage axis deer cause on the island of Maui (see *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range* above). Most of the available information on axis deer in the Hawaiian Islands concerns observations and reports from the island of Maui. On Maui, axis deer were introduced by the State as a game animal, but their numbers have steadily increased, especially in recent years on Haleakala (Luna 2003, p. 44). During the 4-year El Niño drought from 1998 through 2001, Maui experienced an 80 to 90 percent decline in shrub and vine species caused by deer browsing and girdling of young saplings. High mortality of rare and native plant species was observed (Medeiros 2010, pers. comm.). Axis deer consume progressively less palatable plants until no edible vegetation is left (Hess 2008, p. 3). Axis deer are highly adaptable to changing conditions, and are characterized as ''plastic'' (meaning flexible in their behavior) by Ables (1977, cited in Anderson 1999, p. 5). They exhibit a high degree of opportunism regarding their choice of forage (Dinerstein 1987, cited in Anderson 1999, p. 5) and can be found in all but the highest elevation ecosystems (subalpine and alpine) and montane bogs, according to Medeiros (2010, pers. comm.).

Axis deer on Maui follow a cycle of grazing and browsing in open lowland grasslands during the rainy season (November–March) and then migrate to the lava flows of montane mesic forests during the dry summer months to graze and browse native plants (Medeiros 2010, pers. comm.). Axis deer are known to favor the native plants *Abutilon menziesii* (an endangered species), *Erythrina sandwicensis* (wiliwili), and *Sida fallax* (ilima) (Medeiros 2010, pers. comm.). During the driest months of summer (July and August), axis deer can even be found along Maui's coastal roads as they search for food. Hunting pressure also appears to drive the deer into native forests, particularly the lower rainforests up to 4,000 to 5,000 ft (1,220 and 1,525 m) in elevation (Medeiros 2010, pers. comm.), and according to Kessler and Hess (2010, pers. comms.) axis deer can be found up to 9,000 ft (2,743 m) elevation. On Lanai, grazing by axis deer has been reported as a major threat to the endangered *Gardenia brighamii* (nau) (Mehrhoff 1993, p. 11). Swedberg and Walker (1978, cited in Anderson 2003, pp. 124–125) reported that in the upper forests of Lanai, the native plants *Osteomeles anthyllidifolia* (ulei) and *Leptecophylla tameiameiae* (pukiawe) comprised more than 30 percent of axis deer rumen volume. On Molokai browsing by axis deer has been reported on *Erythrina sandwicensis* and *Nototrichium sandwicense* (kului) (Medeiros *et al.* 1996, pp. 11, 19). Other native plant species consumed by axis deer include *Achyranthes splendens* (NCN), *Bidens campylotheca* ssp. *pentamera* (kookoolau) and *B. campylotheca* ssp. *waihoiensis* (kookoolau), *Chamaesyce celastroides* var. *lorifolia* (akoko), *Diospyros sandwicensis* (lama), *Geranium multiflorum* (nohoanu; an endangered species), *Lipochaeta rockii* var. *dissecta* (nehe), *Osmanthus sandwicensis* (ulupua), *Panicum torridum* (kakonakona), and *Santalum ellipticum* (laau ala) (Anderson 2002, poster; Perlman 2009, in litt., pp. 4–5). As demonstrated on the Islands of Lanai, Maui, and Molokai, axis deer will spread into nine of the described ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) on Hawaii Island if not controlled. The newly established axis deer partnership (see *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range,* above) is currently implementing an axis deer response and removal plan, and just recently reported their first confirmed removal on April 11, 2012 (Osher 2012, in litt.). In addition, there is a proposed revision to HRS 91 (see *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range* and *Factor D. The Inadequacy of Existing Regulatory Mechanisms*) that would address the gap in the current emergency rules authority and expand the ability of State agencies to adopt emergency rules to include situations that impose imminent threats to natural resources (*i.e.,* axis deer on Hawaii Island). The results from the studies above, combined with direct observations from field biologists, suggest that grazing and browsing by axis deer can impose negative impacts to the nine ecosystems above and their associated native plants should this nonnative ungulate increase in numbers and range on Hawaii Island.

Other Introduced Vertebrates

Rats

There are three species of introduced rats in the Hawaiian Islands. Studies of Polynesian rat (*Rattus exulans*) DNA suggest they first appeared in the Hawaiian Islands along with emigrants from the Marquesas about 400 A.D., with a second interaction around 1100 A.D (Ziegler 2002, p. 315). The black rat (*R. rattus*) and the Norway rat (*R. norvegicus*) most likely arrived in the Hawaiian Islands more recently, as stowaways on ships sometime in the late 19th century (Atkinson and Atkinson 2000, p. 25). The Polynesian rat and the black rat are primarily found in the wild, in dry to wet habitats, while the Norway rat is typically found in manmade habitats such as urban areas or agricultural fields (Tomich 1986, p. 41). The black rat is widely distributed among the main Hawaiian Islands and can be found in a broad range of ecosystems up to 9,744 ft (2,970 m), but it is most common at low-to mid-elevations (Tomich 1986, pp. 38–40). While Sugihara (1997, p. 194) found both the black and Polynesian rats up to 6,972 ft (2,125 m) elevation on Maui, the Norway rat was not seen at the higher elevations in his study. Rats occur in nine of the described ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff), and predation by rats threatens 11 of the 13 plant species proposed for listing in this rule (rats are not a reported threat to the proposed picture-wing fly or anchialine pool shrimp (see Table 3)).

Rats impact native plants by eating fleshy fruits, seeds, flowers, stems, leaves, roots, and other plant parts (Atkinson and Atkinson 2000, p. 23), and can seriously affect regeneration. Research on rats in forests in New Zealand has also demonstrated that, over time, differential regeneration as a consequence of rat predation may alter the species composition of forested areas (Cuddihy and Stone 1990, pp. 68–69). Rats have caused declines or even the total elimination of island plant species (Campbell and Atkinson 1999, cited in Atkinson and Atkinson 2000, p. 24). In the Hawaiian Islands, rats may consume as much as 90 percent of the seeds produced by some trees, or in some cases prevent the regeneration of forest species completely (Cuddihy and Stone 1990, pp. 68–69). All three species of rat (black, Norway, and Polynesian) have been reported to be a serious threat to many endangered or threatened Hawaiian plants (Stone 1985, p. 264; Cuddihy and Stone 1990, pp. 67–69). Plants with fleshy fruits are particularly susceptible to rat predation, including some of the species proposed for listing here. For example, the fruits of plants in the bellflower family (*e.g., Cyanea* spp.) appear to be a target of rat predation (Cuddihy and Stone 1990, pp. 67–69). In addition to both species of *Cyanea* (*Cyanea marksii* and *Cyanea tritomantha*), nine other species of plants proposed for listing are significantly impacted by rat predation, including *Bidens hillebrandiana* ssp. *hillebrandiana, B. micrantha* ssp. *ctenophylla* (Bio 2011, pers. comm.), *Cyrtandra nanawaleensis, Cyrtandra wagneri* (Lorence and Perlman 2007, pp. 357–361; Bio 2011, pers. comm.), *Pittosporum hawaiiense, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei, Schiedea hawaiiensis,* and *Stenogyne cranwelliae* (Cuddihy and Stone 1990, pp. 67–69; Gon III and Tierney 1996, in litt.; Bio 2008, in litt.; Pratt 2008b, in litt.; Bio 2010, pers. comm.; HBMP 2010c; HBMP 2010f; HBMP 2010j; HBMP 2010k; PEPP 2010, pp. 101, 113; Pratt 2011f, in litt.). As rats occur in nine of the described ecosystems (coastal, lowland dry, lowland mesic, lowland wet, montane dry, montane mesic, montane wet, dry cliff, and wet cliff) on Hawaii Island, the results from the above studies, in addition to direct observations from field biologists, suggest that rats can directly damage or destroy native plants.

Nonnative Fish

In Hawaii, the introduction of nonnative fish, including bait-fish, into anchialine pools may have been a major contributor to the decline of native shrimp. Predation by, and competition with, introduced nonnative fish is considered the greatest threat to native shrimp within anchialine pool ecosystems (Bailey-Brock and Brock 1993, p. 354; Brock 2004, pp. 13–17). These impacts are discussed further in *Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence* below.

Invertebrates

Nonnative Slugs

Predation by nonnative slugs adversely impacts 5 of the 13 plant species (*Cyanea marksii, Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri,* and *Stenogyne cranwelliae;* see Table 3) proposed for listing through mechanical damage, destruction of plant parts, and mortality (U.S. Army Garrison 2006, p. 3–51; Joe 2006, p. 10; Lorence and Perlman 2007, p. 359; Bio 2008, in litt.; Perlman and Bio 2008, in litt.; HBMP 2010k). On Oahu, slugs have been reported to destroy *Cyanea calycina* and *Cyrtandra kaulantha* in the wild, and have been observed eating leaves and fruit of wild and cultivated individuals of *Cyanea* (Mehrhoff 1995, in litt.; Pratt and Abbott 1997, p. 13; U.S. Army Garrison 2006, pp. 3–34, 3–51). In addition, slugs have damaged individuals of other *Cyanea* and *Cyrtandra* species in the wild (Wood *et al.* 2001, p. 3; Sailer and Keir 2002, in litt., p. 3; PEPP 2007, p. 38; PEPP 2008, pp. 23, 49, 52–53, 57).

Little is known about predation of certain rare plants by slugs; however, information in the U.S. Army's 2005 ''Status Report for the Makua Implementation Plan'' indicates that slugs can be a threat to all species of *Cyanea* (U.S. Army Garrison 2006, p. 3–51). Research investigating slug herbivory and control methods shows that slug impacts on seedlings of *Cyanea* spp. results in up to 80 percent seedling mortality (U.S. Army Garrison 2006, p. 3–51). Slug damage has also been reported on other Hawaiian plants including *Argyroxiphium grayanum* (greensword), *Alsinidendron* sp., *Hibiscus* sp., *Schiedea kaalae* (maolioli), *Solanum sandwicense* (popolo aiakeakua), and *Urera* sp. (Gagne 1983, p. 190–191; Sailer 2002 cited in Joe 2006, pp. 28–34).

Joe and Daehler (2008, p. 252) found that native Hawaiian plants are more vulnerable to slug damage than nonnative plants. In particular, they found that the individuals of the endangered plant *Cyanea superba* and the plant *Schiedea obovata* had 50 percent higher mortality when exposed to slugs when compared to individuals of the same species that were protected within slug exclosures. Slug damage has been documented on the plant *Stenogyne cranwelliae* (HBMP 2010k). As slugs are found in three of the described ecosystems (lowland wet, montane wet, and wet cliff) on Hawaii Island, the data from the above studies, in addition to direct observations from field biologists, suggest that slugs can directly damage or destroy native plants.

Nonnative Western Yellow-Jacket Wasps

The western yellow-jacket wasp (*Vespula pensylvanica*) is a social wasp species native to the mainland of North America. It was first reported from Oahu in the 1930s (Nishida and Evenhuis in Sherley 2000, p. 121), and an aggressive race became established in 1977 (Gambino *et al.* 1987, p. 170). This species is now particularly abundant between 1,969 and 5,000 ft (600 and 1,524 m) in elevation (Gambino *et al.*

1990, pp. 1,088–1,095; Foote and Carson 1995, p. 371) on Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii Island (GISD 2012b). The western yellow-jacket wasp is an aggressive, generalist predator (Gambino *et al.* 1987, p. 170). In temperate climates, the western yellow-jacket wasp has an annual life cycle, but in Hawaii's tropical climate, colonies of this species persist through a second year, allowing them to have larger numbers of individuals and thus a greater impact on prey populations (Gambino *et al.* 1987, pp. 169–170). In Haleakala National Park on Maui, western yellow-jacket wasps were found to forage predominantly on native arthropods (Gambino *et al.* 1987, pp. 169–170; Gambino *et al.* 1990, pp. 1,088–1,095; Gambino and Loope 1992, pp. 15–21). Western yellow-jacket wasps have also been observed carrying and feeding upon recently captured adult Hawaiian *Drosophila* (Kaneshiro and Kaneshiro 1995, pp. 40–45). These wasps are also believed to feed upon picture-wing fly larvae within their host plants (Carson 1986, pp. 3–9). In addition, native picture-wing flies, including the species in this proposed rule, may be particularly vulnerable to predation by wasps due to their lekking (male territorial defensive displays during courtship and mating) behavior and conspicuous courtship displays that can last for several minutes (Kaneshiro 2006, pers. comm.). The concurrent arrival of the western yellow-jacket wasp and decline of picture-wing fly observations in some areas suggest that the wasp may have played a significant role in the decline of some of the picture-wing fly populations, including populations of the picture-wing fly proposed for listing in this rule (Carson 1986, pp. 3–9; Foote and Carson 1995, p. 371; Kaneshiro and Kaneshiro 1995, pp. 40–45; Science Panel 2005, pp. 1–23). As the western yellow-jacket wasp is widespread within three ecosystems (lowland mesic, montane mesic, and wet ecosystems) on Hawaii Island in which the two known occurrences of the proposed picture-wing fly occur, the results from the studies above, in addition to observations by field biologists, suggest that western yellow-jacket wasps can directly kill individuals of the picture-wing fly (Foote and Carson 1995, p. 371; Kaneshiro and Kaneshiro 1995, pp. 40–45; Science Panel 2005, pp. 1–23).

Nonnative Parasitoid Wasps

The number of native parasitic Hymenoptera (parasitic wasps) in Hawaii is limited, and only species in the family Eucoilidae are known to use Hawaiian picture-wing flies as hosts (Montgomery 1975, pp. 74–75; Kaneshiro and Kaneshiro 1995, pp. 44–45). However, several species of small parasitic wasps (Family Braconidae), including *Diachasmimorpha tryoni* (NCN), *D. longicaudata* (NCN), *Opius vandenboschi* (NCN), and *Biosteres arisanus* (NCN), were purposefully introduced into Hawaii to control nonnative pest tephritid fruit flies (Funasaki *et al.* 1988, pp. 105–160). These parasitic wasps are also known to attack other species of flies, including native flies in the family Tephritidae. While these parasitic wasps have not been recorded parasitizing Hawaiian picture-wing flies and, in fact, may not successfully develop in Drosophilidae, females will indiscriminately sting any fly larvae in their attempts to oviposit (lay eggs), resulting in mortality of the fly larvae (Evans 1962, pp. 468–483).

Nonnative Ants

Ants are not a natural component of Hawaii's arthropod fauna, and native species 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. 13–17). Ants can prey directly upon native arthropods, exclude them through interference or exploitation competition for food resources, or displace them by monopolizing nesting or shelter sites (Krushelnychy *et al.* 2005, p. 6). The threat of ant predation on the picture-wing fly species proposed for listing in this rule 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 additional suitable habitats (Staples and Cowie 2001, p. 55). These attributes allow some ants to destroy otherwise geographically isolated populations of native arthropods (Nafus 1993, pp. 19, 22–23).

At least 47 species of ants are known to be established in the Hawaiian Islands (Krushelnycky 2008, pp. 1–11), and at least 4 particularly aggressive species (the big-headed ant (*Pheidole megacephala*), the long-legged ant (also known as the yellow crazy ant) (*Anoplolepis gracilipes*), *Solenopsis papuana* (NCN), and *Solenopsis geminata* (NCN)) have severely impacted the native insect fauna, likely including native picture-wing flies (Reimer 1993, pp. 13–17). Numerous other species of ants are recognized as threats to Hawaii's native invertebrates, and an unknown number of new species are established every few years (Staples and Cowie 2001, p. 53). As a group, ants occupy most of Hawaii's habitat types, from coastal to subalpine ecosystems; however, many species are still invading mid-elevation montane mesic forests, and few species have been able to colonize undisturbed montane wet ecosystems (Reimer 1993, pp. 13–17). The lowland forests are a portal of entry to the montane and subalpine ecosystems, and, therefore, because ants are actively invading increasingly elevated ecosystems, ants are more likely to occur in high densities in the lowland mesic and montane mesic ecosystems currently occupied by the picture-wing fly (Reimer 1993, pp. 13–17).

The big-headed ant 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 (Holway *et al.* 2002, pp. 181–233; 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 the picture-wing fly proposed for listing in this rule. With few exceptions, native insects have been eliminated in habitats where the big-headed ant is present (Gagne 1979, p. 81; Gillespie and Reimer 1993, p. 22). Consequently, big-headed ants represent a threat to the picture-wing fly, in the lowland mesic and montane mesic ecosystems (Reimer 1993, pp. 14, 17; Holway *et al.* 2002, pp. 181–233; Daly and Magnacca 2003, pp. 9–10; Krushelnycky *et al.* 2005, p. 5).

The long-legged ant appeared in Hawaii in 1952, and now occurs on Hawaii, Kauai, Maui, and Oahu (Reimer *et al.* 1990, p. 42; *http://www.antweb.org* 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 the two known sites occupied by the picture-wing fly, we believe that the long-legged ant likely occurs within the lowland mesic ecosystem that supports the picture-wing fly due to the ant's aggressive nature and ability to spread and colonize new locations (Foote 2008, pers. comm.). 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 the long-legged ant. Lester and Tavite

(2004, p. 391) found that long-legged ants 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 the red land crab (*Gecarcoidea natalis*), as a result of predation by supercolonies of the long-legged ant (Abbott 2006, p. 102). Long-legged ants 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 (*Agrotis* spp. and *Peridroma* spp.) in ant-infested areas. Nests of groundnesting 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 long-legged ants are a threat to the proposed picture-wing fly in the lowland mesic ecosystem.

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 this species' presence in either of the two known sites occupied by the picture-wing fly, because of the ant's expanding range and its widespread occurrence in coastal, lowland dry, and lowland mesic habitats, we believe *S. papuana* is a threat to the picture-wing fly in the lowland mesic and montane mesic ecosystems.

Like *Solenopsis papuana, S. geminata* is also considered a significant threat to native invertebrates (Gillespie and Reimer 1993, pp. 21–33) and occurs on all the main Hawaiian Islands (Reimer *et al.* 1990, p. 42; Loope and Krushelnycky 2007, p. 70). Found in drier areas of the Hawaiian Islands, it has displaced *Pheidole megacephala* as the dominant ant in some areas (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 2012—*Ant Distribution Database*). *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 (GISD 2012c), and is included as one of five ant species listed among the ''100 of the World's Worst Invaders'' (Manaaki Whenua Landcare Research 2012—*Ant Distribution Database*). Although surveys have not been conducted to ascertain this species' presence in either of the two sites occupied by the picture-wing fly, because of the ant's expanding range and its widespread occurrence in coastal, lowland dry, and lowland mesic habitats, it is a potential threat to the picture-wing fly in the lowland mesic ecosystem.

The Argentine ant (*Iridomyrmex humilis*) was discovered on the island of Oahu in 1940, and is now established on all the main Hawaiian Islands (Reimer *et al.* 1990, p. 42). Argentine ants do not disperse by flight. Instead colonies are moved about with soil and construction material. The Argentine ant is found from coastal to subalpine ecosystems on the island of Maui, and on the slopes of Mauna Loa, in the lowland mesic and montane mesic ecosystems on Hawaii Island, the location of one of the two occurrences of the picture-wing fly (Hartley *et al.* 2010, pp. 83–94; Krushelnychy and Gillespie 2010, pp. 643–655). The Argentine ant has been documented to reduce populations, or even eliminate native arthropods in Haleakala National Park on Maui (Cole *et al.* 1992, pp. 1313–1322). On Maui, Argentine ants are significant predators on pest fruit flies (Wong *et al.* 1984, pp. 1454–1458), and Krushelychy and Gillespie (2010, pp. 643–655) found that Argentine ants on Hawaii Island are associated with the decline of an endemic phorid fly (*Megaselia* sp.). Krushelychy and Gillespie (2010, pp. 643–655) suggest that ants severely impact larval stages of many flies. While we are not aware of documented occurrences of predation by Argentine ants on picture-wing flies, including the species proposed for listing, these ants are considered to be a threat to native arthropods located at higher elevations (Cole *et al.* 1992, pp. 1313–1322) and thus potentially to the picture-wing fly that occurs from 2,000 ft to 4,500 ft (610 m to 1,372 m) in elevation, in the lowland mesic, montane mesic, and montane wet ecosystems (Science Panel 2005, pp. 1–23; Magnacca 2011b, pers. comm.).

The rarity or disappearance of native picture-wing fly species, including the species in this proposed rule, from historical observation sites over the past 100 years is due to a variety of factors. While there is no documentation that conclusively ties the decrease in picture-wing fly observations to the establishment of nonnative ants in lowland mesic, montane mesic, and montane wet ecosystems on Hawaii Island, the presence of nonnative ants in these habitats and the decline of picture-wing fly observations in some areas in these habitats suggest that nonnative ants may have played a role in the decline of some populations of the picture-wing fly proposed for listing in this rule. As nonnative predatory ants are found in three of the described ecosystems (lowland mesic, montane mesic, and montane wet) on Hawaii Island in which the picture-wing fly occurs, the data from the above studies, in addition to direct observations from field biologists, suggest that nonnative predatory ants contribute to the reduction in range and abundance of the picture-wing fly (Science Panel 2005, pp. 1–23).

Two-Spotted Leaf Hopper

Predation by the two-spotted leafhopper (*Sophonia rufofascia*) has been reported on plants in the genus *Pritchardia* throughout the main Hawaiian Islands and may be a threat to the plant *Pritchardia lanigera* proposed for listing in this rule (Chapin *et al.* 2004, p. 279). This nonnative insect damages the leaves it feeds on, typically causing chlorosis (yellowing due to disrupted chlorophyll production) to browning and death of foliage (Jones *et al.* 2000, pp. 171–180). The damage to plants can result in the death of affected leaves or the whole plant, owing to the combined action of its feeding and oviposition behavior (Alyokhin *et al.* 2004, p. 1). In addition to the mechanical damage caused by the feeding process, the insect may introduce plant pathogens that lead to eventual plant death (Jones *et al.* 2006, p. 2). The two-spotted leafhopper is a highly polyphagous insect (it feeds on many different types of food). Sixty-eight percent of its recorded host plant species in Hawaii are fruit, vegetable, and ornamental crops, and 22 percent are endemic plants, over half of which are rare and endangered (Alyokhin *et al.* 2004, p. 6). Its range is limited to below

4,000 ft (1,219 m) in elevation, unless there is a favorable microclimate. While there has been a dramatic reduction in the number of two-spotted leafhopper populations between 2005 and 2007 (possibly due to egg parasitism), this nonnative insect has not been eradicated, and predation by this nonnative insect remains a threat (Fukada 2007, in litt.). Chapin *et al.* (2004, p. 279) believe that constant monitoring of both wild and cultivated *Pritchardia* populations will be necessary to abate this threat.

Nonnative Beetles

The Hawaiian Islands now support several species of nonnative beetles (family Scolytidae, genus *Coccotrypes*), a few of which bore into and feed on the nuts produced by certain native and nonnative palm trees, including those in the genus *Pritchardia* (Swezey 1927, in litt.; Science Panel 2005, pp. 1–23; Magnacca 2011b, pers. comm.). Species of *Coccotrypes* beetles prefer trees with large seeds, like those of *Pritchardia* spp. (Beaver 1987, p. 11). Trees of *Pritchardia* spp. drop their fruit before the fruit reaches maturity due to the boring action of the *Coccotrypes* spp. Beetles, thereby reducing natural regeneration in the wild (Beaver 1987, p. 11; Magnacca 2005, in litt.; Science Panel 2005, pp. 1–23). The threat from *Coccotrypes* spp. beetles on *Pritchardia* spp. in Hawaii is expected to increase with time if the beetles are not controlled (Richardson 2011, pers. comm.). Although *Pritchardia* spp. are long-lived (up to 100 years), over time, *Coccotrypes* spp. beetles may severely impact Hawaiian species of *Pritchardia,* including *Pritchardia lanigera,* which is proposed for listing in this rule.

Summary of Factor C

We are unaware of any information that indicates that disease is a threat to any of the 15 species proposed for listing in this rule.

We consider predation by nonnative animal species (pigs, goats, cattle, sheep, mouflon sheep, rats, slugs, wasps, ants, the two-spotted leaf hopper, and beetles) to pose an ongoing threat to all 13 plant species and the picture-wing fly proposed for listing throughout their ranges for the following reasons:

(1) Observations and reports have documented that pigs, goats, cattle, sheep, and mouflon sheep browse and trample all 13 proposed plant species and the host plants of the picture-wing fly (see Table 3), in addition to other studies demonstrating the negative impacts of ungulate browsing and trampling on native plant species of the islands (Spatz and Mueller-Dombois 1973, p. 874; Diong 1982, p. 160; Cuddihy and Stone 1990, p. 67).

(2) Nonnative rats and slugs cause mechanical damage to plants and destruction of plant parts (branches, fruits, and seeds), and are considered a threat to 11 of the 13 plant species proposed for listing (see Table 3). All of the plants and the picture-wing fly proposed for listing are impacted by either introduced ungulates, as noted in item (1) above, or nonnative rats and slugs, or both.

(3) Predation of adults and larvae of Hawaiian picture-wing flies by the western yellow-jacket wasp has been observed, and it has been suggested that wasp predation has played a significant role in the dramatic declines of some populations of picture-wing flies (Carson 1986, pp. 3–9; Foote and Carson 1995, p. 371; Kaneshiro and Kaneshiro 1995, pp. 40–45; Science Panel 2005, pp. 1–23). Because western yellow-jacket wasps are found in the three ecosystems in which the picture-wing fly is found, and western yellow-jacket wasps are known to prey on picture-wing flies, we consider predation by the western yellow-jacket wasp to be a serious and ongoing threat to *Drosophila digressa.*

(4) Parasitic wasps purposefully introduced to Hawaii to control nonnative pest fruit flies will indiscriminately sting any fly larvae when attempting to lay their eggs. Predation by one or more of these nonnative parasitic wasps is a potentially serious threat to *Drosophila digressa.*

(5) Picture-wing flies are vulnerable to predation by ants, and the range of *Drosophila digressa* overlaps that of particularly aggressive, nonnative predatory ant species that currently occur from sea level to the montane mesic ecosystem (over 3,280 ft (1,000 m) elevation) on all of the main Hawaiian Islands. We therefore consider predation by these nonnative ants to be a threat to *Drosophila digressa.*

(6) The plant *Pritchardia lanigera* is vulnerable to predation by nonnative invertebrates. The two-spotted leafhopper has been observed on plants in the genus *Pritchardia* throughout the main Hawaiian Islands, and poses a threat to *Pritchardia lanigera* (Chapin *et al.* 2004, p. 279). Two-spotted leafhopper damage results in the death of affected leaves or the entire plant (Alyokhin *et al.* 2004, p. 1).

(7) Several species of nonnative beetles (*Coccotrypes* spp.) bore into and feed upon the seeds of the native palm genus *Pritchardia* (Swezey 1927, in litt.; Science Panel 2005, pp. 1–23; Magnacca 2011b, pers. comm.), which results in reduced natural regeneration of the plants (Beaver 1987, p. 11; Magnacca 2005, in litt.; Science Panel 2005, pp. 1–23).

These threats are serious and ongoing, act in concert with other threats to the species, and are expected to continue or increase in magnitude and intensity into the future without effective management actions to control or eradicate them. In addition, negative impacts to native Hawaiian plants on Hawaii Island from grazing and browsing by axis deer are likely should this nonnative ungulate increase in numbers and range on the island. The combined threat of ungulate, rat, and invertebrate predation on native Hawaiian flora and fauna suggests the need for immediate implementation of recovery and conservation actions.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Feral Ungulates

Nonnative ungulates pose a major ongoing threat to all 13 plant species, and to the picture-wing fly, through destruction and degradation of terrestrial habitat, and through direct predation of the 13 plant species (see Table 3). In addition, nonnative ungulates (feral goats and cattle) pose an ongoing threat to the anchialine pool shrimp through destruction and degradation of its anchialine pool habitat. Feral goats and cattle trample and forage on both native and nonnative plants around and near the pool opening at Lua O Palahemo, and increase erosion around the pool and sediment entering the pool. The State of Hawaii provides game mammal (feral pigs, goats, cattle, sheep, and mouflon sheep) hunting opportunities on 42 State-designated public hunting areas on the island of Hawaii (H.A.R. 13–123; Mello 2011, pers. comm.). The State's management objectives for game animals range from maximizing public hunting opportunities (*e.g.,* ''sustained yield'') in some areas to removal by State staff, or their designees, in other areas (H.A.R. 13–123). Ten of the 13 plant species (*Cyanea marksii, Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea hawaiiensis,* and *Stenogyne cranwelliae*) and the picture-wing fly have occurrences in areas where terrestrial habitat may be manipulated for game enhancement and where game populations are maintained at prescribed levels using public hunting (Perlman *et al.* 2001, in litt.; Perlman *et al.* 2004, in litt.; Lorence and Perlman

2007, pp. 357–361; PEPP 2007, p. 61; Pratt 2007a, in litt.; Pratt 2007b, in litt.; Benitez *et al.* 2008, p. 58; Agorastos 2010, in litt.; HBMP 2010c; HBMP 2010e; HBMP 2010f; HBMP 2010g; HBMP 2010h; HBMP 2010i; HBMPk; PEPP 2010, p. 63; Bio 2011, pers. comm.; Evans 2011, in litt.; Perry 2011, in litt.; Magnacca 2011b, pers. comm.; H.A.R. 13–123). Public hunting areas are 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 protect areas from game mammals, the current number and locations of fences are not adequate to prevent habitat degradation and destruction for 14 of the 15 species, and the direct predation of the 13 plant species on Hawaii Island (see Table 3). However, the State game animal regulations are not designed nor intended to provide habitat protection, and there are no other regulations designed to address habitat protection from ungulates.

The capacity of Federal and State agencies and their nongovernmental partners in Hawaii to mitigate the effects of introduced pests, such as ungulates and weeds, is limited due to the large number of taxa currently causing damage (Coordinating Group on Alien Pest Species (CGAPS) 2009). Many invasive weeds established on Hawaii Island have currently limited but expanding ranges and are of concern. Resources available to reduce the spread of these species and counter their negative ecological effects are limited. Control of established pests is largely focused on a few invasive species that cause significant economic or environmental damage to public and private lands. Comprehensive control of an array of invasive pests and management to reduce disturbance regimes that favor certain invasive species remains limited in scope. If current levels of funding and regulatory support for invasive species control are maintained on Hawaii Island, the Service expects existing programs to continue to exclude or, on a very limited basis, control invasive species only in high-priority areas. Threats from established pests (*e.g.,* nonnative ungulates, weeds, and invertebrates) are ongoing and expected to continue into the future.

Introduction of Nonnative Species

Currently, four agencies are responsible for inspection of goods arriving in Hawaii (CGAPS 2009). The Hawaii Department of Agriculture (HDOA) inspects domestic cargo and vessels, and focuses on pests of concern to Hawaii, especially insects or plant diseases not yet known to be present in the State (HDOA 2009). The U.S. Department of Homeland Security-Customs and Border Protection (CBP) is responsible for inspecting commercial, private, and military vessels and aircraft, and related cargo and passengers arriving from foreign locations. Customs and Border Protection focuses on a wide range of quarantine issues involving non-propagative plant materials (processed and unprocessed); wooden packing materials, timber, and products; internationally regulated commercial species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); seeds and plants listed as noxious; soil; and pests of concern to the greater United States, such as pests of mainland U.S. forests and agriculture. The U.S. Department of Agriculture-Animal and Plant Health Inspection Service-Plant Protection and Quarantine (USDA–APHIS–PPQ) inspects propagative plant material, provides identification services for arriving plants and pests, conducts pest risk assessments, trains CBP personnel, conducts permitting and preclearance inspections for products originating in foreign countries, and maintains a pest database that, again, has a focus on pests of wide concern across the United States. The Service inspects arriving wildlife products, with the goal of enforcing the injurious wildlife provisions of the Lacey Act (18 U.S.C. 42; 16 U.S.C. 3371 *et seq.*), and CITES.

The State of Hawaii's unique biosecurity needs are not recognized by Federal import regulations. Under the USDA–APHIS–PPQ's commodity risk assessments for plant pests, regulations are based on species considered threats to the mainland United States and do not address many species that could be pests in Hawaii (Hawaii Legislative Reference Bureau (HLRB) 2002, pp. 1–109; USDA–APHIS–PPQ 2010, pp. 1–88; CGAPS 2009, pp. 1–14). Interstate commerce provides the pathway for invasive species and commodities infested with non-Federal quarantine pests to enter Hawaii. Pests of quarantine concern for Hawaii may be intercepted at Hawaiian ports by Federal agents, but are not always acted on by them because these pests are not regulated under Federal mandates. Hence, Federal protection against pest species of concern to Hawaii has historically been inadequate. It is possible for the USDA to grant Hawaii protective exemptions under the ''Special Local Needs Rule,'' when clear and comprehensive arguments for both agricultural and conservation issues are provided; however, this exemption procedure operates on a case-by-case basis. Therefore, that avenue may only provide minimal protection against the large diversity of foreign pests that threaten Hawaii.

Adequate staffing, facilities, and equipment for Federal and State pest inspectors and identifiers in Hawaii devoted to invasive species interdiction are critical biosecurity gaps (HLRB 2002, pp. 1–14; USDA–APHIS–PPQ 2010, pp. 1–88; CGAPS 2009, pp. 1–14). State laws have recently been passed that allow the HDOA to collect fees for quarantine inspection of freight entering Hawaii (*e.g.,* Act 36 (2011) H.R.S. 150A–5.3). Legislation passed and enacted on July 8, 2011 (H.B. 1568), now requires commercial harbors and airports in Hawaii to provide biosecurity and inspection facilities to facilitate the movement of cargo through the ports. This enactment is a significant step toward optimizing the biosecurity capacity in the State of Hawaii; however, only time will determine the true effectiveness of this Act (Act 202(11)). From a Federal perspective, there is a need to ensure that all civilian and military port and airport operations and construction are in compliance with the Act. The introduction of new pests to the State of Hawaii is a significant risk to federally listed species.

Nonnative Animal Species

Vertebrate Species

The State of Hawaii's laws prohibit the importation of all animals unless they are specifically placed on a list of allowable species (HLRB 2002, pp. 1–109; CGAPS 2010, pp. 1–14). The importation and interstate transport of invasive vertebrates is federally regulated by the Service under the Lacey Act as ''injurious wildlife'' (Fowler *et al.* 2007, pp. 353 – 359); the list of vertebrates considered ''injurious wildlife'' is provided at 50 CFR 16. However, the law in its current form has limited effectiveness in preventing invasive vertebrate introductions into the State of Hawaii. On June 21, 2012, a new State law, Act 144 (''Relating to Wildlife'') was signed into law. This Act prohibits the interisland possession, transfer, transport, or release after transport of wild or feral deer, and establishes mandatory fines. On June 21, 2012, Act 149 (''Relating to Emergency Rules for Threats to Natural Resources or the Health of the Environment'') was also signed into State law. Act 149 expands the ability of State agencies to adopt emergency rules to address

situations that impose imminent threats to natural resources (Aila 2012a, in litt.; Martin 2012, in litt.). However, the effectiveness of these two recently enacted laws has not yet been demonstrated.

Invertebrate Species

Predation by nonnative invertebrate pests (slugs, wasps, ants, leafhoppers, and beetles) threaten 6 of the 13 the plant species and the picture-wing fly (see Table 3). It is likely that the introduction of most nonnative invertebrate pests to the State has been and continues to be accidental and incidental to other intentional and permitted activities. Although Hawaii State government and Federal agencies have regulations and some controls in place (see above), the introduction and movement of nonnative invertebrate pest species between islands and from one watershed to the next continues. For example, an average of 20 new alien invertebrate species have been introduced to Hawaii per year since 1970, an increase of 25 percent over the previous totals between 1930 and 1970 (The Nature Conservancy of Hawaii (TNCH) 1992, p. 8). Existing regulatory mechanisms therefore appear inadequate to ameliorate the threat of introductions of nonnative invertebrates, and we have no evidence to suggest that any changes to these regulatory mechanisms are anticipated in the future.

Nonnative Plant Species

Nonnative plants destroy and modify habitat throughout the ranges of 14 of the 15 species proposed for listing in this rule (see Table 3, above). As such, they represent a serious and ongoing threat to each of these species. In addition, nonnative plants have been shown to outcompete native plants and convert native-dominated plant communities to nonnative plant communities (see ''Habitat Destruction and Modification by Nonnative Plants'' above).

The State of Hawaii allows the importation of most plant taxa, with limited exceptions, if shipped from domestic ports (HLRB 2002; USDA–APHIS–PPQ 2010; CGAPS 2010). Hawaii's plant import rules (H.A.R. 4–70) regulate the importation of 13 plant taxa of economic interest; regulated crops include pineapple, sugarcane, palms and pines. Certain horticultural crops (*e.g.,* orchids) may require import permits and have pre-entry requirements that include treatment or quarantine or both, prior to or following entry into the State. The State noxious weed list (H.A.R. 4–68) and USDA–APHIS–PPQ's Restricted Plants List restrict the import of a limited number of noxious weeds. If not specifically prohibited, current Federal regulations allow plants to be imported from international ports with some restrictions. The Federal Noxious Weed List (see 7 CFR 360.200) includes few of the many globally known invasive plants, and plants in general do not require a weed risk assessment prior to importation from international ports. The USDA–APHIS–PPQ is in the process of finalizing rules to include a weed risk assessment for newly imported plants. 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 for the reasons described above. In addition, government funding is inadequate to provide for sufficient inspection services and monitoring.

In 1995, the Coordinating Group on Alien and Plant Species (CGAPS), a partnership comprised primarily of managers from every major Federal, State, County, and private agency and organization involved in invasive species work in Hawaii, 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 continue 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; H.R.S. 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* spp. (pampas grass), coqui frogs (*Eleutherodactylus coqui*), and ants (HISC 2009). However, in early 2009, HISC projected that, due to a tighter economy in Hawaii and anticipated budget cuts in State funding support of up to 50 percent, there will be a serious setback in conservation achievements, and the loss of experienced, highly trained staff (HISC 2009).

The Lua O Palahemo anchialine pool is located in a remote, largely undeveloped area, but is well known and frequently visited by residents and visitors for recreational opportunities, as indicated by the numerous off-road vehicle tracks around the pool (USFWS 2012 in litt.; Richardson 2012, in litt., pp. 1–2). As of the 2010 survey, a sign posted near Lua O Palahemo indicates that individuals who disturb the site are subject to fines under Haw. Rev. Stat. 6E (Hawaii's State Historic Preservation Act (SHPA)). This statute makes it unlawful for any person to take, appropriate, excavate, injure, destroy, or alter any historic property or aviation artifact located upon lands owned or controlled by the State or any of its political subdivisions, except as permitted by the State. Violators are subject to fines of not less than $500 nor more than $10,000 for each separate offense. However, sometime between the 2010 survey and the June 2012 visit by Service biologists, the sign had been removed (Richardson 2012, in litt., pp. 1–2). *Vetericaris chaceorum* is not protected under Hawaii's endangered species law (Haw. Rev. Stat. Sect. 195–D).

On the basis of the above information, existing State and Federal regulatory mechanisms are not adequately preventing the introduction of nonnative species to Hawaii via interstate and international mechanisms, or intrastate movement of nonnative species between islands, watersheds, and anchialine pools in Hawaii, and thus do not adequately protect 14 of the 15 species (all except the anchialine pool shrimp) proposed for listing in this proposed rule from the threat of new introductions of nonnative species, or from and the continued expansion of nonnative species populations on and between islands, watersheds, and anchialine pools. Nonnative species may prey upon, modify, or destroy habitat, or directly compete with one or more of the 14 species for food, space, and other necessary resources. The impacts from these introduced threats are ongoing and are expected to continue into the future.

We do not believe that existing regulatory mechanisms provide adequate protection for the anchialine pool shrimp, *Vetericaris chaceorum,* from the intentional dumping of trash and introduction of nonnative fish into Lua O Palahemo (see *Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence*). Existing regulatory mechanisms are therefore inadequate to ameliorate the threat of introductions of trash and nonnative

fish into Lua O Palahemo, and we have no evidence to suggest that any changes to these regulatory mechanisms are anticipated in the future.

Summary of Inadequacy of Existing Regulatory Mechanisms

The State's current management of nonnative game mammals is inadequate to prevent the degradation and destruction of habitat of the 13 plant species, and the picture-wing fly (*Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*), and to prevent predation of all 13 plant species (Factor C. *Disease or Predation*).

Existing State and Federal regulatory mechanisms are not effectively preventing the introduction and spread of nonnative species from outside the State of Hawaii and between islands and watersheds within the State of Hawaii. Habitat-altering nonnative plant species (*Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*) and predation by nonnative animal species (*Factor C. Disease or Predation*) pose a major ongoing threat to all 15 species proposed for listing in this proposed rule.

Existing State and Federal regulatory mechanisms do not provide adequate protection for the anchialine pool shrimp, *Vetericaris chaceorum,* from the intentional dumping of trash and introduction of nonnative fish into Lua O Palahemo (see *Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence*).

Because these regulatory mechanisms are inadequate to maintain habitat for the 15 species, and to prevent the spread of nonnative species (including nonnative fish into the Lua O Palahemo anchialine pool), the inadequacy of existing regulatory mechanisms is considered a serious threat, both now and in the future. Habitat degradation and loss caused by nonnative plants are a threat to each of the 13 plant species and the picture-wing fly (*Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*), and nonnative animals (including nonnative fish) are a threat to the 15 species (*Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range* and *Factor C. Disease or Predation*). Therefore, the inadequacy of the regulatory mechanisms to prevent the dumping of trash and introduction of nonnative fish into anchialine pool shrimp habitat, and to address threats posed by other nonnative species threatens these 15 species.

Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence

Other factors threatening some or all of the 15 species include dumping of trash and the introduction of nonnative fish, small numbers of populations and small population sizes, hybridization, lack of or declining regeneration, loss of host plants, and other activities. Each threat is discussed in detail below, along with identification of which species are affected by these threats.

Dumping of Trash and Introduction of Nonnative Fish

The depressional features of anchialine pools make them susceptible to dumping. Refuse found in degraded pools and pools that have been filled in with rubble have been dated to about 100 years old, and the practice continues today (Brock 2004, p. 15). Lua O Palahemo is located approximately 558 ft (170 m) from a sandy beach frequented by visitors who fish and swim. In addition, there are multiple dirt roads that surround the pool making it highly accessible. Plastic bags, paper, fishing line, water bottles, soda cans, radios, barbed wire, and a bicycle have been documented within the pool (Kensley and Williams 1986, pp. 417–418; Bozanic 2004, p. 1; Wada 2010, in litt). Physical trash is likely to increase the accumulation of sediment in the pool portion of Lua O Palahemo, and could affect adequate water flushing as well, by blocking the currently narrow passage into the much larger water body in the lava tube below. Introduction of trash involving chemical contamination into anchialine pools, as has been observed elsewhere on Hawaii Island (Brock 2004, pp. 15–16), could more drastically affect water quality and result in local extirpation of hypogeal shrimp species.

In general, the accidental or intentional introduction and spread of nonnative fish (bait and aquarium fish) is considered the greatest threat to anchialine pools in Hawaii (Brock 2004, p. 16). Maciolek (1983, p. 612) found that the abundance of shrimp in a given population is indirectly related to predation by fish. The release of mosquito fish (*Gambusia affinis*) and tilapia (*Tilapia mossambica*) into the Waikoloa Anchialine Pond Preserve (WAAPA) at Waikoloa, North Kona, Hawaii, resulted in the infestation of all ponds within an approximately 3.2-ha (8-ac) area, which represented approximately two-thirds of the WAAPA. Within 6 months, all native hypogeal shrimp species disappeared (Brock 2004, pp. iii). Nonnative fish drive anchialine species out of the lighted, higher productivity portion of the pools, into the surrounding water table bed rock, subsequently leading to the decimation of the benthic community structure of the pool (Brock 2004, p. iii). In addition, nonnative fish prey on and exclude native hypogeal shrimp that are usually a dominant and essential (Brock 2004, p. 16) faunal component of anchialine pool ecosystems (Bailey-Brock and Brock 1993, pp. 338–355). The loss of the shrimp changes ecological succession by reducing herbivory of macroalgae, allowing an overgrowth and change of pool flora. This overgrowth changes the system from clear, well-flushed basins to a system characterized by heavy sedimentation and poor water exchange, which increases the rate of pool senescence (Brock 2004, p. 16). Nonnative fish, unlike native fish, are able to complete their life cycles within anchialine habitats, and remain a permanent detrimental presence in all pools in which they are introduced (Brock 2004, p. 16). In Hawaii, the most frequently illegally introduced fish are in the Poeciliidae family (freshwater fish which bear live young) and include mosquito fish, various mollies (*Poecilia* spp.), and tilapia, which prey on and exclude native hypogeal shrimp such as the herbivorous species upon which *Vetericaris chaceorum* presumably feed. More than 90 percent of the 600 to 700 anchialine habitats in Hawaii have been degraded in the last 30 years due to the introduction of nonnative fish (Brock 2004, p. 24).

Lua O Palahemo is highly accessible to off-road vehicle traffic and located near an area frequented by residents and visitors for fishing and other outdoor recreational activities. We believe the pool is vulnerable to the intentional dumping of trash and introduction of nonnative fish (bait and aquarium fish) because the area is easily accessible to vehicles and human traffic, and yet due to its remote location, is far from regulatory oversight by the DHHL or DAR. According to Brock (2012, pers. comm.), sometime in the 1980s, nonnative fish were introduced into Lua O Palahemo. It is our understanding that the fish were subsequently removed with a fish poison, and to our knowledge the pool currently remains free of nonnative fish. The most commonly used piscicide (fish pesticide) in the United States for management of fish in freshwater systems is a naturally occurring chemical, marketed as a product called Rotenone. Unfortunately, Rotenone use in marine systems (including anchialine

pools) is illegal according to the Environmental Protection Agency (EPA 2007, pp. 22–23; Finlayson et al. 2010, p. 2).

More than 90 percent of Hawaii's anchialine pool habitats have been degraded or destroyed by the intentional dumping of trash and introduction of nonnative fish. Because the anchialine pool shrimp *Vetericaris chaceorum* is only known from one pool, the introduction of nonnative fish which prey on and exclude native hypogeal shrimp like *Vetericaris chaceorum* or its associated prey shrimp species would likely lead to the extirpation of this species, directly or indirectly due to the lower abundance of co-occurring shrimp species that provide food resources to *Vetericaris chaceorum.* In addition, the loss of native shrimp species leads to changes in ecological succession in anchialine pools, leading to senescence of the pool habitat, thereby rendering the pool unsuitable habitat (Brock 2004, p. 16).

Small Number of Individuals and Populations

Species that are endemic to single islands are inherently more vulnerable to extinction than are widespread species, because of the increased risk of genetic bottlenecks, random demographic fluctuations, climate change effects, and localized catastrophes such as hurricanes, drought, rockfalls, landslides, and disease outbreaks (Pimm *et al.* 1988, p. 757; Mangel and Tier 1994, p. 607). These problems are further magnified when populations are few and restricted to a very small geographic area, and when the number of individuals in each population 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 (Gilpin and Soulé 1986, pp. 24–34). Small, isolated populations often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (*e.g.,* Barrett and Kohn 1991, p. 4; Newman and Pilson 1997, p. 361). Very small, isolated populations are also more susceptible to reduced reproductive vigor due to ineffective pollination (plants), inbreeding depression (plants and shrimp), and hybridization (plants and flies). The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic interactions with other threats, such as those discussed above (see *Factor A* and *Factor C* above).

Plants

A limited number of individuals (fewer than 50 individuals) is a threat to the following six plant species in this proposal: *Bidens hillebrandiana* ssp. *hillebrandiana, Cyanea marksii, Cyrtandra wagneri, Platydesma remyi, Schiedea diffusa* ssp. *macraei,* and *S. hawaiiensis.* We consider these species highly vulnerable to extinction due to threats associated with small population size or small number of populations because:

- The only known occurrences of *Bidens hillebrandiana* ssp. *hillebrandiana, Cyanea marksii,* and *Cyrtandra wagneri* are threatened either by landslides, rockfalls, or erosion, or a combination of these, because of their locations in lowland wet, montane wet, and dry cliff ecosystems.
- *Platydesma remyi* is known from fewer than 40 scattered individuals (Stone *et al.* 1999, p. 1210; HBMP 2010i). Declining or lack of regeneration in the wild appears to threaten this species.
- *Schiedea diffusa* ssp. *macraei* is known from a single individual in the Kohala Mountains (Perlman *et al.* 2001, in litt.; Wagner *et al.* 2005d, p. 106; HBMP 2010j; Bio 2011, pers. comm.).
- Habitat destruction or direct predation by ungulates, nonnative plants, drought, and fire are threats to the 25 to 40 individuals of *Schiedea hawaiiensis* (Mitchell *et al.* 2005a; NDMC 2012–*Online Archives*).

Animals

Like most native island biota, the endemic anchialine pool shrimp and Hawaiian picture-wing fly are particularly sensitive to disturbances due to low number of individuals, low population numbers, and small geographic ranges. We consider the picture-wing fly vulnerable to extinction due to threats associated with low number of individuals and low number of populations because *Drosophila digressa* is known from only two of its five historically known locations. The following threats to this species have all been documented: Predation by nonnative wasps and ants; habitat degradation and destruction by nonnative ungulates, fire, and drought; loss of its host plants; and competition with nonnative flies for its host plants (Science Panel 2005, pp. 1–23; Magnacca 2011b, pers. comm.).

Hybridization

Natural hybridization is a frequent phenomenon in plants and can lead to the formation of new species (Orians 2000, p. 1,949), or sometimes to the decline of species through genetic assimilation or ''introgression'' (Ellstrand 1992, pp. 77, 81; Levine *et al.* 1996, pp. 10–16; Rhymer and Simberloff 1996, p. 85). Hybridization, however, is especially problematic for rare species that come into contact with species that are abundant or more common (Rhymer and Simberloff 1996, p. 83). We consider hybridization to be a threat to three species, and potentially a threat to one more species in this proposed rule because hybridization may lead to extinction of the original genotypically distinct species. Hybrid swarms (hybrids that can interbreed among themselves and also with the parent species) have been reported between the plant *Bidens micrantha* ssp. *ctenophylla* and *B. menziesii* ssp. *filiformis* near Puuwaawaa in north Kona (Ganders and Nagata 1983, p. 12; Ganders and Nagata 1999, p. 278); the plant *Cyrtandra nanawaleensis* is known to hybridize with *C. lysiosepala* in and around the Nanawale FR (Price 2011, in litt.); and *Cyrtandra wagneri* is reported to hybridize with *C. tintinnabula.* Only eight individuals express the true phenotype of *C. wagneri,* and only three of these individuals are reproducing successfully (PEPP 2010, p. 102; Bio 2011, pers. comm.). Native species can also hybridize with related nonnative species. For example, native species of *Pittosporum,* including the plant *Pittosporum hawaiiense,* are known to exhibit high levels of gene flow, and hybridization between native *Pittosporum* and nonnative species of *Pittosporum* may occur when they occupy similar habitat and elevation (Daehler and Carino 2001, pp. 91–96; Bacon *et al.* 2011, p. 733).

Regeneration

Lack of, or low levels of, regeneration (reproduction and recruitment) in the wild has been observed, and is a threat to, *Pittosporum hawaiiense, Platydesma remyi,* and *Pritchardia lanigera* (Bio 2011, pers. comm.; Magnacca 2011b, pers. comm.). The reasons for this are not well understood: however, seed predation by rats, ungulates, and beetles is thought to play a role (Bio 2011, pers. comm.; Magnacca 2011b, pers. comm.). In addition, *Cyanea tritomantha* is reported to produce few seeds with low viability. The reasons for this are unknown (Bio 2008, in litt.).

Competition

Competition with nonnative tipulid flies (large crane flies, family Tipulidae) for larvae host plants threatens the picture-wing fly proposed for listing in this rule. The Hawaiian Islands now support several species of nonnative tipulid flies, and the larvae of some species within this group feed within the decomposing bark of some of the host plants utilized by picture-wing flies, including *Cheirodendron, Clermontia, Pleomele,* and *Charpentiera,* the host plant for *Drosophila digressa* (Science Panel 2005, pp. 1–23; Magnacca 2005, in litt.). The effect of this competition is a reduction of available host plant material for the larvae of the picture-wing fly. In laboratory studies, Grimaldi and Jaenike (1984, pp. 1,113–1,120) demonstrated that competition between *Drosophila* larvae and other fly larvae can exhaust food resources, which affects both the probability of larval survival and the body size of adults, resulting in reduced adult fitness, fecundity, and lifespan. Both soldier and nephritid flies have been suggested to impose a similar threat to Hawaiian picture-wing flies (Montgomery 2005, in litt.; Science Panel 2005, pp. 1–23).

Loss of Host Plant

Drosophila digressa is dependent on decaying stem bark from plants in the genus *Charpentiera* for oviposition and larval development (Montgomery 1975, p. 95). *Charpentiera* is considered highly susceptible to damage from alien ungulates, such as pigs and goats, as well as competition with nonnative plants (*e.g., Omalanthus populifolius, Schinus terebinthifolius,* and *Psidium cattleianum*) (Foote and Carson 1995, pp. 370–37; Science Panel 2005, pp. 1–23; Magnacca 2011b, pers.comm.). Bark-breeding *Drosophila* species are sensitive to bottlenecks in host plant populations due to their dependence on older, senescent or dying plants (Magnacca *et al.* 2008, p. 32). Altered decay cycles in host plants caused by genetic bottlenecks, or decreasing availability of host plants due to browsing and trampling by nonnative ungulates (pigs, goats, cattle, and mouflon), competition with nonnative plants, drought, or other phenomena can subsequently alter the life cycle of the picture-wing fly by disrupting the early stages of development. Predation by nonnative beetles (the branch and twig borer (*Amphicerus cornutus*), the black twig borer (*Xylosandrus compactus*), and weevils (*Oxydema fusiforme*) have been documented as threats to *Charpentiera* spp. (Medeiros *et al.* 1986, p. 29; Giffin 2009, p. 81).

Summary of Other Natural or Manmade Factors Affecting Their Continued Existence

We consider the threats from dumping of trash and introduction of nonnative fish into the pool that supports the anchialine pool shrimp proposed for listing in this rule to be serious threats that have the potential to occur at any time, although their occurrence is not predictable. The use of anchialine pools for dumping of trash and introduction of nonnative fish are widespread practices in Hawaii and have the potential to occur at any time at the Lua O Palahemo pool. Nonnative fish prey on or outcompete native herbivorous anchialine pool shrimp that serve as the prey base for predatory species of shrimp, including the anchialine pool shrimp proposed for listing in this rule.

We consider the threat from limited number of populations and few (less than 50) individuals to be a serious and ongoing threat to the 6 plant species proposed for listing (*Bidens hillebrandiana ssp. hillebrandiana, Cyanea marksii, Cyrtandra wagneri, Platydesma remyi, Schiedea diffusa* ssp. *macraei,* and *S. hawaiiensis*) because (1) these species may experience reduced reproductive vigor due to ineffective pollination or inbreeding depression; (2) they may experience reduced levels of genetic variability, leading to diminished capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence; and (3) a single catastrophic event may result in extirpation of remaining populations and extinction of the species. This threat applies to the entire range of each species.

The threat to the picture-wing fly from limited numbers of individuals and populations is ongoing and is expected to continue into the future because (1) this species may experience reduced reproductive vigor due to inbreeding depression; (2) it may experience reduced levels of genetic variability leading to diminished capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence; (3) a single catastrophic event (*e.g.,* hurricane, drought) may result in extirpation of remaining populations and extinction of this species; and (4) species with few known locations, such as *Drosophila digressa,* are less resilient to threats that might otherwise have a relatively minor impact on widely-distributed species. For example, the reduced availability of host trees or an increase in predation of the picture-wing fly adults that might be absorbed in a widely-distributed species could result in a significant decrease in survivorship or reproduction of a species with limited distribution. The limited distribution of this species thus magnifies the severity of the impact of the other threats discussed in this proposed rule.

The threat from hybridization is unpredictable but an ongoing and ever-present threat to *Bidens micrantha* ssp. *ctenophylla, Cyrtandra nanawaleensis,* and *Cyrtandra wagneri,* and a potential threat to *Pittosporum hawaiiense.* We consider the threat to *Cyanea tritomantha, Pittosporum hawaiiense, Platydesma remyi,* and *Pritchardia lanigera* from lack of regeneration to be ongoing and to continue into the future because the reasons for the lack of recruitment in the wild are unknown and uncontrolled, and any competition from nonnative plants or habitat modification by ungulates or fire could lead to the extirpation of these species.

Competition for host plants with nonnative tipulid flies is a threat to *Drosophila digressa* and is expected to continue into the future because field biologists report that these nonnative flies are widespread and there is no mechanism in place to control their population growth. Loss of host plants (*Charpentiera* spp.) is a threat to the picture-wing fly, and we consider this threat to continue into the future because field biologists have reported that species of *Charpentiera* are declining in the wild.

Proposed Determination for 15 Species

We have carefully assessed the best scientific and commercial information available regarding threats to each of the 15 species proposed for listing. We find that each of the 13 plant species and the picture-wing fly face threats that are ongoing and expected to continue into the future throughout their ranges from the present destruction and modification of their habitats from nonnative feral ungulates and nonnative plants (Factor A). Destruction and modification of habitat by development and urbanization is a threat to one plant species (*Bidens micrantha* ssp. *ctenophylla*). Habitat destruction and modification from fire is a threat to three of the plant species (*Bidens micrantha* ssp. *ctenophylla, Phyllostegia floribunda,* and *Schiedea hawaiiensis*) and the picture-wing fly. Destruction and modification of habitat from rockfalls, landslides, treefalls, or heavy rain is a threat to four plant species (*Bidens hillebrandiana* ssp.

hillebrandiana, Cyanea marksii, Cyanea tritomantha, and *Cyrtandra wagneri*). Habitat loss or degradation due to drought is a threat to two plants, *Bidens micrantha* ssp. *ctenophylla* and *Schiedea hawaiiensis,* as well as to the picture-wing fly. We are concerned about the effects of projected climate change on all species, particularly rising temperatures, but recognize there is limited information on the exact nature of impacts that these species may experience. In addition, habitat loss or degradation is a threat to the anchialine pool shrimp *Vetericaris chaceorum* due to sedimentation resulting from degradation of the immediate area surrounding the Lua O Palahemo anchialine pool. Sedimentation reduces both food productivity and the ability of Lua O Palahemo to support the anchialine pool shrimp (Factor A).

Overcollection for commercial and recreational purposes poses a threat to *Pritchardia lanigera* (Factor B).

Predation and herbivory on all 13 plant species by feral pigs, goats, cattle, sheep, mouflon, rats, slugs, two-spotted leaf hoppers, or beetles poses a serious and ongoing threat; as does predation of the picture-wing fly by nonnative wasps and ants (Factor C).

The inadequacy of existing regulatory mechanisms (*i.e.,* inadequate protection of habitat and inadequate protection from the introduction of nonnative species) poses a serious and ongoing threat to all 15 species (Factor D). There are serious and ongoing threats to six plant species (*Bidens hillebrandiana* ssp. *hillebrandiana, Cyanea marksii, Cyrtandra wagneri, Platydesma remyi, Schiedea diffusa* ssp. *macraei,* and *S. hawaiiensis*) and the picture-wing fly due to factors associated with small numbers of populations and individuals; to *Bidens micrantha* ssp. *ctenophylla, Cyrtandra nanawaleensis, Cyrtandra wagneri,* and potentially to *Pittosporum hawaiiense* from hybridization; to *Cyanea tritomantha, Pittosporum hawaiiense, Platydesma remyi, and Pritchardia lanigera* from the lack of regeneration in the wild; and to the picture-wing fly from competition for host plants with nonnative flies and declining numbers of host plants. The anchialine pool shrimp is threatened by the intentional dumping of trash and introduction of nonnative fish into its only known location. Nonnative fish drive anchialine species out of the lighted, highly productive portion of the pools into the surrounding water table bed rock, subsequently leading to the decimation of the benthic community structure of the pool, and prey on and exclude native hypogeal shrimp that are usually a dominant and essential faunal component of anchialine pool ecosystems. Because anchialine pool health and the presence of hypogeal shrimp are interdependent, the loss of the shrimp changes ecological succession by reducing herbivory of cyanobacteria and macroalgae allowing an overgrowth and change of pool flora. This overgrowth changes the system from clear, well-flushed basins to a system characterized by heavy sedimentation and poor water exchange which increases the rate of pool senescence (Bailey-Brock and Brock 1993, pp. 338–355; Brock 2004, pp. iii and 16) (Factor E) (see Table 3). These threats are exacerbated by these species' inherent vulnerability to extinction from stochastic events at any time because of their endemism, small numbers of individuals and populations, and restricted habitats.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We find that each of these 15 endemic species is presently in danger of extinction throughout its entire range, based on the severity and scope of the ongoing and projected threats described above. These threats are exacerbated by small population sizes, the loss of redundancy and resiliency of these species, and the continued inadequacy of existing protective regulations. Therefore, on the basis of the best available scientific and commercial information, we have determined that each of these species 15 species meets the definition of an endangered species under the Act. We therefore propose to list the following 15 species as endangered species in accordance with section 3(6) of the Act: The plants *Bidens hillebrandiana* ssp. *hillebrandiana, B. micrantha* ssp. *ctenophylla, Cyanea marksii, Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei, Schiedea hawaiiensis,* and *Stenogyne cranwelliae;* the anchialine pool shrimp, *Vetericaris chaceorum;* and the picture-wing fly, *Drosophila digressa.*

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. Each of the 15 Hawaii Island species proposed for listing in this rule is highly restricted in its range, and the threats occur throughout its range. Therefore, we assessed the status of each species throughout its entire range. In each case, the threats to the survival of these species occur throughout the species' ranges and are not restricted to any particular portion of those ranges. Accordingly, our assessment and proposed determination applies to each species throughout its entire range, and we do not need to further consider the status of each species in a significant portion of their respective ranges.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain activities. Recognition through listing results in public awareness and conservation by Federal, State, and local agencies: Private organizations; and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection measures required of Federal agencies and the prohibitions against certain activities involving listed animals and plants are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed, preparation of a draft and final recovery plan, and revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that will achieve recovery of the species, measurable criteria that help to determine when a species may be downlisted or delisted, and methods for

monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprised of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outlines, draft recovery plans, and the final recovery plans will be available from our Web site (*http://www.fws.gov/endangered*), or from our Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (*e.g.,* restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private and State lands.

If these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, under section 6 of the Act, the State of Hawaii would be eligible for Federal funds to implement management actions that promote the protection and recovery of the 15 species. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Although these species are only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for these species. Additionally, we invite you to submit any new information on these species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(1) of the Act mandates that all Federal agencies shall utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of endangered and threatened species listed pursuant to section 4 of the Act. Section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or result in destruction or adverse modification of critical habitat. If a Federal action may affect the continued existence of a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

For the 15 plants and animals proposed for listing as endangered species in this rule, Federal agency actions that may require consultation as described in the preceding paragraph include, but are not limited to, actions within the jurisdiction of the Natural Resources Conservation Service, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and branches of the Department of Defense (DOD). Examples of these types of actions include activities funded or authorized under the Farm Bill Program, Environmental Quality Incentives Program, Ground and Surface Water Conservation Program, Clean Water Act (33 U.S.C. 1251 et seq.), Partners for Fish and Wildlife Program, and DOD construction activities related to training or other military missions.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered wildlife and plants. The prohibitions, codified at 50 CFR 17.21 for wildlife and 17.61 for plants, apply. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed wildlife species. It is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. In addition, for plants listed as endangered, the Act prohibits the malicious damage or destruction on areas under Federal jurisdiction and the removal, cutting, digging up, or damaging or destroying of such plants in knowing violation of any State law or regulation, including State criminal trespass law. Certain exceptions to the prohibitions apply to agents of the Service and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving endangered or threatened wildlife or plant species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 and 17.62 for endangered wildlife and plants, respectively. With regard to endangered wildlife, a permit must be issued for the following purposes: For scientific purposes, to enhance the propagation and survival of the species, and for incidental take in connection with otherwise lawful activities. For endangered plants, a permit must be issued for scientific purposes or for the enhancement of propagation or survival. Requests for copies of the regulations regarding listed species and inquiries about prohibitions and permits may be addressed to U.S. Fish and Wildlife Service, Pacific Region, Ecological Services, Eastside Federal Complex, 911 NE. 11th Avenue, Portland, OR 97232–4181 (telephone 503–231–6131; facsimile 503–231–6243).

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of species proposed for listing. The following activities could potentially result in a violation of section 9 of the Act; however, this list is not comprehensive:

(1) Unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act;

(2) Introduction of nonnative species that compete with or prey upon the 15 species, such as the introduction of competing, nonnative plants or animals to the State of Hawaii; and

(3) The unauthorized release of biological control agents that attack any life stage of these 15 species.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be

addressed to the U.S. Fish and Wildlife Service, Pacific Region, Ecological Services, Endangered Species Permits, Eastside Federal Complex, 911 NE. 11th Avenue, Portland, OR 97232–4181 (telephone 503–231–6131; facsimile 503–231–6243).

If made final, Federal listing of the 15 species included in this rule would automatically invoke State listing under Hawaii's Endangered Species law (H.R.S. 195D 1–32) and supplement the protection available under other State laws. These protections would prohibit take of these species and encourage conservation by State government agencies. Further, the State would be able to enter into agreements with Federal agencies to administer and manage any area required for the conservation, management, enhancement, or protection of endangered species (H.R.S. 195D–5). Funds for these activities could be made available under section 6 of the Act (Cooperation with the States). Thus, the Federal protection afforded to these species by listing them as endangered species would be reinforced and supplemented by protection under State law.

Critical Habitat

Background

Critical habitat is defined in section 3 of the Act as:

(i) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features

(I) Essential to the conservation of the species and

(II) Which may require special management considerations or protection; and

(ii) Specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided under the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management, such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot otherwise be relieved, may include regulated taking.

Critical habitat receives protection under section 7 of the Act through the prohibition against Federal agencies carrying out, funding, or authorizing the destruction or adverse modification of critical habitat. Section 7(a)(2) of the Act requires consultation on Federal actions that may affect critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public access to private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by the landowner. Where a landowner seeks or requests Federal agency funding or authorization that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) of the Act would apply, but in the event of a destruction or adverse modification finding, the Federal action agency's and the applicant's obligation is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

For inclusion in a critical habitat designation, the habitat within the geographical area occupied by the species at the time of listing must contain the physical or biological features essential to the conservation of the species, and be included only if those features may require special management considerations or protection. Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species. Under the Act and regulations at 50 CRF 424.12(e), we can designate critical habitat in areas outside the geographical area occupied by the species at the time it is listed only when we determine that those areas are essential for the conservation of the species and that designation limited to those areas occupied at the time of listing would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific and commercial data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas should be proposed as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species; articles in peer-reviewed journals; conservation plans developed by States and counties; scientific status surveys and studies; biological assessments; or other unpublished materials and expert opinion or personal knowledge.

Habitat is often dynamic, and species may move from one area to another over time. Furthermore, we recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine to be necessary for the recovery of the species, as additional scientific information may become available in the future. For these reasons, a critical habitat designation does not signal that habitat outside the designated area is unimportant or may not be required for recovery of the species.

The information currently available on the effects of global climate change and increasing temperatures does not make sufficiently precise estimates of the location and magnitude of the effects to allow us to incorporate this information into our current designation of critical habitat, nor are we currently aware of any climate change information specific to the habitat of any of the species being addressed in this proposed rule that would indicate what areas may become important to the species in the future. Therefore, we are unable to determine what additional areas, if any, may be appropriate to include in the proposed critical habitat for these species; however, we specifically request information from the public on the currently predicted effects of climate change on the species addressed in this proposed rule and their habitats. Furthermore, we recognize that designation of critical habitat may not include all of the habitat areas we may eventually determine are necessary for the recovery of the species, based on scientific data

now available to the Service. For these reasons, a critical habitat designation does not signify that habitat outside of the designated area is unimportant or may not be required for the recovery of the species.

Areas that are important to the conservation of the species, but are outside the critical habitat designation, will continue to be subject to conservation actions we implement under section 7(a)(1) of the Act. Areas that support populations are also subject to the regulatory protections afforded by the section 7(a)(2) jeopardy standard, as determined on the basis of the best available scientific information at the time of the agency action. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may require consultation under section 7 of the Act and may still result in jeopardy findings in some cases. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, habitat conservation plans (HCPs), section 7 consultations, or other species conservation planning efforts if any new information available to these planning efforts calls for a different outcome.

Prudency Determination for 15 Proposed Species and 2 Listed Species on Hawaii Island

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12) require that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time a species is determined to be endangered or threatened. Our regulations at 50 CFR 424.12(a)(1) state that designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species; or (2) such designation of critical habitat would not be beneficial to the species.

As we have discussed under the threats analysis for Factor B, above, there is currently no documentation that 14 of the 15 species proposed for listing are threatened by taking or other human activity. Overcollection is a threat to the plant *Pritchardia lanigera* (see ''*Overutilization for Commercial, Recreational, Scientific or Educational Purposes,*'' above). Rare palm trees are highly desirable to collectors, and there is an active Internet sale and online auction market for their seeds and seedlings, including *P. lanigera* (rarepalmseeds.com 2011; junglemusic.net 2012; ebay.com 2012). Several nurseries advertise and sell seedlings and young plants, including at least 13 species of Hawaiian *Pritchardia*. Seven of these species are federally protected, including *P. affinis* and *P. schattaueri* on Hawaii Island (ebay.com 2012; junglemusic.net 2012). Seeds of the endangered *P. hardyi* on Kauai have been illegally removed from an outplanting site in the past (75 FR 18960, April 13, 2010), and there is evidence of vandalism and illegal collection of other species of endangered *Pritchardia* palms on Kauai (75 FR 18960, April 13, 2010). In the 1990s, seeds of the endangered *P. schattaueri* were removed from plants in two of the three locations on Hawaii Island where this species was known at that time (PEPP 2007, in litt.). We do not believe that the designation of critical habitat for *P. lanigera* will increase the threat of overcollection for the following reasons: (1) The area of the known locations is extremely difficult to access because most of the rigorous and steep trails leading into Waimanu and neighboring valleys were destroyed in the 2005 Kona earthquake (Magnacca 2011b, pers. comm.); and (2) critical habitat designation, as proposed, does not identify the specific location of individual species . In addition, we believe that the potential benefit to *P. lanigera* from designating critical habitat is that the designation could serve to educate landowners, State and local government agencies, and the general public regarding the potential conservation value of the area. Therefore, we find that the designation of critical habitat for *P. lanigera* is prudent.

At the time we listed the plant *Mezoneuron kavaiense* (uhiuhi) as endangered we found that designation of critical habitat was not prudent because publication of the location of a species-specific critical habitat description would increase the risk of taking or vandalism, while providing no additional benefit to the species (51 FR 24672; July 8, 1986). However, we have examined the best available information and found no current information to indicate that this plant is currently threatened by overcollection or vandalism, or is otherwise used for commercial, recreational, scientific, or educational purposes. Thus, we believe there is a benefit to a critical habitat designation for this species (see discussion below). Moreover, we have no current information to indicate that identification of critical habitat is expected to initiate such a threat to any of the other species addressed in this proposed rule.

We reviewed the information available for the 13 plants, anchialine pool shrimp, and picture-wing fly proposed for listing in this rule, and the endangered plant *Mezoneuron kavaiense,* pertaining to the biological needs of these 16 species and characteristics of their last known habitats. In the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, then a prudent finding is warranted. The potential benefits to the 15 species proposed for listing and the endangered plant *Mezoneuron kavaiense* include: (1) Triggering consultation under section 7 of the Act, in new areas for actions in which there may be a Federal nexus where it would not otherwise occur because, for example, it is or has become unoccupied or the occupancy is in question; (2) focusing conservation activities on the most essential features and areas; (3) providing educational benefits to State or county governments or private entities; and (4) preventing people from causing inadvertent harm to the species.

The primary regulatory effect of critical habitat is the section 7(a)(2) requirement that Federal agencies refrain from taking any action that destroys or adversely modifies critical habitat. We find that the designation of critical habitat for each of the 15 species proposed for listing in this rule and the endangered plant *Mezoneuron kavaiense* would benefit them by serving to focus conservation efforts on the restoration and maintenance of ecosystem functions that are essential for attaining their recovery and long-term viability. In addition, the designation of critical habitat serves to inform management and conservation decisions by identifying any additional physical or biological features of the ecosystem that may be essential for the conservation of certain species. Therefore, as we have determined that the designation of critical habitat will not likely increase the degree of threat to the species and may provide some measure of benefit, we find that designation of critical habitat is prudent for the following 16 species, as critical habitat would be beneficial and there is no evidence that the designation of critical habitat would result in an increased threat from taking or other human activity for these species:

(1) Plants— *Bidens hillebrandiana* ssp. *hillebrandiana, Bidens micrantha* ssp. *ctenophylla, Cyanea marksii,*

Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Mezoneuron kavaiense, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa ssp. *macraei, Schiedea hawaiiense,* and *Stenogyne cranwelliae;*

(2) Animals— insects: *Drosophila digressa;* crustaceans: *Vetericaris chaceorum*.

In this rule, we are also proposing critical habitat for the listed plant, *Isodendrion pyrifolium*. We previously found that critical habitat is prudent and determinable (67 FR 36968; May 28, 2002) for *Isodendrion pyrifolium* on Hawaii Island, but we did not designate any critical habitat for the species in 2003, as discussed below.

Critical Habitat Determinability for 16 Species on Hawaii Island

As stated above, section 4(a)(3) of the Act requires the designation of critical habitat concurrently with the species' listing ''to the maximum extent prudent and determinable.'' Our regulations at 50 CFR 424.12(a)(2) state that critical habitat is not determinable when one or both of the following situations exist:

(i) Information sufficient to perform required analyses of the impacts of the designation is lacking, or

(ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

When critical habitat is not determinable, the Act provides for an additional year to publish a critical habitat designation (16 U.S.C. 1533(b)(6)(C)(ii)).

Pursuant to section 4(a)(3) of the Act we are to designate critical habitat to the maximum extent prudent and determinable at the time a species is proposed for listing. In our previous discussion, we indicated that the designation of critical habitat would provide a benefit for the 15 species proposed for listing in this rule, and the plant, *Mezoneuron kavaiense* listed as endangered in 1986 (51 FR 24672; July 8, 1986). As a consequence, we determined that the designation of critical habitat for these 16 species is prudent.

Next we are to evaluate whether the designation of critical habitat is determinable, and if so, propose critical habitat concurrent with our proposed listing. At this time, we have found that the designation of critical habitat is determinable for only one species that we are proposing to list, *Bidens micrantha* ssp. *ctenophylla,* and are including critical habitat for it in this proposal. We also find that the designation of critical habitat is determinable for the listed plant, *Mezoneuron kavaiense,* and are including critical habitat for it in this proposal. In addition, we are including critical habitat for a third species, the plant *Isodendrion pyrifolium* listed as endangered in 1994 (59 FR 10305; March 4, 1994). We had previously determined that critical habitat was prudent and determinable (67 FR 36968; May 28, 2002) and proposed areas as critical habitat for *Isodendrion pyrifolium* on Hawaii Island. However, in the final rule for Hawaii Island plants (68 FR 39624, July 2, 2003), the areas proposed for critical habitat for this species were excluded from final designation under section 4(b)(2) of the Act (see discussion regarding ''Reconsideration of Lands Previously Excluded Under Section 4(b)(2) of the Act'').

The species *Bidens micrantha* ssp. *ctenophylla,* which is proposed for listing in this rule, and the listed species *Isodendrion pyrifolium* and *Mezoneuron kavaiense* co-occur in the same lowland dry ecosystem on the island of Hawaii. These three species (*Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense*) share many of the same physical or biological features (*e.g.,* elevation, annual rainfall, substrate, associated native plant genera) as well as the same threats from development, fire, and nonnative ungulates and plants. In this proposed rule, we have identified areas that provide the physical or biological features essential for the conservation of these three species and areas that are essential for the conservation of these three species in the lowland dry ecosystem on the island of Hawaii. Therefore, we find that critical habitat is determinable for *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense* in this rule.

However, for the remaining 14 species proposed for listing in this rule, we do not have the analysis necessary to refine the identification of the physical and biological features and delineate the specific areas that contain those features in the appropriate arrangement and quantity or the specific unoccupied areas essential to the species' conservation. As a result, we find that for the remaining 14 species that we are proposing to list in this rule, the designation of critical habitat is not determinable at this time.

Proposed Critical Habitat for *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense* on Hawaii Island

In this section, we discuss the proposed designation of critical habitat for three plant species (*Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense*). *Bidens micrantha* ssp. *ctenophylla* is 1 of the 15 species proposed for listing in this rule, for which critical habitat was determined to be prudent and determinable. Critical habitat wa for *Isodendrion pyrifolium* on the island of Hawaii, but was excluded from designation as critical habitat under section 4(b)(2) of the Act in the final rule published on July 2, 2003 (68 FR 39624). In this proposed rule, we have determined that critical habitat is both prudent and determinable for the listed plant species *Mezoneuron kavaiense*.

Background for the Listed Plants Isodendrion pyrifolium and Mezoneuron kavaiense

It is our intent to discuss only those topics directly relevant to the proposed designation of critical habitat on the island of Hawaii. For additional information on *Isodendrion pyrifolium* and its proposed critical habitat on Oahu, Molokai, and Maui, refer to the proposed rules for *Listing 23 Species on Oahu as Endangered and Designating Critical Habitat for 124 Species* (76 FR 46362; August 2, 2011) and the proposed rule *Listing 38 Species on Molokai, Lanai, and Maui as Endangered and Designating Critical Habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 Species* (77 FR 34464; June 11, 2012). For additional information on the listed endangered plant *Mezoneuron kavaiense,* which does not have designated critical habitat in Hawaii, please refer to the listing rule published in the **Federal Register** on July 8, 1986 (51 FR 24672).

Currently designated critical habitat on the island of Hawaii includes critical habitat for the plant *Kokia drynarioides* (49 FR 47397, December 4, 1984), and 41 other listed plants (68 FR 39624, July 2, 2003), Blackburn's sphinx moth (68 FR 34710, June 10, 2003), and 3 picture-wing flies (73 FR 73794, December 4, 2008). Approximately 55 percent of the area being proposed as critical habitat in this rule overlaps with these areas previously designated as critical habitat. In some areas, the footprint of the proposed critical habitat is larger than the 1984, 2003, and 2008 designations, to accommodate the future expansion of one or more of the three species'

populations within the particular ecosystem in which they occur (*e.g.,* expansion into unoccupied habitat). The proposed critical habitat correlates each species' physical or biological requirements with the characteristics of the lowland dry ecosystem within which they occur (*e.g.,* elevation, rainfall, species associations, etc.), and also includes areas unoccupied by the species but determined to be essential for the conservation of the species. The proposed critical habitat will enable managers to focus conservation management efforts on common threats and facilitate the restoration of the ecosystem function and species-specific habitat needs for the recovery of *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense*. This information represents the best current scientific and commercial information available.

Current Status of *Isodendrion pyrifolium* and *Mezoneuron kavaiense*

The plant, *Bidens micrantha* ssp. *ctenophylla,* is proposed for listing as endangered in this rule. For the status of *B. micrantha* ssp. *ctenophylla* see Description of the 15 Species Proposed for Listing above.

Isodendrion pyrifolium (wahine noho kula), a perennial shrub in the violet family (Violaceae), is known from Niihau, Oahu, Molokai, Lanai, Maui, and Hawaii (Wagner *et al.* 1999k, p. 1,331). *Isodendrion pyrifolium* was thought to be extinct since 1870, but was rediscovered in 1991 at Kealakehe, near Kailua on the island of Hawaii. In 2003, *I. pyrifolium* was only known from a single occurrence of approximately nine individuals at Kealakehe on the island of Hawaii (68 FR 39624, July 2, 2003). Currently, there are no extant occurrences on Oahu, Lanai, Molokai, or Maui. Surveys in 2006 and 2007 have documented the decline of the total number of individuals at Kealakehe (from nine individuals in 2003, to four individuals in 2006, to three individuals in 2007) (David 2007, pers. comm. in USFWS 2008, in litt.). Currently, there are only two wild individuals at Kealakehe, in the lowland dry ecosystem (Wagner 2011b, in litt.). The two wild individuals are found within two small, managed preserves situated in an urban setting. The larger 26-ac (11-ha) preserve is bordered by a high school, residential development, and construction of the Kealakehe portion of Ane Keohokalole Highway. The smaller 4-ac (1-ha) preserve is bordered by the same highway construction and open space. Three individuals are represented in ex situ collections (PEPP 2011, p. 32). Plants are under propagation at the Volcano Rare Plant Facility and at the Future Forests Nursery for seed production and for outplanting (VRPF 2010, in litt.; VRPF 2011, in litt; Wagner 2011b, in litt.). Five *I. pyrifolium* plants have been outplanted at the Kaloko-Honokohau National Historical Park (NHP), and another 20 plants were outplanted in Puu Waawaa and Kaupulehu in 2010 (Wagner 2011c, in litt.). There are plans to outplant an additional 25 plants at both Kealakehe and Kaupulehu (Wagner 2011c, in litt.). Critical habitat for this species is also being proposed on the islands of Oahu (76 FR 46362; August 2, 2011), and Maui and Molokai (77 FR 34464; June 11, 2012). There is no currently designated critical habitat for this plant on Hawaii Island.

Mezoneuron kavaiense (uhiuhi), a medium-sized tree in the pea family (Fabaceae), was known historically from Kauai, Oahu, Lanai, Maui, and Hawaii (Geesink *et al.* 1999, pp. 647–648). At the time of listing in 1986, a single large occurrence of approximately 30 individuals at Puu Waawaa contained the majority of individuals of this species on Hawaii Island (51 FR 24672, July 8, 1986; HBMP 2010m). In 1992, a second occurrence of 21 individuals was discovered at Kealakehe (USFWS 1994, p. 14; HBMP 2010m). In 1993, fire within a kipuka (an area of older land within the younger Kaupulehu lava flow) destroyed 80 percent of the individuals known from Puu Waawaa. Surveys in 2006 reported the number of individuals at Puu Waawaa to be approximately 50 to 100 individuals (HBMP 2010m). In addition, recently new information documented 13 individuals near Waikoloa Village (Faucette 2010, p. 3). Currently, *M. kavaiense* is found in 4 occurrences totaling 90 to 140 individuals in the lowland dry ecosystem of Hawaii Island (HBMP 2010m). Critical habitat is not currently designated for this plant.

Methods

As required by section 4(b) of the Act, we used the best scientific data available in determining those areas that contain the physical or biological features essential to the conservation of the three species, and for which designation of critical habitat is considered prudent, by identifying the occurrence data for each species and determining the ecosystems upon which they depend. This information was developed by using:

- The known locations of the three species, including site-specific species information from the HBMP database (HBMP 2010b; HBMP 2010m; HBMP 2010n), the TNC database (TNC 2007—*Ecosystem Database of ArcMap Shapefiles,* unpublished), and our own rare plant database;
- Species information from the plant database housed at NTBG;
- Maps of habitat essential to the recovery of Hawaiian plants, as determined by the Hawaii and Pacific Plant Recovery Coordinating Committee (HPPRCC 1998, 32 pp. + appendices);
- Maps of important habitat for the recovery of plants protected under the Act (USFWS 1999, pp. F12);
- The Nature Conservancy's Ecoregional Assessment of the Hawaiian High Islands (2006) and ecosystem maps (TNC 2007—*Ecosystem Database of ArcMap Shapefiles,* unpublished);
- Color mosaic 1:19,000 scale digital aerial photographs for the Hawaiian Islands (March 2006 to January 2009);
- Island-wide Geographic Information System (GIS) coverage (*e.g.,* Gap Analysis Program (GAP) vegetation data of 2005;
- 1:24,000 scale digital raster graphics of U.S. Geological Survey (USGS) topographic quadrangles;
- Geospatial data sets associated with parcel data from Hawaii County (2008);
- Recent biological surveys and reports; and
- Discussions with qualified individuals familiar with these species and ecosystems.

Based upon all of this data, we determined that those portions of the lowland dry ecosystems being proposed for critical habitat designation in this rule are either currently occupied or were occupied at the time of listing by one or more of the 3 species addressed in this rule. These areas contain the physical or biological features essential to the conservation of the species, or to the extent that they are not currently occupied by one or more of the three species, they are essential for the conservation of the species (TNC 2006b, pp. 1–2)).

Physical or Biological Features

In accordance with section 3(5)(A)(i) and 4(b)(1)(A) of the Act and the regulations at 50 CFR 424.12, in determining which areas within the geographical area occupied at the time of listing to propose as critical habitat, we consider the physical and biological features essential to the conservation of the species and which may require special management considerations or protection. These physical or biological features provide the essential life-history requirements of the species, and include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, rearing (or development) of offspring, germination, or seed dispersal; and

(5) Habitats that are protected from disturbance or are representative of the historical geographical and ecological distributions of a species.

For plant species, ecosystems that provide appropriate seasonal wetland and dry land habitats, host species, pollinators, soil types, and associated plant communities are taken into consideration when determining the physical or biological features essential for a species.

The recovery plans (Recovery Plan for *Caesalpinia kavaiensis* and *Kokia drynarioides,* June 1994; and Recovery Plan for the Big Island Plant Cluster, September 1996) identify several actions needed to recover the endangered *Isodendrion pyrifolium* and *Mezoneuron kavaiense,* including: Expanding existing wild populations and reestablishing wild populations within the historic range. These actions are also needed to recover *Bidens micrantha* ssp. *ctenophylla* because this species, found in the same habitat as the two listed plants, faces the same threats. Furthermore, because of their small numbers or low population sizes, each of the three species requires suitable habitat and space for the expansion of existing populations to achieve a level that could approach recovery. We have determined that to recover these species, it is essential to conserve suitable habitat in both occupied and unoccupied units, which will in turn allow for the establishment of additional populations through natural recruitment or managed reintroductions. Establishment of these additional populations will increase the likelihood that the species will survive and recover in the face of normal and stochastic events (*e.g.,* hurricanes, fire, and nonnative species introductions) (Mangel and Tier 1994, p. 612; Pimm *et al.* 1998, p. 777; Stacey and Taper 1992, p. 27). In this regard, the designation of critical habitat limited to the geographic areas occupied by the species at the time of listing would be insufficient to achieve recovery objectives.

We have derived the specific physical and biological features required for each of the two listed plants, *Isodendrion pyrifolium* and *Mezoneuron kavaiense,* from studies of the species' habitat, ecology, and life history. In addition, we have reevaluated the physical and biological features for *I. pyrifolium* based on ecosystem definitions using species information from the 2003 *Final Designation and Nondesignation of Critical Habitat for 46 Plant Species From the Island of Hawaii, HI* (68 FR 39624, July 2, 2003) and new scientific information that has become available since that time. *Bidens micrantha* ssp. *ctenophylla* is found in locations with the same substrate age and soil type as *Isodendrion pyrifolium* and *Mezoneuron kavaiense,* and is known to share the same land cover (vegetation) type as *Mezoneuron kavaiense* throughout over 85 percent of its range (HBMP 2010m). Therefore, we believe that *B. micrantha* ssp. *ctenophylla* shares the same physical or biological features that we have determined for *Isodendrion pyrifolium* and *Mezoneuron kavaiense.*

When designating critical habitat in occupied areas, we focus on the physical or biological features that may be essential to the conservation of the species and which may require special management considerations or protections. In unoccupied habitat, we focus on whether the area is essential to the conservation of the species. The currently proposed physical or biological features for occupied areas, in conjunction with the unoccupied areas needed to expand and reestablish wild populations within their historical range, provide a more accurate picture of the geographic areas needed for the recovery of each species. We believe this information will be helpful to Federal agencies and our other partners, as we collectively work to recover these imperiled species.

Under the Act and its implementing regulations, we are required to identify the physical or biological features essential to the conservation of the three species for which we are proposing critical habitat. We identify these features in areas occupied at the time of listing, focusing on the features' primary constituent elements. We consider the primary constituent elements (PCEs) to be the elements of physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species. The PCEs identified in this proposed rule take into consideration the ecosystem in which each species occurs and reflects a distribution that we believe is essential to achieving the species' recovery needs within that ecosystem.

In this proposal, PCEs for each of the three species are defined based on those physical or biological features essential to support the successful functioning of the ecosystem upon which each species depends, and which may require special management considerations or protection. As the conservation of each species is dependent upon a functioning ecosystem to provide its fundamental life requirements, such as a certain soil type, minimum level of rainfall, or suitable native host plant, we consider the physical or biological features present in the ecosystem described in this rule to provide the necessary elements for each of the three species in this proposal. The ecosystem's features collectively provide the suite of environmental conditions essential to meeting the requirements of each of the three species, including the appropriate microclimatic conditions for germination and growth of the plants (*e.g.,* light availability, soil nutrients, hydrologic regime, temperature), and in all cases, space within the appropriate habitats for population growth and expansion, to maintain the historical, geographical, and ecological distribution of each species. In the case of *Isodendrion pyrifolium,* due to its recent rediscovery and limited geographic distribution at one known occurrence, the more general description of the physical or biological features that provide for the successful function of the ecosystem that is essential to the conservation of the species represents the best, and in many cases, the only, scientific information available. Accordingly, the physical or biological features of the lowland ecosystem are the physical or biological features essential to the conservation of the three species at issue here.

Table 4 identifies the physical or biological features of a functioning lowland dry ecosystem, which each of the three species identified in this rule requires.

TABLE 4—PRIMARY CONSTITUENT ELEMENTS OF THE LOWLAND DRY ECOSYSTEM

Ecosystem	Elevation	Annual precipitation	Substrate	Potential habitat for one or more of these associated native plant genera		
				Canopy	Subcanopy	Understory
Lowland Dry [2]	< 3,300 ft (<1,000 m)	< 50 in (<130 cm)	Weathered silty loams to stony clay, rocky ledges, little-weathered lava.	*Diospyros, Erythrina, Metrosideros, Myoporum, Pleomele, Santalum, Sapindus.*	*Chamaesyce, Dodonaea, Osteomeles, Psydrax, Scaevola, Wikstroemia.*	*Alyxia, Artemisia, Bidens, Capparis, Chenopodium, Nephrolepis, Peperomia, Sicyos.*

Table 4 indicates that the specific elements or PCEs in the lowland dry ecosystem include elevations of less than 3,300 ft (1,000 m); annual precipitation of less than 50 in (130 cm); weathered silty loams to stony clay, rocky ledges, and little-weathered lava; and potential habitat for one or more genera of the subcanopy plants *Chamaesyce, Dodonaea, Osteomeles, Psydrax, Scaevola,* and *Wikstroemia,* one or more of the understory plants *Alyxia, Artemisia, Bidens, Capparis, Chenopodium, Nephrolepis, Peperomia,* and *Sicyos,* and one or more of the genera of the canopy species *Diospyros, Erythrina, Metrosideros, Myoporum, Pleomele, Santalum,* and *Sapindus.*

Criteria Used To Identify Critical Habitat Boundaries

We considered several factors in the selection and proposal of specific boundaries for critical habitat for these three species. We propose to designate critical habitat on lands that contain the physical or biological features essential to conserving multiple species, based on their shared dependence on the functioning ecosystem they have in common. The lowland dry ecosystem that supports the three plant species addressed here does not form a contiguous area, and is divided into seven geographic subunits that we refer to as ''sections.'' Although we do not usually refer to areas of critical habitat as sections, compliance with **Federal Register** publication requirements necessitated the subdivision into smaller subunits to correspond with existing critical habitat units currently published in the Code of Federal Regulations (CFR), as some of the proposed critical habitat for the three plant species overlies critical habitat already designated for other plants on the island of Hawaii. We, thus, refer to ''sections'' here in order to retain the focus on the contiguous ecosystem areas of interest in this proposed rule, while recognizing that multiple critical habitat units may comprise these sections. Further details are provided under the section titled ''Proposed Critical Habitat Designation,'' below.

The proposed critical habitat is a combination of areas currently occupied by these three species, as well as areas that may be currently unoccupied. The best available scientific information suggests that these species either presently occur within, or have occupied, these habitats. A properly functioning ecosystem provides the physical or biological features that support life-history requirements of the species that rely on the ecosystem, and the specific elements or PCEs essential for the conservation of the species that occur there. In addition, due to the small population sizes, few numbers of individuals, and reduced geographic range of each of the three species for which critical habitat is here proposed, we have determined that a designation limited to known present range of each species would be inadequate to achieve the conservation of those species. The areas that may have been unoccupied at the time of listing have been determined to be essential for the conservation and recovery of the species because they provide the habitat necessary for the expansion of existing wild populations and reestablishment of wild populations within the historical range of the species. Designating unoccupied critical habitat for these species would promote conservation actions to restore their historical, geographical, and ecological representation, which is essential for their recovery. Critical habitat boundaries for all species were delineated to clearly depict and promote the recovery and conservation of these species by identifying the functioning ecosystem on which they depend.

Current and historical species location information was used to develop initial critical habitat boundaries (polygons) in the lowland dry ecosystem that would individually and collectively provide for the conservation of the three species addressed in this proposed rule. For these three species, we propose critical habitat only in the geographic area of historical occurrence, which is restricted to the lowland dry ecosystem in the north Kona and south Kohala regions. The initial polygons were superimposed over digital topographic maps of the island of Hawaii and further evaluated. In general, land areas that were identified as highly degraded were removed from the proposed critical habitat units, and natural or manmade features (*e.g.,* ridge lines, valleys, streams, coastlines, roads, obvious land features, etc.) were used to delineate the proposed critical habitat boundaries.

The critical habitat areas described below constitute our best assessment of the physical or biological features essential for the conservation of the three plant species, and the unoccupied areas essential for the species' conservation by providing for the expansion of existing populations. The approximate size of each of the seven plant critical habitat sections and the status of their land ownership, are identified in Table 5A. As noted in Table 5A, all areas proposed for critical habitat designation are found within the lowland dry ecosystem. Table 5B identifies the areas under consideration for exclusion from critical habitat designation under section 4(b)(2) of the Act (see Exclusions, below).

When determining critical habitat boundaries within this proposed rule, we made every effort to avoid including developed areas such as buildings, paved areas, and other structures that lack the physical or biological features essential for the conservation of the three plant species. The scale of the maps we prepared under the parameters for publication within the Code of Federal Regulations may not reflect the exclusion of such developed areas. Any such structures and the land under them inadvertently left inside critical habitat boundaries shown on the maps of this proposed rule have been excluded by text in the proposed rule and are not proposed for designation as critical habitat. Therefore, Federal actions involving these areas would not trigger section 7 consultation with respect to critical habitat unless the specific action

would affect the adjacent critical habitat or its primary constituent elements.

TABLE 5A—CRITICAL HABITAT PROPOSED FOR *Bidens micrantha* SSP. *ctenophylla, Mezoneuron kavaiense,* AND *Isodendrion pyrifolium* ON THE ISLAND OF HAWAII

[Totals may not sum due to rounding]

Proposed critical habitat area	Size of section in acres	Size of section in hectares	State	Federal	County	Private	Corresponding critical habitat map in the Code of Federal Regulations (CFR)
Hawaii—Lowland Dry							
—Section 1							
Unit 10	2,914	1,179	2,914	.....	.....	.....	Map 39a.
Unit 31	9,936	4,021	7,101	.....	.....	2,834	Map 104.
—Unit 32	1,779	720	21	.....	.....	1,758	Map 105.
—Unit 33	1,583	640	1,080	.....	.....	502	Map 106.
—Unit 34	961	389	259	.....	.....	702	Map 106.
—Unit 35	1,192	485	606	.....	19	568	Map 106.
—Unit 36	402	163	5	397	.....	.....	Map 106.
Total Lowland Dry.	18,766	7,597	11,986	397	19	6,364	

TABLE 5B—AREAS UNDER CONSIDERATION FOR EXCLUSION UNDER SECTION 4(B)(2) OF THE ACT

[Totals may not sum due to rounding]

Owner	Total area proposed as critical habitat in acres (hectares)	Area considered for exclusion in acres (hectares)
Kamehameha Schools	2,834 (1,147)	2,834 (1,147)
Palamanui Global Holdings LLC	502 (203)	502 (203)
Kaloko Properties Corp.	48 (19)	48 (19)
Lanihau Properties	47 (19)	47 (19)
SCD–TSA Kaloko Makai LLC	558 (226)	558 (226)
TSA Corporation	26 (10)	26 (10)
Department of Hawaiian Home Lands	446 (181)	87 (35)
Total	4,461 (1,805)	4,099 (1,659)

The proposed critical habitat designation is defined by the maps, as modified by any accompanying regulatory text, presented at the end of this document in the rule portion. We include more detailed information on the boundaries of the proposed critical habitat designation in the preamble of this document. We will make the coordinates or plot points or both on which each map is based available to the public on *http://www.regulations.gov* at Docket No. [FWS–R1–ES–2012–0070], on our Internet site *http://www.fws.gov/pacificislands,* and at the Pacific Islands Fish and Wildlife Office responsible for the designation. You may obtain field office location information by contacting one of the Service regional offices, the addresses of which are listed at 50 CFR 2.2.

Special Management Considerations or Protections

The term critical habitat is defined in section 3(5)(A) of the Act, in part, as geographic areas on which are found these physical or biological features essential to the conservation of the species and ''which may require special management considerations or protection.''

In identifying critical habitat in occupied areas, we determine whether those areas that contain the features essential to the conservation of the species require any special management actions. Although the determination that special management may be required is not a prerequisite to designating critical habitat in unoccupied areas, special management is needed throughout all of the proposed critical habitat units. The following discussion of special management needs is, therefore, applicable to each of the three Hawaii Island species for which we are proposing to designate critical habitat.

For each of the three species currently found in the wild on Hawaii Island, we have determined that the features essential to their conservation are those required for the successful functioning of the lowland dry ecosystem in which they occur (see Table 4 above). Special management considerations or protections are necessary throughout the critical habitat areas proposed here to avoid further degradation or destruction of the habitat that provides those features essential to their conservation. The primary threats to the physical or biological features essential to the conservation of these three species include habitat destruction and modification by development, nonnative ungulates, competition with nonnative species, hurricanes, fire, drought, and climate change. The

reduction of these threats will require the implementation of special management actions within each of the critical habitat areas identified in this proposed rule.

All proposed critical habitat requires special management actions to address the ongoing degradation and loss of habitat caused by agricultural and urban development. Urbanization also increases the likelihood of wildfires ignited by human sources. Without protection and special management, habitat containing the features that are essential for the conservation of these species will continue to be degraded and destroyed.

All proposed critical habitat requires active management to address the ongoing degradation and loss of native habitat caused by nonnative ungulates (goats and cattle). Nonnative ungulates also impact the habitat through predation and trampling. Without this special management, habitat containing the features that are essential for the conservation of these species will continue to be degraded and destroyed.

All proposed critical habitat requires active management to address the ongoing degradation and loss of native habitat caused by nonnative plants. Special management is also required to prevent the introduction and spread of nonnative plant species into native habitats. Particular attention is required in nonnative plant control efforts to avoid creating additional disturbances that may facilitate the further introduction and establishment of invasive plant seeds. Precautions are also required to avoid the inadvertent trampling of listed plant species in the course of management activities.

The active control of nonnative plant species will help to address the threat posed by fire in all six of the proposed critical habitat units. This threat is largely a result of the presence of nonnative plant species such as the grasses *Pennisetum setaceum* and *Melinis minutiflora* that increase the fuel load and quickly regenerate after a fire. These nonnative grass species can outcompete native plants that are not adapted to fire, creating a grass-fire cycle that alters ecosystem functions (D'Antonio and Vitousek 1992, pp. 64–66; Brooks *et al.* 2004, p. 680).

In summary, we find that each of the areas we are proposing as critical habitat contains features essential for the conservation of the species that may require special management considerations or protection to ensure the conservation of the three plant species for which we are proposing critical habitat. These special management considerations and protections are required to preserve and maintain the essential features provided to these species by the lowland dry ecosystem upon which they depend. The specific areas proposed for critical habitat that are outside the geographical area occupied by these species have been determined to be essential for their conservation.

Proposed Critical Habitat Designation

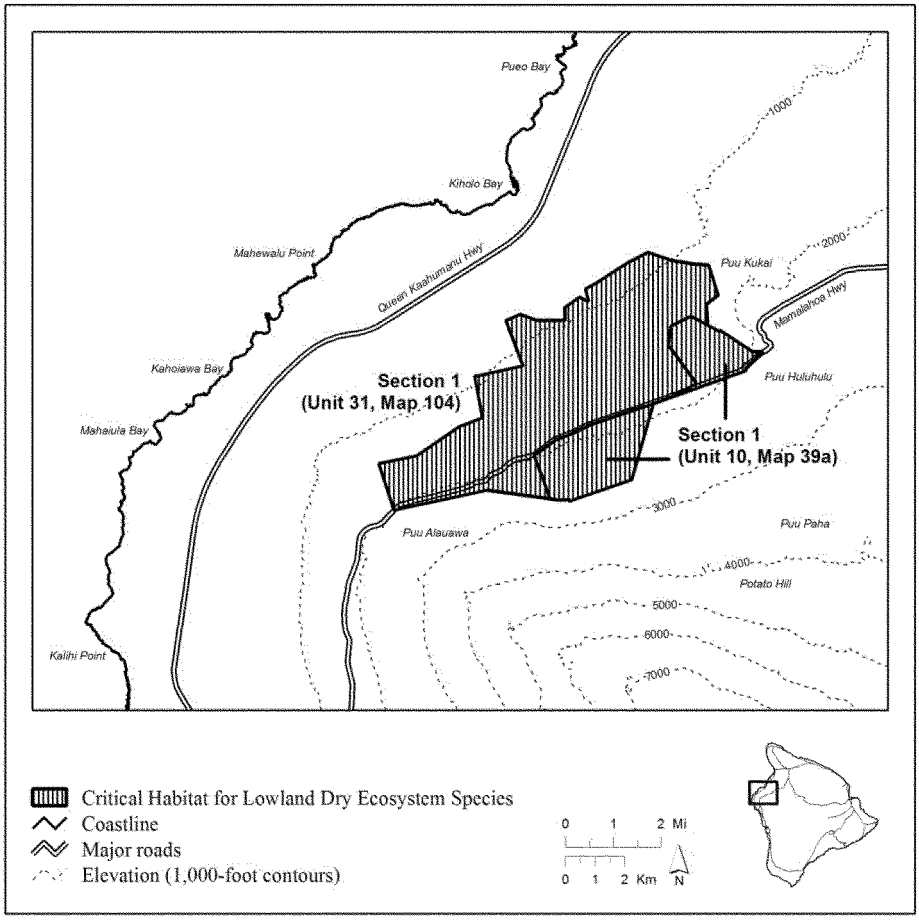
We are proposing 18,766 ac (7,597 ha) as critical habitat in 7 units within the lowland dry ecosystem for *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense.* (See Table 5A above for details). Of these proposed units, 10,304 ac (4,170 ha), or 55 percent, are already designated as critical habitat for other listed species. The proposed critical habitat includes land under State, County of Hawaii, Federal (Kaloko-Honokohau NHP), and private ownership. The critical habitat units we describe below constitute our current best assessment of those areas that meet the definition of critical habitat for the three species of plants.

Because some of the proposed critical habitat for the three plants overlays critical habitat already designated for other plant species on the island of Hawaii, we have incorporated the maps of the areas proposed for critical habitat in this proposed rule into the existing critical habitat unit numbering system established for the plants on the island of Hawaii in the Code of Federal Regulations (50 CFR 17.99(k)). This required further subdividing some of the ecosystem areas that we identified as ''sections'' into units that correspond to both existing and new critical habitat unit numbers and maps numbers as published in the CFR. The maps and area descriptions presented here represent the lowland dry ecosystem areas that we have identified for the three plant species, subdivided into a total of 6 sections. The critical habitat unit numbers and the corresponding map numbers that will appear at 50 CFR 17.99 are additionally provided for ease of reference in the CFR.

Descriptions of Proposed Critical Habitat

Hawaii—Lowland Dry—Section 1 consists of 10,015 ac (4,053 ha) of State land, and 2,834 ac (1,147 ha) of privately owned land for a total of 12,849 ac (5,200 ha), from Puu Waawaa to Kaupulehu on the northwestern slope of Hualalai between the elevations of 760 and 2,600 ft (231 and 793 m) (Figure 2). The section includes 2,914 ac (1,179 ha) of State land within previously designated critical habitat and 9,936 ac (4,021 ha) of newly proposed critical habitat on 7,101 ac (2,874 ha) of State land and 2,834 ac (1,147 ha) of privately owned land. The area that falls within designated critical habitat lies within Hawaii Unit 10 of 50 CFR 17.99(k), Map 39a, and proposed new critical habitat Hawaii Unit 31, Map 104. The area of Section 1 that overlaps previously designated critical habitat includes critical habitat for the following listed plant species: *Bonamia menziesii, Colubrina oppositifolia, Hibiscadelphus hualalaiensis, Neraudia ovata,* and *Nothocestrum breviflorum.* This section is occupied by the plants *Bidens micrantha* spp. *ctenophylla* and *Mezoneuron kavaiense* and includes the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland dry ecosystem (see Table 4).

This section also contains unoccupied habitat that is essential to the conservation of these two species by providing the PCEs necessary for the expansion of the existing wild populations. Although Hawaii—Lowland Dry—Section 1 is not known to be occupied by *Isodendrion pyrifolium,* we have determined this area to be essential for the conservation and recovery of this lowland dry species because it provides the PCEs necessary for the reestablishment of wild populations within its historical range. Due to its small numbers of individuals this species requires suitable habitat and space for expansion or reintroduction to achieve population levels that could approach recovery.



Hawaii—Lowland Dry—Unit 32 consists of 21 ac (8 ha) of State land, and 1,758 ac (712 ha) of privately owned land for a total of 1,779 ac (720 ha), at Waikoloa on the western slope of Mauna Kea between the elevations of 720 and 1,220 ft (220 and 372 m). This unit is not in previously designated critical habitat and comprises proposed critical habitat shown on Map 105 in this proposed rule. This unit is occupied by the plant *Mezoneuron kavaiense* and includes the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland dry ecosystem (see Table 4). Although Hawaii—Lowland Dry—Unit 32 is not currently occupied by *Bidens micrantha* ssp. *ctenophylla* or *Isodendrion pyrifolium,* we have determined this area to be essential for the conservation and recovery of these lowland dry species because it provides the physical or biological features necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, these two species require suitable habitat and space for expansion or reintroduction to achieve population levels that could approach recovery.

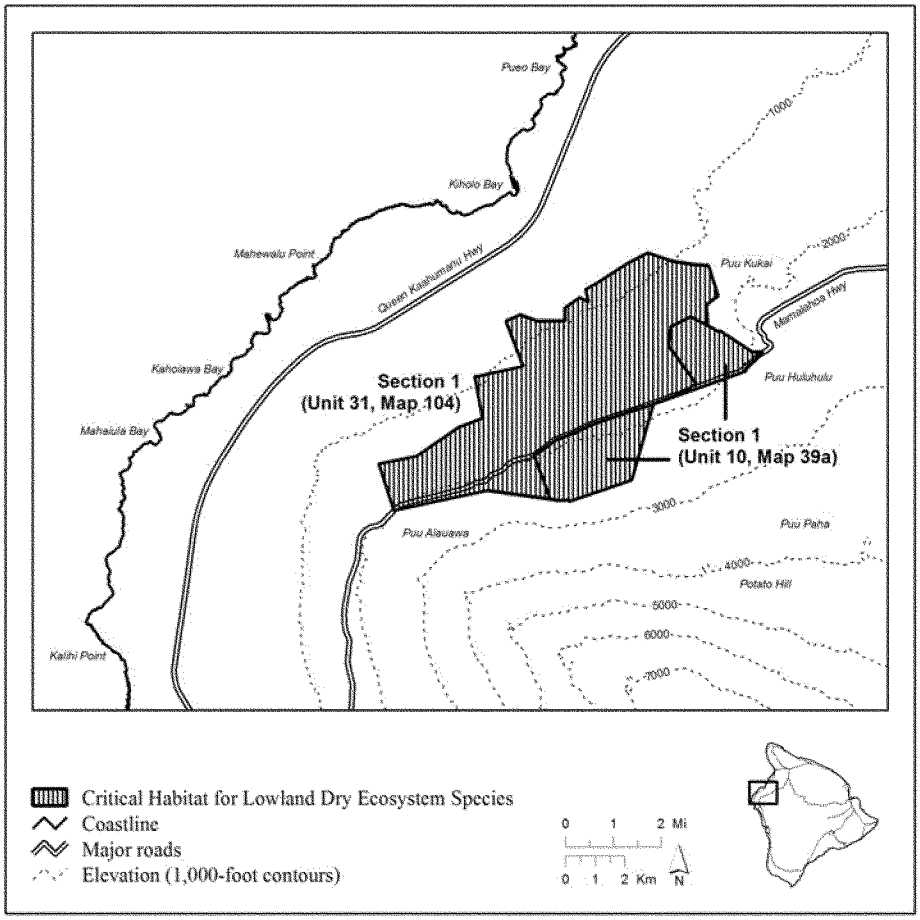


FIGURE 2. Area designated as critical habitat for *Bidens micrantha* ssp. *ctenophylla*, *Isodendrion pyrifolium*, and *Mezoneuron kavaiense* in the Lowland Dry Ecosystem (Section 1). Section 1 consists of multiple critical habitat units; a portion of an existing critical habitat unit on Hawaii Island (Unit 10) and the area proposed as critical habitat on Hawaii Island (Unit 31). Unit and map numbers for each section, as published in the Code of Federal Regulations (50 CFR 17.99(k)), are provided for ease of referencing.

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Hawaii—Lowland Dry—Unit 33 consists of 1,080 ac (437 ha) of State land, and 502 ac (203 ha) of privately owned land, from Puukala to Kalaoa on the western slope of Hualalai between the elevations of 360 and 1,080 ft (110 and 329 m). This unit is not in previously designated critical habitat and comprises proposed critical habitat Hawaii—Lowland Dry—Unit 33 of Map 106 in this proposed rule. This unit is occupied by the plant *Mezoneuron kavaiense* and includes the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland dry ecosystem (see Table 4). This unit also contains unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Hawaii—Lowland Dry—Unit 33 is not known to be occupied by *Bidens micrantha* ssp. *ctenophylla* and *Isodendrion pyrifolium,* we have determined this area to be essential for the conservation and recovery of these lowland dry species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, these species require suitable habitat and space for expansion or reintroduction to achieve population levels that could approach recovery.

Hawaii—Lowland Dry—Unit 34 consists of 259 ac (105 ha) of State land, and 702 ac (284 ha) of privately owned land for a total of 961 ac (389 ha), from Kalaoa to Puukala on the western slope of Hualalai between the elevations of 280 and 600 ft (85 and 183 m). This unit is not in previously designated critical habitat and comprises proposed critical habitat Hawaii—Lowland Dry—Unit 34 of Map 106 in this proposed rule. This unit is occupied by the plant *Bidens micrantha* ssp. *ctenophylla,* and includes the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland dry ecosystem (see Table 4). This unit also contains unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Hawaii—Lowland Dry—Unit 34 is not known to be occupied by *Isodendrion pyrifolium* and *Mezoneuron kavaiense,* we have determined this area to be essential for the conservation and recovery of these lowland dry species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, these species require suitable habitat and space for expansion or reintroduction to achieve population levels that could approach recovery.

Hawaii—Lowland Dry—Unit 35 consists of 606 ac (245 ha) of State land, 19 ac (7.8 ha) of County land, and 568 ac (230 ha) of privately owned land for a total of 1,192 ac (485 ha), at Kealakehe on the western slope of Hualalai between the elevations of 80 and 560 ft (24 and 171 m). This unit is not in previously designated critical habitat and comprises proposed critical habitat Hawaii—Lowland Dry—Unit 35 of Map 106 in this proposed rule. This unit is occupied by the plants *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense,* and includes the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland dry ecosystem (see Table 4). This unit also contains unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations.

Hawaii—Lowland Dry—Unit 36 consists of 5 ac (2 ha) of State land and 397 ac (161 ha) of Federal land for a total of 402 ac (163 ha), near the coastline at Kaloko and Honokohau on the western slope of Hualalai between the elevations of 20 and 90 ft (6 and 27 m). This unit is not in previously designated critical habitat and comprises proposed critical habitat Hawaii—Lowland Dry—Unit 36 of Map 106 in this proposed rule. This unit is occupied by the plant *Bidens micrantha* ssp. *ctenophylla,* and includes the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland dry ecosystem (see Table 4). This unit also contains unoccupied habitat for the plant *Isodendrion pyrifolium* that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Hawaii—Lowland Dry—Unit 36 is not known to be occupied by *Isodendrion pyrifolium,* we have determined this area to be essential for the conservation and recovery of this lowland dry species because it provides the PCEs necessary for the reestablishment of wild populations within its historical range. Due to their small numbers of individuals or low population sizes, these species require suitable habitat and space for expansion or reintroduction to achieve population levels that could approach recovery.

Effects of Critical Habitat Designation

Section 7 Consultation

Section 7(a)(2) of the Act, as amended, requires Federal agencies, including the Service, to ensure that actions they fund, authorize, or carry out are not likely to destroy or adversely modify critical habitat. Decisions by the Fifth and Ninth Circuit Court of Appeals have invalidated our definition of ''destruction or adverse modification'' (50 CFR 402.02) (See *Gifford Pinchot Task Force* v. *U.S. Fish and Wildlife Service,* 378 F.3d 1059 (9th Cir. 2004) and *Sierra Club* v. *U.S. Fish and Wildlife Service et al.,* 245 F.3d 434, 442F (5th Cir. 2001)), and we do not rely on this regulatory definition when analyzing whether an action is likely to destroy or adversely modify critical habitat. Under the statutory provisions of the Act, we determine destruction or adverse modification on the basis of whether, with implementation of the proposed Federal action, the affected critical habitat would remain functional (or retain those physical or biological features that relate to the current ability of the area to support the species) to serve its intended conservation role for the species.

If a species is listed or critical habitat is designated, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency (action agency) must enter into consultation with us. As a result of this consultation, we issue either:

(1) A concurrence letter for Federal actions that may affect, but are not likely to adversely affect, listed species or critical habitat; or

(2) A biological opinion for Federal actions that may affect, and are likely to adversely affect, listed species or critical habitat.

If we issue a biological opinion concluding that a project is likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat, we also provide reasonable and prudent alternatives to the project, if any are identifiable. We define ''reasonable and prudent alternatives'' at 50 CFR 402.02 as alternative actions identified during consultation that:

- Can be implemented in a manner consistent with the intended purpose of the action;
- Can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction;
- Are economically and technologically feasible; and
- Would, in the Director's opinion, avoid jeopardizing the continued existence of the listed species or destroying or adversely modifying critical habitat.

Reasonable and prudent alternatives can vary from slight project modifications to extensive redesign or relocation of the project. Costs associated with implementing a reasonable and prudent alternative are similarly variable.

Regulations at 50 CFR 402.16 require Federal agencies to reinitiate formal consultation on previously reviewed actions in instances where we have listed a new species or subsequently designated critical habitat that may be affected and the Federal agency has retained discretionary involvement or control over the action (or the agency's discretionary involvement or control is authorized by law). Consequently, Federal agencies may sometimes need to request reinitiation of consultation with us on actions for which formal consultation has been completed, if

those actions with discretionary involvement or control may affect subsequently listed species or designated critical habitat.

Federal activities that may adversely affect the species included in this proposed rule or their designated critical habitat require section 7 consultation under the Act. This includes activities on State, tribal, local, or private lands requiring a Federal permit (such as a permit from the U.S. Army Corps of Engineers under section 404 of the Clean Water Act (33 U.S.C. 1251 *et seq.*), or a permit from us under section 10 of the Act), or activities involving some other Federal action (such as funding from the Federal Highway Administration, Federal Aviation Administration, or the Federal Emergency Management Agency). These types of activities are subject to the section 7 consultation process. Federal actions not affecting listed species or critical habitat, and actions on State, tribal, local, or private lands that are not federally funded, authorized, or permitted, do not require section 7 consultations.

Application of the Jeopardy and Adverse Modification Standards

Application of the Jeopardy Standard

The jeopardy analysis usually expresses the survival and recovery needs of a listed species in a qualitative fashion without making distinctions between what is necessary for survival and what is necessary for recovery. Generally, the jeopardy analysis focuses on the status of a species, the factors responsible for that condition, and what is necessary for the species to survive and recover. An emphasis is also placed on characterizing the condition of the species in the area affected by the proposed Federal action. That context is then used to determine the significance of adverse and beneficial effects of the proposed Federal action and any cumulative effects for purposes of making the jeopardy determination. The jeopardy analysis also considers any conservation measures that may be proposed by a Federal action agency to minimize or compensate for adverse effects to the species or to promote its recovery.

Application of the Adverse Modification Standard

The analytical framework described in the Director's December 9, 2004, memorandum is used to complete section 7(a)(2) analysis for Federal actions affecting critical habitat. The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species, or would retain its current ability for the essential features to be functionally established. Activities that may destroy or adversely modify critical habitat are those that alter the essential features, or the essential habitat qualities of unoccupied habitat, to an extent that appreciably reduces the conservation value of critical habitat for the three species identified in this proposed rule.

Section 4(b)(8) of the Act requires us to briefly evaluate and describe, in any proposed or final regulation that designates critical habitat, activities involving a Federal action that may destroy or adversely modify such habitat, or that may be affected by such designation. Activities that, when carried out, funded, or authorized by a Federal agency, may destroy or adversely modify critical habitat for the three plant species, and therefore may be affected by this proposed designation, include, but are not limited to:

(1) Activities that may appreciably degrade or destroy the physical or biological features for the species, including, but not limited to, overgrazing, maintaining or increasing feral ungulate levels, clearing or cutting native live trees and shrubs (*e.g.,* woodcutting, bulldozing, construction, road building, mining, herbicide application), and taking actions that pose a risk of fire.

(2) Activities that may alter watershed characteristics in ways that would appreciably reduce groundwater recharge or alter natural, wetland, aquatic, or vegetative communities. Such activities include new water diversion or impoundment, excess groundwater pumping, and manipulation of vegetation through activities such as the ones mentioned in (1) above.

(3) Recreational activities that may appreciably degrade vegetation.

(4) Mining sand or other minerals.

(5) Introducing or encouraging the spread of nonnative plant species.

(6) Importing nonnative species for research, agriculture, and aquaculture, and releasing biological control agents.

Application of Section 4(a)(3) of the Act

The Sikes Act Improvement Act of 1997 (Sikes Act) (16 U.S.C. 670a) required each military installation that includes land and water suitable for the conservation and management of natural resources to complete an Integrated Natural Resources Management Plan (INRMP) by November 17, 2001. An INRMP integrates implementation of the military mission of the installation with stewardship of the natural resources found on the base. Each INRMP includes:

- An assessment of the ecological needs on the installation, including the need to provide for the conservation of listed species;
- A statement of goals and priorities;
- A detailed description of management actions to be implemented to provide for these ecological needs; and
- A monitoring and adaptive management plan.

Among other things, each INRMP must, to the extent appropriate and applicable, provide for fish and wildlife management; fish and wildlife habitat enhancement or modification; wetland protection, enhancement, and restoration where necessary to support fish and wildlife; and enforcement of applicable natural resource laws.

The National Defense Authorization Act for Fiscal Year 2004 (Pub. L. 108–136) amended the Act to limit areas eligible for designation as critical habitat. Specifically, section 4(a)(3)(B)(i) of the Act (16 U.S.C. 1533(a)(3)(B)(i)) provides: ''The Secretary shall not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan prepared under section 101 of the Sikes Act (16 U.S.C. 670a), if the Secretary determines in writing that such plan provides a benefit to the species for which critical habitat is proposed for designation.''

We consult with the military on the development and implementation of INRMPs for installations with listed species. We analyze INRMPs developed by military installations located within the areas that were being considered for critical habitat designation during the development of this proposed rule to determine if these installations may warrant consideration for exemption under section 4(a)(3) of the Act. There are no Department of Defense (DOD) lands within this proposed critical habitat designation. Therefore, no lands have been exempted from this proposed critical habitat designation under section 4(a)(3) of the Act.

Exclusions

Application of Section 4(b)(2) of the Act

Section 4(b)(2) of the Act states that the Secretary must designate or make revisions to critical habitat on the basis

of the best available scientific data after taking into consideration relevant impacts, including economic and national security impacts, of specifying any particular area as critical habitat. The Secretary may exclude an area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific data available, that the failure to designate such area as critical habitat will result in the extinction of the species.

When considering the benefits of inclusion of an area in critical habitat, we consider the regulatory benefits that area would receive from the protection from adverse modification or destruction as a result of consultation under section 7(a)(2) of the Act for actions with a Federal nexus; the educational benefits of mapping habitat essential for recovery of the listed species; and any benefits that may result from a designation due to State or Federal laws that may apply to critical habitat. Benefits could include public awareness of the presence of listed species and the importance of habitat protection, and in cases where a Federal nexus exists, increased habitat protection due to the protection from adverse modification or destruction of critical habitat.

When considering the benefits of exclusion, we consider factors such as whether exclusion of a specific area is likely to result in conservation; the continuation, strengthening, or encouragement of partnerships; or the implementation of a management plan that provides equal to or more conservation than a critical habitat designation would provide.

The Secretary can consider conservation agreements and other land management plans with Federal, private, State, and tribal entities when making decisions under section 4(b)(2) of the Act. The Secretary may also consider voluntary partnerships and conservation plans, and weigh the implementation and effectiveness of these against that of designation. Consideration of relevant impacts of designation or exclusion under section 4(b)(2) may include, but is not limited to, any of the following factors: (1) Whether the plan provides specific information on how it protects the species and the physical or biological features, and whether the plan is at a geographic scope commensurate with the species; (2) whether the plan is complete and will be effective at conserving and protecting the physical or biological features; (3) whether a reasonable expectation exists that conservation management strategies and actions will be implemented, that those responsible for implementing the plan are capable of achieving the objectives, that an implementation schedule exists, and that adequate funding exists; (4) whether the plan provides assurances that the conservation strategies and measures will be effective (*i.e.,* identifies biological goals, has provisions for reporting progress, and is of a duration sufficient to implement the plan); (5) whether the plan has a monitoring program or adaptive management to ensure that the conservation measures are effective; (6) the degree to which the record supports a conclusion that a critical habitat designation would impair the benefits of the plan; (7) the extent of public participation; (8) a demonstrated track record of implementation success; (9) the level of public benefits derived from encouraging collaborative efforts and encouraging private and local conservation efforts; and (10) the effect designation would have on partnerships. We will also consider whether these efforts would be affected by critical habitat, and, if so, whether this would outweigh the benefits of critical habitat.

Based on the information provided by entities seeking exclusion, as well as any additional public comments we receive, we will evaluate whether certain lands in proposed critical habitat may be appropriate for exclusion from the final designation.

To ensure that our final determination is based on the best available information, we are inviting comments on any foreseeable economic, national security, or other potential impacts resulting from this proposed designation of critical habitat from governmental, business, or private interests and, in particular, or any potential impacts on small businesses.

Exclusions Based on Economic Impacts

Under section 4(b)(2) of the Act, we consider the economic impacts of specifying any particular area as critical habitat. In order to consider economic impacts, we are preparing an analysis of the potential economic impacts of the proposed critical habitat designation and related factors.

We will announce the availability of the draft economic analysis as soon as it is completed, at which time we will seek public review and comment. At that time, copies of the draft economic analysis will be available for downloading from the Internet at the Federal eRulemaking Portal: *http://www.regulations.gov,* or by contacting the Pacific Islands Fish and Wildlife Office directly (see **FOR FURTHER INFORMATION CONTACT**). During the development of a final designation, we will consider economic impacts, public comments, and other new information, and as an outcome of our analysis of this information, we may exclude areas from the final critical habitat designation under section 4(b)(2) of the Act and our implementing regulations at 50 CFR 424.19.

Exclusions Based on National Security Impacts

Under section 4(b)(2) of the Act, we consider whether there are lands owned or managed by the DOD where a national security impact might exist. There are no DOD lands within this proposed critical habitat designation, and we are unaware of any potential impacts to national security on any lands within the proposed critical habitat designation. Therefore, we do not propose to exclude any areas from the final designation based on impacts on national security, but will fully consider all comments in this regard in the final critical habitat designation.

Exclusions Based on Other Relevant Factors

Under section 4(b)(2) of the Act, we consider any other relevant impacts, in addition to economic impacts and impacts to national security. We consider a number of factors, including whether the landowners have developed any conservation plans or other management plans for the area, or whether there are conservation partnerships that would be encouraged by designation of, or exclusion from, critical habitat. We also consider any social impacts that might occur because of the designation.

We have identified certain areas that we are considering excluding from the final revised critical habitat designation for the three plant species based on conservation partnerships. However, we solicit comments on the inclusion or exclusion of such particular areas (see ''Public Comments'' section). During the development of the final designation, we will consider economic and other relevant impacts, public comments, and other new information before deciding if inclusion or exclusion of these areas is warranted. As a result, additional areas, in addition to those identified below for potential exclusion in this proposed rule, may be excluded from the final critical habitat designation under section 4(b)(2) of the Act. Alternatively, we may decide not to exclude these lands based on information received

during the public comment period or other new information.

Conservation Partnerships on Non-Federal Lands

Kamehameha Schools

We are considering excluding 2,834 ac (1,147 ha) of habitat associated with Kamehameha Schools lands at Kaupulehu on the western slope of Hualalai between the elevations of 940 and 2,600 ft (2,90 and 7,90 m) (Figure 3).

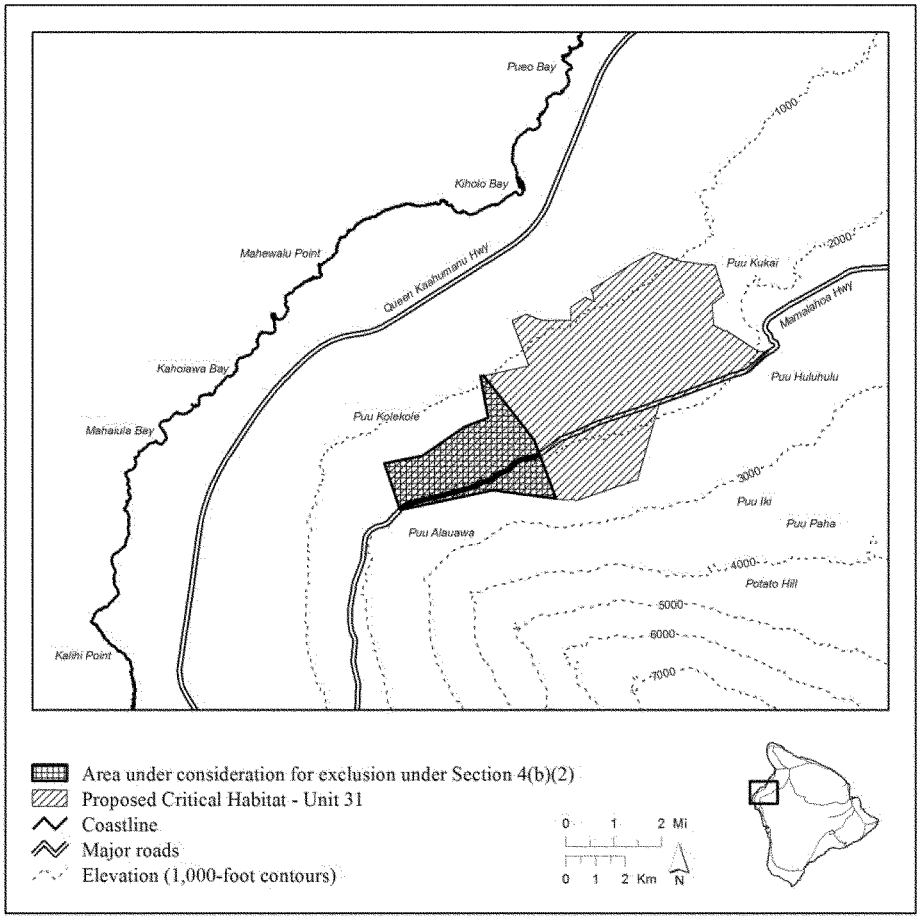

FIGURE 3. Kamehameha Schools lands in Kaupulehu (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

Two plant species included in this rule (*Bidens micrantha* ssp. *ctenophylla* and *Mezoneuron kavaiense*) occur in this area. The area under consideration falls within proposed critical habitat Hawaii Unit 31, Map 104, and comprises the entire area owned by Kamehameha Schools (2,834 ac (1,147 ha)) within the proposed designation (see Table 5B). This unit is occupied by the plants *Bidens micrantha* ssp. *ctenophylla* and *Mezoneuron kavaiense* and contains the features essential to the lowland dry ecosystem and therefore essential to each species. This area also contains unoccupied habitat that is essential to the conservation of *Isodendrion pyrifolium.*

Kamehameha Schools is conducting voluntary actions to promote the conservation of rare and endangered species and their lowland dry ecosystem habitats on their lands, including the installation of fencing to exclude ungulates, restoring habitat, conducting actions to reduce rodent populations, reestablishing native plant species, and conducting activities reducing the threat of wildfire. We will continue working with Kamehameha Schools during the public comment period, and will make a determination regarding the exclusion from critical habitat designation in the final rule. In addition, we are requesting comments and information regarding these areas and will determine whether these lands may warrant exclusion from critical habitat in our final rule for the three plants for which critical habitat is here proposed on Kamehameha Schools land.

Palamanui Global Holdings LLC

The Service is considering excluding 502 ac (203 ha) of habitat associated with the land owned by Palamanui Global Holdings LLC (Palamanui) at Kau, on the western slope of Hualalai between the elevations of 400 and 1,000 ft (120 and 300 m) (Figure 4). The area

under consideration falls within proposed critical habitat Hawaii—Lowland Dry—Unit 33, Map 106, and comprises the entire area owned by Palamanui (502 ac (203 ha)) within the proposed designation (see Table 5B). This unit is occupied by the plant *Mezoneuron kavaiense* and contains the features essential to the lowland dry ecosystem and therefore for this species. This area also contains habitat that is unoccupied but essential to the conservation of the proposed plant, *Bidens micrantha* ssp. *ctenophylla,* and the endangered plant, *Isodendrion pyrifolium.*

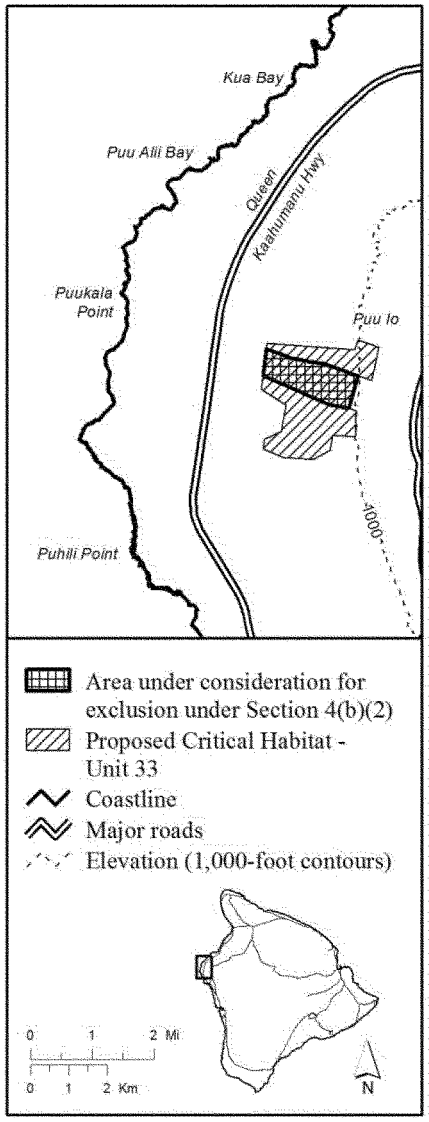

FIGURE 4. Palamanui Global Holdings LLC lands at Kau (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

The Kona Community Development Plan (Hawaii County Ordinance 08–131) identifies the lands owned by Palamanui Global Holdings LLC as located within the Kona Urban Area with a land use designation of Urban Expansion (Wilson Okamoto Corporation 2008, pp. 4–29—4–37). Hiluhilu Development LLC has proposed development of a master planned community (Palamanui Hiluhilu Development Project), which includes single and multi-family residential units, university residential facilities, health facilities, research and development facilities, mixed commercial development, a small hotel, natural and cultural preserves, parks, open space, and parking areas on a 725-ac (293-ha) parcel owned by Palamanui (Group 70 International 2004, p. 3–36; DHHL 2009, p. 10). A portion of the proposed development (502 ac (203 ha)) falls within the area of proposed critical habitat in Hawaii—Lowland Dry—Unit 33.

Palamanui Global Holdings LLC is involved in several voluntary actions that promote the conservation of rare and endangered species on their lands,

including their participation in the North Kona Dry Forest working group, the construction of fencing to exclude ungulates, developing a dry forest preserve management plan, and establishing a fenced research area to measure and monitor forest dynamics within the lowland dry ecosystem. We will continue working with Palamanui Global Holdings LLC during the public comment period for the proposed rule, and will make a determination regarding the exclusion from critical habitat designation in the final rule. In addition, we are requesting comments and information regarding these areas and will determine whether these lands may warrant exclusion from critical habitat in our final rule for the three plants for which critical habitat is proposed here on Palamanui Global Holdings LLC land.

Kaloko Makai Development

The Service is considering excluding 630 ac (255 ha) of habitat associated with the Kaloko Makai Development, on the western slope of Hualalai in the land divisions of Kaloko and Ooma between the elevations of 320 and 650 ft (100 and 200 m). There are three landowners with a common interest in the Kaloko Makai Development, Kaloko Properties Corporation (Figure 5–A), SCD–TSA Kaloko Makai LLC (Figure 5–B), and TSA Corporation (Figure 5–C). Two plant species included in this rule *Bidens micrantha* ssp. *ctenophylla* and *Mezoneuron kavaiense* are reported from this area. The area under consideration for exclusion falls within proposed critical habitat Hawaii—Lowland Dry—Unit 34, Map 106, and is comprised of, in their entirety, the areas owned by Kaloko Properties Corporation, SCD–TSA Kaloko Makai LLC, and TSA Corporation within the proposed designation (see Table 5B).

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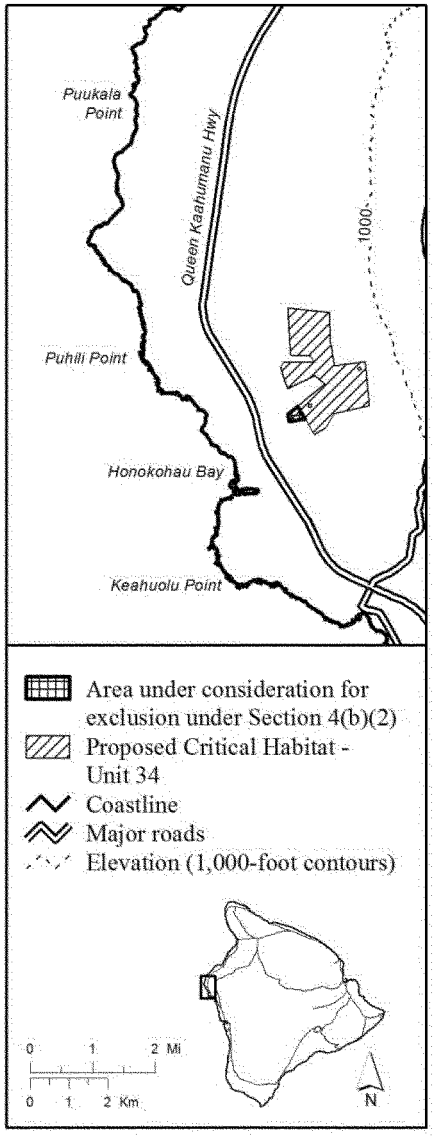

FIGURE 5-A. Kaloko Properties Corporation lands at Kaloko (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

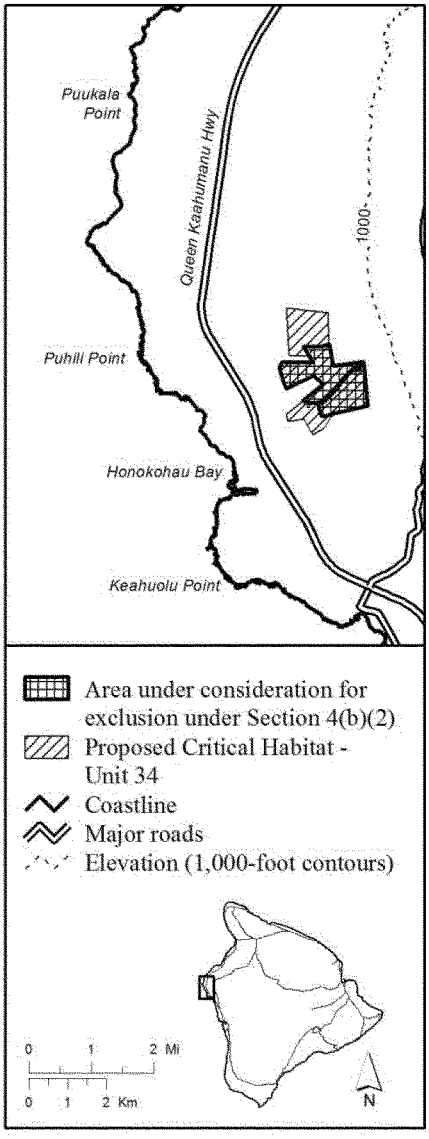

FIGURE 5-B. SCD-TSA Kaloko Makai LLC lands at Kaloko (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

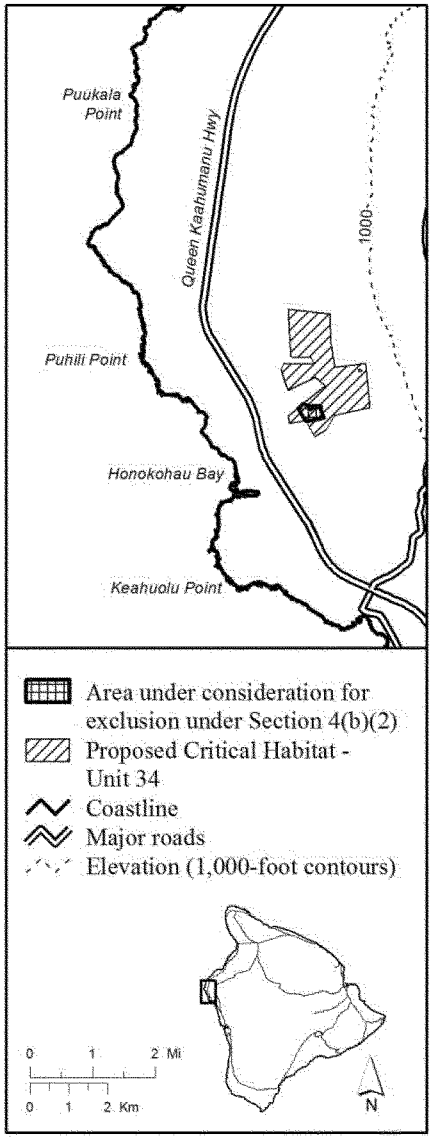

FIGURE 5-C. TSA Corporation lands at Kaloko (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

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This unit is occupied by the plant *Bidens micrantha* ssp. *ctenophylla* and contains the features essential to the lowland dry ecosystem and therefore this species. This area also contains unoccupied habitat that is essential to the conservation of *Isodendrion pyrifolium* and *Mezoneuron kavaiense.*

SCD–TSA Kaloko Makai LLC has proposed the Kaloko Makai Development, a master-planned community on 1,139 ac (461 ha) of which 630 ac (255 ha) are included within the proposed critical habitat Hawaii Unit 34, Map 106. This project is a master-planned, mixed-use community village consisting of 5,000 single and multi-family residential units, up to 1.1 million square (sq) ft (102,193 sq m) of commercial space, light industrial use, three public school sites, a dryland forest preserve, park and open space, a site for development of a regional hospital, and four potable well sites (Hookuleana LLC 2011).

The developers of Kaloko Makai are participating in several important partnerships, conservation agreements, and other actions on their lands to promote the conservation of rare and endangered species, including setting aside a Dryland Forest Preserve area in perpetuity, installing fencing to exclude ungulates, removing ungulates, and eradicating nonnative species. The landowner is also working with the State to develop a multi-species habitat conservation plan that will provide a net conservation benefit to the covered species. We will continue working with Kaloko Makai LLC during the public comment period for the proposed rule, and will make a determination regarding the exclusion from critical

habitat designation in the final rule. In addition, we are requesting comments and information regarding these areas and will determine whether these lands may warrant exclusion from critical habitat in the final rule for the three plants for which critical habitat is proposed here on Kaloko Makai Development land.

Lanihau Properties

The Service is considering excluding 47 ac (19 ha) of habitat associated with the lands owned by Lanihau Properties, on the western slope of Hualalai at Kaloko between the elevations of 320 and 440 ft (100 and 135 m) (Figure 6). Two plant species included in this rule, *Bidens micrantha* ssp. *ctenophylla* and *Mezoneuron kavaiense,* are reported from this area. The area under consideration falls within proposed critical habitat Hawaii—Lowland Dry—Unit 34, Map 106, and comprises the entire area (47 ac (19 ha)) owned by Lanihau Properties within the proposed designation. This unit is occupied by the plant *Bidens micrantha* ssp. *ctenophylla* and contains the features essential to the lowland dry ecosystem and therefore essential to this species. This area also contains unoccupied habitat that is essential to the conservation of *Isodendrion pyrifolium* and *Mezoneuron kavaiense.*

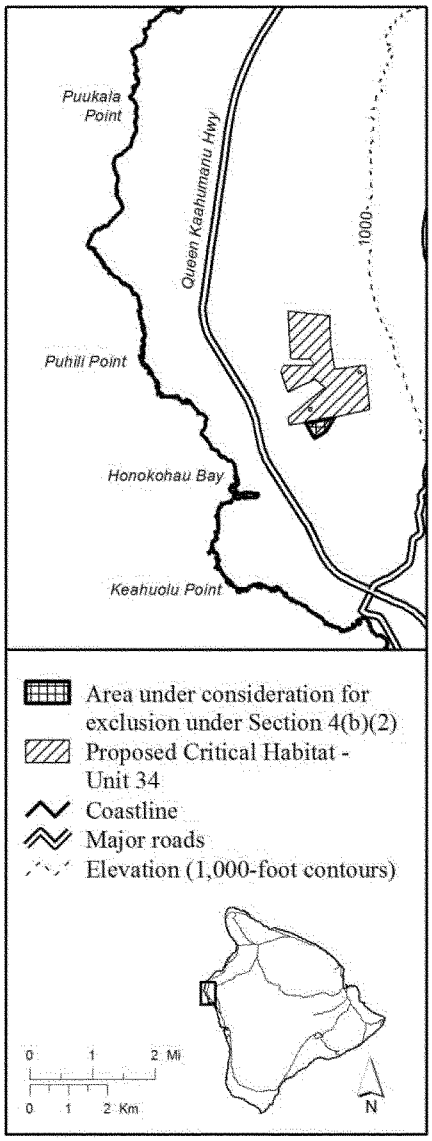


FIGURE 6. Lanihau Properties lands at Kaloko (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

Lanihau Properties is promoting the conservation of rare and endangered species through their land management strategies, conservation agreements, and by setting aside a portion of their land for establishment of the Kaloko Makai Dryland Forest Preserve. We will continue working with Lanihau Properties during the public comment

period, and will make a determination regarding the exclusion from critical habitat designation in the final rule. In addition, we are requesting comments and information regarding these areas and will determine whether these lands may warrant exclusion from critical habitat in our final rule for the three plants for which critical habitat is proposed here on Lanihau Properties land.

Department of Hawaiian Homelands

The Service is considering excluding 87 ac (35 ha) of habitat associated with the DHHL's Villages of Laiopua development at Kealakehe on the western slope of Hualalai between the elevations of 400 and 720 ft (122 and 220 m) (Figure 7). Three plant species included in this rule (*Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense*) occur in this area. The area under consideration falls within proposed critical habitat Hawaii—Lowland Dry—Unit 35, Map 106, and comprises a portion of the 355 ac (144 ha) owned by DHHL within the proposed designation (see Table 5B). The area owned by DHHL that is not being considered for exclusion is approximately 268 ac (109 ha) in size. This unit is occupied by the plants *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium* and *Mezoneuron kavaiense,* and contains the features essential to the lowland dry ecosystem and therefore essential to each species.

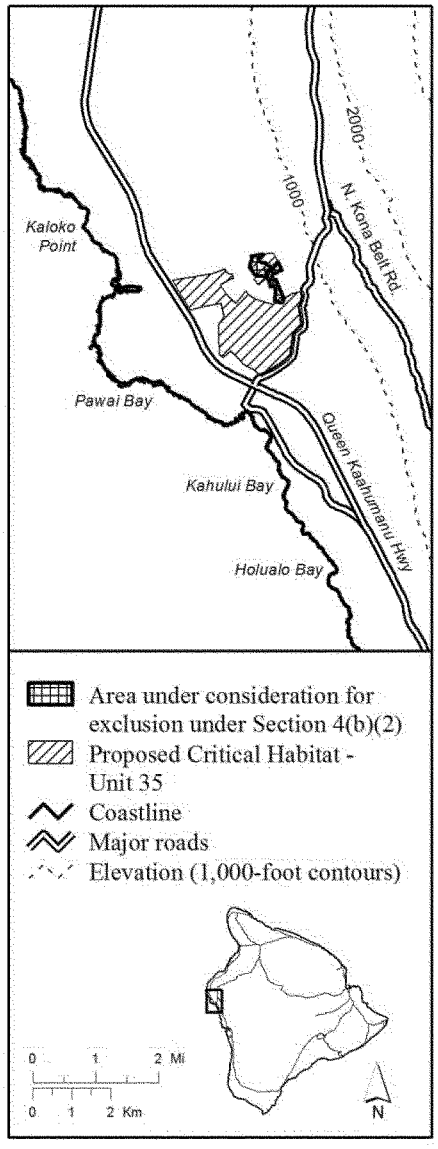


FIGURE 7. Department of Hawaiian Homelands lands at Kealakehe (cross-hatch) under consideration for exclusion from critical habitat under section 4(b)(2) of the Act.

Beginning in 1990, Housing and Community Development Corporation of Hawaii (HCDCH) was the State agency placed in charge of the master-planned community known as ''Villages of Laiopua'' (VOLA). The construction of VOLA would be phased, with increments of the proposed 1,700 homes (of which approximately 60 percent, would be offered as affordable housing) developed as discrete villages as funding allowed. From 1993 to 1999, the Service, DOFAW, and HCDCH worked to develop a mitigation plan for the listed and other rare plant species affected by the proposed development. In 1999, HCDCH produced the ''Mitigation Plan for Endangered Species at Villages of Laiopua, Kealakehe, North Kona, Hawaii'' to address impacts to listed and other plant species affected by the construction and development of VOLA (Belt Collins Hawaii 1999, pp. 1–29). By 2004, most of the lands within the VOLA development were transferred to the DHHL, which, in consultation with the Service, continues to implement these plans for conservation management. DHHL is involved in several actions to promote the conservation of rare and endangered species, including providing funding to establish and maintain preserves for listed plants, installing fencing for ungulate control, removing nonnative plants, and promoting community volunteer programs that support native plant conservation. In total, DHHL has allocated $741,564 toward construction of the preserves, habitat restoration, and education and community outreach activities through 2014.

We will continue working with the DHHL during the public comment period, and will make a determination regarding the exclusion from critical habitat designation in the final rule. In addition, we are requesting comments and information regarding these areas and will determine whether these lands may warrant exclusion from critical habitat in our final rule for the three plants for which critical habitat is proposed here on DHHL lands at Kealakehe.

Lands Previously Excluded Under Section 4(b)(2) of the Act

In 2003, we excluded approximately 329 ac (approximately 133 ha) of land in proposed unit Y2 owned by the Queen Liliuokalani Trust (Trust) because we believed there was a higher likelihood of beneficial conservation activities occurring on those private lands without the designation of critical habitat than there would be with a critical habitat designation (68 FR 39624; July 2, 2003). The exclusion of this area under 4(b)(2) of the Act was based on the Trust's offer to implement voluntary conservation activities and a proposal to: (1) Partner with the Service on a project to conduct research on the propagation of *Isodendrion pyrifolium,* and (2) set aside two areas totaling approximately 53 ac (21 ha) and allow for the outplanting of *I. pyrifolium, Neraudia ovata,* and other endangered species.

In 2004, the Service and the Trust partnered on a project to conduct research on propagation of *Isodendrion pyrifolium* and *Neraudia ovata* to: (1) Secure genetic material in *ex situ* storage, and (2) provide individuals for reintroduction or restoration projects. The Service and the Trust each contributed $10,000 toward the completion of the propagation project. On June 27, 2005, representatives of the Trust, the Service's Partners for Fish and Wildlife Program, Amy Greenwell Botanical Garden, and U.S. Army Garrison Hawaii—Pohakuloa Training Area conducted a site visit to identify appropriate outplanting sites for *I. pyrifolium* and *N. ovata.* Since 2005, the Trust has completed an approximately 28-ac (11-ha) chain-link fence exclosure (to discourage human traffic) in the southeast portion of the property above Queen Kaahumanu Highway adjacent to Palani Road. Within this chain-link exclosure is a smaller exclosure approximately 2 ac (less than 1 ha) in size (to exclude feral pigs) in which common native plants have been outplanted. For the outplanting effort, the Trust partnered with Amy Greenwell Botanical Garden for propagation of native plant material and used the opportunity to educate the community regarding the restoration of the native lowland dry ecosystem. Because the larger, chain-link exclosure contains various archaeological features, it has been proposed as a historical preservation preserve. In addition, the Trust has consulted with numerous cultural descendants of the Keahuolu area who are of native Hawaiian ancestry. Therefore, work in the fenced areas involves consideration of both natural and cultural resources management. According to Trust representatives, all work in the proposed historical preservation preserve has been suspended until the historical preservation plan has been approved by the State Historic Preservation Division. Aside from the contribution to research and propagation of *I. pyrifolium* and protection of the 2-ac (1-ha) area, there have been no additional conservation measures conducted for *I. pyrifolium* and *N. ovata* in the lowland dry ecosystem on the Trust's lands at Keahuolu.

Although the planned management activities described above (*i.e.,* propagation and outplanting, and habitat conservation) are consistent with recovery objectives for the endangered *I. pyrifolium* (USFWS 1996, pp. 1–252), they do not address conservation of the other two plants, the plant *Bidens micrantha* ssp. *ctenophylla* or the endangered plant *Mezoneuron kavaiense* (USFWS 1994, pp. 1–82), for which critical habitat is proposed. Further, since 2005, we are unaware of efforts to outplant propagated individuals of *I. pyrifolium* or any current plans to conserve listed species or their habitats in the lowland dry ecosystem on the lands at Keahuolu owned by the Trust. Therefore, the 329 ac (133 ha) of lands owned by the Trust are not proposed for exclusion in this proposed critical habitat rule.

Peer Review

In accordance with our joint policy published in the **Federal Register** on July 1, 1994 (59 FR 34270), we will seek the expert opinions of at least three appropriate and independent specialists regarding this proposed rule. The purpose of such review is to ensure that our proposed listing and critical habitat designation are based on scientifically sound data, assumptions, and analyses. We have posted our proposed peer review plan on our Web site at *http://www.fws/pacific/informationquality/index.htm.* We will invite these peer reviewers to comment, during the public comment period (see DATES), on the specific assumptions and conclusions regarding the proposed listing of 15 species and designation of critical habitat for 3 species.

We will consider all comments and information we receive during the comment period on this proposed rule during our preparation of a final determination. Accordingly, our final decision may differ from this proposal.

Public Hearings

The Act provides for one or more public hearings on this proposal, if requested. Requests for public hearings must be made within 45 days of the publication of this proposal (see **DATES**). We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and place of those hearings, in the **Federal Register** and local newspapers at least 15 days before the first hearing.

Persons needing reasonable accommodations to attend and

participate in a public hearing should contact the Pacific Islands Fish and Wildlife Office at 808–792–9400 as soon as possible. To allow sufficient time to process requests, please call no later than one week before the hearing date. Information regarding this proposal is available in alternative formats upon request.

Required Determinations

These required determinations relate only to the portion of this rule designating critical habitat. Listing determinations are made solely on the basis of the best scientific and commercial data available. 16 U.S.C. 1533(b)(1)(A).

Regulatory Planning and Review—Executive Order 12866

Executive Order 12866 provides that the Office of Information and Regulatory Affairs (OIRA) will review all significant rules. The Office of Information and Regulatory Affairs has determined that this rule is not significant.

Executive Order 13563 reaffirms the principles of E.O. 12866 while calling for improvements in the nation's regulatory system to promote predictability, to reduce uncertainty, and to use the best, most innovative, and least burdensome tools for achieving regulatory ends. The executive order directs agencies to consider regulatory approaches that reduce burdens and maintain flexibility and freedom of choice for the public where these approaches are relevant, feasible, and consistent with regulatory objectives. E.O. 13563 emphasizes further that regulations must be based on the best available science and that the rulemaking process must allow for public participation and an open exchange of ideas. We have developed this rule in a manner consistent with these requirements.

Regulatory Flexibility Act (5 U.S.C. 601 et seq.)

Under the Regulatory Flexibility Act (RFA; 5 U.S.C. 601 *et seq.,* as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), whenever an agency must publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effects of the rule on small entities (small businesses, small organizations, and small government jurisdictions). However, no regulatory flexibility analysis is required if the head of the agency certifies the rule will not have a significant economic impact on a substantial number of small entities. SBREFA amended RFA to require Federal agencies to provide a statement of the factual basis for certifying that the rule will not have a significant economic impact on a substantial number of small entities.

Small entities include small organizations, such as independent nonprofit organizations; small governmental jurisdictions, including school boards and city and town governments that serve fewer than 50,000 residents; as well as small businesses. Small businesses include manufacturing and mining concerns with fewer than 500 employees, wholesale trade entities with fewer than 100 employees, retail and service businesses with less than $5 million in annual sales, general and heavy construction businesses with less than $27.5 million in annual business, special trade contractors doing less than $11.5 million in annual business, and agricultural businesses with annual sales less than $750,000. To determine if potential economic impacts to these small entities are significant, we consider the types of activities that might trigger regulatory impacts under this rule, as well as the types of project modifications that may result. In general, the term ''significant economic impact'' is meant to apply to a typical small business firm's business operations.

The RFA/SBREFA defines ''small governmental jurisdiction'' as the government of a city, county, town, school district, or special district with a population of less than 50,000. By this definition, Hawaii County is not a small governmental jurisdiction because its population was estimated at 185,079 residents in 2010 (*http://hawaii.gov/dbedt/info/census/Census_2010*). Certain State agencies may be affected by the proposed critical habitat designation—such as the Department of Land and Natural Resources and the State Department of Transportation. However, for the purposes of the RFA, State governments are considered independent sovereigns, not small governments.

To determine if a designation of critical habitat could significantly affect a substantial number of small entities, we consider the number of small entities affected within particular types of economic activities (*e.g.,* housing development, grazing, oil and gas production, timber harvesting). We apply the ''substantial number'' test individually to each industry to determine if certification is appropriate. However, the SBREFA does not explicitly define ''substantial number'' or ''significant economic impact.'' Consequently, to assess whether a ''substantial number'' of small entities is affected by this designation, this analysis considers the relative number of small entities likely to be impacted in an area. In some circumstances, especially with critical habitat designations of limited extent, we may aggregate across all industries and consider whether the total number of small entities affected is substantial. In estimating the number of small entities potentially affected, we also consider whether their activities have any Federal involvement.

Under the Act, designation of critical habitat only affects activities carried out, funded, or permitted by Federal agencies. Some kinds of activities are unlikely to have any Federal involvement and so will not be affected by critical habitat designation. However, in some States there are State laws that limit activities in designated critical habitat even where there is no Federal nexus. If there is a Federal nexus, Federal agencies would be required to consult with us under section 7 of the Act on activities they fund, permit, or carry out that may affect critical habitat. If we conclude, in a biological opinion, that a proposed action is likely to destroy or adversely modify critical habitat, we can offer ''reasonable and prudent alternatives.'' Reasonable and prudent alternatives are alternative actions that can be implemented in a manner consistent with the scope of the Federal agency's legal authority and jurisdiction, that are economically and technologically feasible, and that would avoid destroying or adversely modifying critical habitat.

A Federal agency and an applicant may elect to implement a reasonable and prudent alternative associated with a biological opinion that has found adverse modification of critical habitat. An agency or applicant could alternatively choose to seek an exemption from the requirements of the Act or proceed without implementing the reasonable and prudent alternative. However, unless an exemption were obtained, the Federal agency would be at risk of violating section 7(a)(2) of the Act if it chose to proceed without implementing the reasonable and prudent alternatives. We may also identify discretionary conservation recommendations designed to minimize or avoid the adverse effects of a proposed action on critical habitat, to help implement recovery plans, or to develop information that could contribute to the recovery of the species.

Within the proposed critical habitat designation, the types of actions or authorized activities that we have

identified as potential concerns and that may be subject to consultation under section 7 if there is a Federal nexus are: (1) Activities that might degrade or destroy the primary constituent elements for the species, including, but not limited to: (a) Grazing; (b) maintaining or increasing feral ungulate levels; (c) clearing or cutting native live trees and shrubs; (d) bulldozing; (e) construction; (f) road building; (g) mining; (h) herbicide application; and (i) taking actions that pose a risk of fire; (2) activities that may alter watershed characteristics in ways that would reduce groundwater recharge or alter natural, wetland, aquatic, or vegetative communities (*e.g.,* new water diversion or impoundment activities, groundwater pumping, and manipulation of vegetation through activities such as the ones mentioned above); (3) recreational activities that may degrade vegetation; (4) mining sand or other minerals; (5) introducing or encouraging the spread of nonnative plant species; (6) importing nonnative species for research, agriculture, and aquaculture; and (7) releasing biological control agents.

Three of the proposed critical habitat units (Hawaii Unit 33, Hawaii Unit 34, and Hawaii Unit 35) contain commercial operations or proposed commercial operations. Hawaii Unit 33 totals approximately 1,583 ac (640 ha) and extends from Puukala to Kalaoa on the western slope of Hualalai between the elevations of 360 and 1,080 ft (110 and 329 m). Approximately 1,080 ac (437 ha) of this unit are owned by the State of Hawaii and 502 ac (203 ha) are privately owned by Palamanui Global Holdings LLC. The area owned by Palamanui Global Holdings LLC and proposed within Hawaii Unit 33 comprises a portion of the 725-ac (293-ha) Palamanui Hiluhilu Development project, which includes single and multi-family residential units, university residential facilities, health facilities, research and development facilities, mixed commercial development, a small hotel, natural and cultural preserves, parks, open space, and parking areas (Group 70 International 2004, p. 3–36; DHHL 2009, p. 10). Plans called for the Palamanui Hiluhilu Development project to be developed over a 10-year period beginning in 2004, in a sequence of phases starting with infrastructure and continuing with residential, multi-family, and commercial improvements. However, to date, only construction of certain infrastructure improvements have been completed, and the sale of residential lots is not anticipated until 2013, at the earliest (Harris 2011, pers. comm.). A draft management plan for the biological resources within the Palamanui Hiluhilu Development project area includes the creation of a lowland dry forest preserve and other protective measures to benefit three endangered plants, *Mezoneuron kavaiense, Nothocestrum breviflorum,* and *Pleomele hawaiiensis,* and their habitats (see Palamanui Global Holdings LLC above). Also within proposed critical habitat Hawaii Unit 33 and to the south of the parcel owned by Palamanui Global Holdings LLC, is a 500-ac (202-ha) parcel owned by the State of Hawaii, a portion of which will be developed for the University of Hawaii Center West Hawaii campus (UHCWH) (Wil Chee—Planning & Environmental, Inc. 2007, p. 1). Development of UHCWH buildings within a 78-acre portion of the State owned parcel could begin as early as May 2012 (Jensen 2011, in litt.). At this time we are unaware of ongoing actions or authorized activities with a Federal nexus that may be subject to consultations under section 7 of the Act on the 502 ac (203 ha) of private land owned by Palamanui Global Holdings LLC. Palamanui Global Holdings LLC has demonstrated a willingness to manage these lands in a manner compatible with the conservation of listed and nonlisted species, therefore in this proposed rule we are considering excluding these 502 ac (203 ha) of land owned by Palamanui Global Holdings LLC within proposed Hawaii Unit 33. If these lands are excluded from critical habitat under section 4(b)(2) of the Act in our final rule because the benefits of exclusion outweigh the benefits of critical habitat designation, consultation with us under section 7 of the Act on activities funded, permitted, or carried out by Federal agencies will not be triggered.

Proposed Hawaii Unit 34 totals 961 ac (389 ha) and extends from Kaloko to Ooma on the western slope of Hualalai between the elevations of 280 and 600 ft (85 and 183 m). There are 259 ac (105 ha) of State land, and 702 ac (284 ha) of privately owned land in this proposed unit. The Kaloko Makai Development is proposed on private land within this unit. Several landowners with a common interest in the proposed Kaloko Makai Development include Kaloko Properties Corporation, SCD–TSA Kaloko Makai LLC, and TSA Corporation. A description of the proposed Kaloko Makai Development is given above (see Kaloko Makai Development). SCD–TSA Kaloko Makai LLC is working with the State's DOFAW to develop a multi-species HCP, to minimize and mitigate the impacts of the proposed development on the plant, *Bidens micrantha* ssp. *ctenophylla,* and four endangered plants, *Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum,* and *Pleomele hawaiiensis* (Hookuleana LLC 2011). In addition, Lanihau Properties owns private land immediately adjacent to the Kaloko Makai Development and is involved in a joint conservation agreement with the Service, the FHWA, DOFAW, the County of Hawaii, and the owners of the Kaloko Makai Development. In 2010, the Service concluded an informal consultation under section 7 of the Act with the FHWA to address impacts to the same four endangered plants and one species proposed for listing in this rule (see above) associated with the proposed construction of Ane Keohokalole Highway from Hina Lani Street to Palani Road. The proposed highway segments covered in the consultation fall within Hawaii Unit 34 in the north and Hawaii Unit 35 in the south. The Service, SCD–TSA Kaloko Makai LLC, FWHA, the County of Hawaii, and Lanihau Properties negotiated several measures to achieve conservation for the four endangered and one plant species proposed for listing in this rule (see above) impacted by highway construction and related development activities. At this time we are unaware of any other ongoing actions or authorized activities with a Federal nexus that may be subject to consultation under section 7 of the Act on the 630 ac (255 ha) of private land owned by the three landowners with a common interest in the Kaloko Makai Development or the 47 ac (19 ha) owned by Lanihau Partners. These landowners have demonstrated a willingness to manage these lands in a manner compatible with the conservation of listed and nonlisted species. Therefore, in this proposed rule we are considering excluding these 676 ac (274 ha) of privately owned land within proposed critical habitat Hawaii Unit 34. If these lands are excluded from critical habitat under section 4(b)(2) of the Act in our final rule because the benefits of exclusion outweigh the benefits of critical habitat designation, consultation with us under section 7 of the Act on activities funded, permitted, or carried out by Federal agencies would not be triggered.

Forest City Hawaii Kona proposes to develop a master-planned community consisting of approximately 270 ac (109 ha) of privately owned lands in proposed critical habitat Hawaii Unit 35

for the HFDC. The development will include 1,020 to 2,330 single and multi-family residences (including the proposed Keahuolu Affordable Housing Project), commercial and retail space, a site reserved for a school, parks, an archaeological preserve, and open space. The State environmental review process has been completed and the developer is targeting early 2012, for receiving the grading and construction permits for Phase 1 of development (Fujimoto 2011a, in litt.; Fujimoto 2011b, in litt.). At this time we are unaware of any ongoing actions or authorized activities with a Federal nexus that may be subject to consultation under section 7 of the Act on the 270 ac (109 ha) of land owned by Forest City Hawaii Kona.

None of the other three proposed critical habitat units contain any significant residential, commercial, industrial, or golf-course projects; crop farming; or intensive livestock operations. Few projects are planned for locations in these other proposed critical habitat units. This situation reflects the fact that existing land-use controls severely limit development and most other economic activities in the rugged lava terrain of the north Kona region of Hawaii Island.

Existing and planned projects, land uses, and activities that could affect the proposed critical habitat but have no Federal involvement would not require section 7 consultation with the Service, so they are not restricted by the requirements of the Act. Further, although some existing and continuing activities involve the operation and maintenance of existing manmade features and structures in certain areas, these areas do not contain the physical or biological features for the species, and would not be impacted by the designation. Finally, for the anticipated projects and activities that will have Federal involvement, many are conservation efforts that would not negatively impact critical habitat, so they will not be subjected to a protracted informal section 7 consultation. We also anticipate that a developer or other project proponent could modify a project or take measures to conserve critical habitat, if designated.

In addition, Federal agencies may also need to reinitiate a previous consultation if discretionary involvement or control over the Federal action has been retained or is authorized by law and the activities may affect critical habitat. In 1984, we designated critical habitat for the endangered plant, *Kokia drynarioides* (49 FR 47397; December 4, 1984), and between 2003 and 2008, we designated critical habitat for 41 endangered plants on Hawaii Island (68 FR 39624; July 2, 2003); for the Blackburn's sphinx moth on Molokai, Maui, and Kahoolawe, and the island of Hawaii (68 FR 34710; June 10, 2003); and for 12 picture-wing flies on Kauai, Oahu, Molokai, Maui, and Hawaii Island (73 FR 73794; December 4, 2008). We discuss our formal and informal consultations conducted prior to 2003 on Hawaii Island in our final rules to designate critical habitat on this island (68 FR 34710, June 10, 2003; 68 FR 39624, July 2, 2003).

Since the 2003 critical habitat designations on Hawaii Island, we have conducted 25 formal consultations and 260 informal consultations on Hawaii Island, in addition to consultations on Federal grants to State wildlife programs that do not affect small entities. Of these 285 formal and informal consultations, 18 formal consultations and 60 informal consultations were primarily consultations regarding Federal permits to Service employees to implement conservation actions for listed species. The remainder, 7 formal consultations and 225 informal consultations, involved (in order of frequency) the Department of Agriculture (USDA-Natural Resources Conservation Service (NRCS), USDA-Pesticide Branch, and USDA-Animal and Plant Health Inspection Service (APHIS)), Federal Communications Commission (FCC), National Park Service (NPS), Federal Highway Administration (FHWA), Department of Housing and Urban Development (HUD), Department of Transportation (DOT), U.S. Army, Environmental Protection Agency (EPA), Hawaii Army National Guard, National Oceanic Atmospheric Administration (NOAA), U.S. Geological Survey-Biological Resource Division (USGS–BRD), Federal Emergency Management Agency (FEMA), U.S. Coast Guard, and the U.S. Army Corps of Engineers.

Three of the seven formal consultations concerned designated critical habitat, and we concurred with each agency's determination that the project as proposed, was not likely to destroy or adversely modify critical habitat.

One of the formal consultations was conducted on behalf of the U.S. Army Garrison regarding routine military training at the Pohakuloa Training Area (PTA). The U.S. Army proposed helicopter pinnacle landings in palila (*Loxioides bailleui*) critical habitat (42 FR 40685; August 11, 1977). The Service determined the pinnacle landings on Puu Omaokaoli at PTA were not likely to adversely modify palila critical habitat. This action was not conducted in proposed critical habitat.

The second formal consultation was conducted on behalf of the FHWA regarding the Saddle Road Realignment and Improvement Project. The FHWA proposed road construction activities in critical habitat for the endangered plants *Clermontia peleana* and *Cyanea platyphylla.* Because the proposed project included beneficial actions for these species in other areas to offset any impacts to habitat from road construction actions, the Service determined that this action was not likely to adversely modify critical habitat. This action was not conducted in proposed critical habitat.

The third formal consultation was conducted on behalf of NOAA regarding Pelekane Bay Watershed restoration. The project area overlapped with 243 ac (98 ha) of unoccupied critical habitat for an endangered plant *Achyranthes mutica.* The NOAA proposed to build an ungulate exclosure fence around the 16,000-ac (6,500-ha) project area, remove all the ungulates within the fenced area, and outplant native plants. Because these actions would greatly enhance the suitability of the site to support *Achyranthes mutica* in the future, and likely result in an overall benefit to the critical habitat by ameliorating several threats, the Service determined that this project was not likely to adversely modify *Achyranthes mutica* critical habitat.

The majority of the 225 informal consultations that did not involve Service actions were related to proposed project effects on seabird (*e.g.,* Newell's shearwater (*Puffinus auricularis newelli*) and Hawaiian petrel (*Pterodroma phaeopygia*)) flyways, the nene or Hawaiian goose (*Branta sandvicensis*), the opeapea or Hawaiian hoary bat (*Lasiurus cinereus semotus*), the io or Hawaiian hawk (*Buteo solitarius*), and other listed species and their associated habitats. About one-third of the informal consultations were conducted with the USDA for proposed funding for habitat restoration projects under NRCS programs such as the Wildlife Habitat Incentives Program and Environmental Quality Incentives Program. A small number of the informal consultations involved the FCC and the construction of cellular telecommunication sites.

Thirteen of the 260 informal consultations concerned designated critical habitat, and in all cases we concurred with each agency's determination that the project, as proposed, had no effect or was not likely to adversely modify critical habitat. These projects were divided between conservation actions that

would benefit listed species, construction, and agricultural operations. For the 247 informal consultations that did not concern designated critical habitat, we concurred with each agency's determination that the project, as proposed, was not likely to adversely affect listed species.

In this rule, we are proposing to designate critical habitat on a total 18,766 ac (7,597 ha) of land. Fifty-five percent (10,304 ac (4,170 ha)) of this proposed critical habitat designation overlaps with already designated critical habitat for one or more species, and 45 percent (8,464 ac (3,426 ha)) of the proposed designation is on land newly proposed as critical habitat. Some of the Federal actions that were subject to previous section 7 consultation are on the lands we are proposing as critical habitat in this rule. Therefore, there may be a requirement to reinitiate consultation for some ongoing Federal projects.

In the 2003 and 2008 economic analyses of the designation of critical habitat for 41 species of plants on the island of Hawaii and Blackburn's sphinx moth, we evaluated the potential economic effects on small business entities resulting from the protection of these species and their habitats related to the proposed designation of critical habitat and determined that it would not have a significant economic impact on a substantial number of small entities. The overlap between the critical habitat designations for the 41 plant species and the Blackburn's sphinx moth, and this proposed critical habitat designation is further evidence that this proposal is not likely to have a significant economic impact on a substantial number of small entities.

Based on our evaluation above, we have determined that the proposed designation of critical habitat for *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense* will not have a significant impact on a substantial number of small entities, for the reasons described above. As a result, an initial Regulatory Flexibility Analysis is not required. However, we will reevaluate the potential impacts to small entities in the economic analysis we develop for this proposed designation.

Unfunded Mandates Reform Act (2 U.S.C. 1501 et seq.)

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501 *et seq.*), we make the following findings:

(a) This rule would not produce a Federal mandate. In general, a Federal mandate is a provision in legislation, statute, or regulation that would impose an enforceable duty upon State, local, or tribal governments, or the private sector, and includes both ''Federal intergovernmental mandates'' and ''Federal private sector mandates.'' These terms are defined in 2 U.S.C. 658(5)–(7). ''Federal intergovernmental mandate'' includes a regulation that ''would impose an enforceable duty upon State, local, or tribal governments'' with two exceptions. It excludes ''a condition of Federal assistance.'' It also excludes ''a duty arising from participation in a voluntary Federal program,'' unless the regulation ''relates to a then-existing Federal program under which $500,000,000 or more is provided annually to State, local, and tribal governments under entitlement authority,'' if the provision would ''increase the stringency of conditions of assistance'' or ''place caps upon, or otherwise decrease, the Federal Government's responsibility to provide funding,'' and the State, local, or tribal governments ''lack authority'' to adjust accordingly. At the time of enactment, these entitlement programs were: Medicaid; AFDC work programs; Child Nutrition; Food Stamps; Social Services Block Grants; Vocational Rehabilitation State Grants; Foster Care, Adoption Assistance, and Independent Living; Family Support Welfare Services; and Child Support Enforcement. ''Federal private sector mandate'' includes a regulation that ''would impose an enforceable duty upon the private sector, except (i) a condition of Federal assistance or (ii) a duty arising from participation in a voluntary Federal program.''

The designation of critical habitat does not impose a legally binding duty on non-Federal Government entities or private parties. Under the Act, the only regulatory effect is that Federal agencies must ensure that their actions do not destroy or adversely modify critical habitat under section 7. While non-Federal entities that receive Federal funding, assistance, or permits, or that otherwise require approval or authorization from a Federal agency for an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency. Furthermore, to the extent that non-Federal entities are indirectly impacted because they receive Federal assistance or participate in a voluntary Federal aid program, the Unfunded Mandates Reform Act would not apply, nor would critical habitat shift the costs of the large entitlement programs listed above onto State governments.

(b) We do not believe that this rule would significantly or uniquely affect small governments. The lands we are proposing for critical habitat designation are owned by the County of Hawaii, the State of Hawaii, private citizens, and the Federal Government. None of these entities fit the definition of ''small governmental jurisdiction.'' Therefore, a Small Government Agency Plan is not required. However, we will further evaluate this issue as we conduct our economic analysis, and review and revise this assessment as warranted.

Takings—Executive Order 12630

In accordance with E.O. 12630 (Government Actions and Interference with Constitutionally Protected Private Property Rights), we have analyzed the potential takings implications of designating critical habitat for each of the three species in a takings implications assessment. The takings implications assessment concludes that this designation of critical habitat for each of these species does not pose significant takings implications for lands within or affected by the proposed designation.

Federalism—Executive Order 13132

In accordance with E.O. 13132 (Federalism), this proposed rule does not have significant Federalism effects. A federalism impact summary statement is not required. In keeping with Department of the Interior and Department of Commerce policy, we requested information from, and coordinated development of, this proposed critical habitat designation with appropriate State resource agencies in Hawaii. The critical habitat designation may have some benefit to these governments because the areas that contain the features essential to the conservation of the species would be more clearly defined, and the essential features themselves are specifically identified. While making this definition and identification does alter where and what federally sponsored activities may occur, it may assist local governments in long–range planning (rather than having them wait for case-by-case section 7 consultations to occur).

Where State and local governments require approval or authorization from a Federal agency for actions that may affect critical habitat, consultation under section 7(a)(2) would be required. While non-Federal entities that receive Federal funding, assistance, or permits, or that otherwise require approval or authorization from a Federal agency for

an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency.

Civil Justice Reform—Executive Order 12988

In accordance with E.O. 12988 (Civil Justice Reform), the Office of the Solicitor has determined that the rule does not unduly burden the judicial system and that it meets the requirements of sections 3(a) and 3(b)(2) of the Order. We propose designating critical habitat in accordance with the provisions of the Act. This proposed rule uses standard property descriptions and identifies the physical and biological features within the designated areas to assist the public in understanding the habitat needs of each of the species being considered in this proposed rule.

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). This rule will not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act (NEPA)

It is our position that, outside the jurisdiction of the Circuit Court of the United States for the Tenth Circuit, we do not need to prepare environmental analyses as defined by NEPA (42 U.S.C. 4321 *et seq.*) in connection with designating critical habitat under the Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244). This assertion was upheld by the U.S. Court of Appeals for the Ninth Circuit (*Douglas County* v. *Babbitt,* 48 F.3d 1495 (9th Cir. 1995), cert. denied 516 U.S. 1042 (1996)).

Clarity of the Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(a) Be logically organized;

(b) Use the active voice to address readers directly;

(c) Use clear language rather than jargon;

(d) Be divided into short sections and sentences; and

(e) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

Energy Supply, Distribution, or Use

On May 18, 2001, the President issued an Executive Order (E.O. 13211; Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use) on regulations that significantly affect energy supply, distribution, and use. Executive Order 13211 requires agencies to prepare Statements of Energy Effects when undertaking certain actions. This proposed rule to designate critical habitat for *Bidens micrantha* ssp. *ctenophylla, Isodendrion pyrifolium,* and *Mezoneuron kavaiense* is not a significant regulatory action under E.O. 12866. There are no energy facilities within the footprint of the proposed critical habitat boundaries. Accordingly, we do not expect the designation of this proposed critical habitat to significantly affect energy supplies, distribution, or use. Therefore, this action is not a significant energy action, and no Statement of Energy Effects is required. Any comments we receive addressing energy supply will be fully considered and addressed in our final determination.

References Cited

A complete list of references cited in this rule is available on the Internet at *http://www.regulations.gov* and upon request from the Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT,** above).

Authors

The primary authors of this document are the staff members of the Pacific Islands Fish and Wildlife Office.

List of Subjects in 50 CFR part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, and Transportation.

Proposed Regulation Promulgation

Accordingly, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

2. Amend § 17.11(h), the List of Endangered and Threatened Wildlife, as follows:

a. By adding an entry for ''Fly, Hawaiian picture-wing'' (*Drosophila digressa*), in alphabetical order under INSECTS, to read as set forth below; and

b. By adding an entry for ''Shrimp, anchialine pool'' (*Vetericaris chaceorum*), in alphabetical order under CRUSTACEANS, to read as set forth below.

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	
INSECTS							
*	*	*	*	*	*	*	
Fly, Hawaiian picture-wing.	*Drosophila digressa*	U.S.A. (HI)	NA	E		NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	
CRUSTACEANS							
*	*	*	*	*	*	*	
Shrimp, anchialine pool	*Vetericaris chaceorum*	U.S.A. (HI)	NA	E		NA	NA
*	*	*	*	*	*	*	

3. Amend § 17.12(h), the List of Endangered and Threatened Plants, as follows:

a. By removing the entry for *Caesalpinia kavaiensis* under FLOWERING PLANTS,

b. By revising the entry for *Isodendrion pyrifolium* under FLOWERING PLANTS to read as set forth below;

c. By adding entries for *Bidens hillebrandiana* ssp. *hillebrandiana, Bidens micrantha* ssp. *ctenophylla, Cyanea marksii, Cyanea tritomantha, Cyrtandra nanawaleensis, Cyrtandra wagneri, Mezoneuron kavaiense, Phyllostegia floribunda, Pittosporum hawaiiense, Platydesma remyi, Pritchardia lanigera, Schiedea diffusa* ssp. *macraei, Schiedea hawaiiensis,* and *Stenogyne cranwelliae* in alphabetical order under FLOWERING PLANTS, to read as set forth below.

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	**Common name**						
FLOWERING PLANTS							
* * * * * * *							
Bidens hillebrandiana ssp. *hillebrandiana*	Kookoolau	U.S.A. (HI)	Asteraceae	E		NA	NA
Bidens micrantha ssp. *ctenophylla*	Kookoolau	U.S.A. (HI)	Asteraceae	E		17.99(k)	NA
* * * * * * *							
Cyanea marksii	Haha	U.S.A. (HI)	Campanulaceae	E		NA	NA
* * * * * * *							
Cyanea tritomantha	ahu	U.S.A. (HI)	Campanulaceae	E		NA	NA
* * * * * * *							

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	**Common name**						
Cyrtandra nanawaleensis	Haiwale	U.S.A. (HI)	Gesneriaceae	E		NA	NA
* * * * * * *							
Cyrtandra wagneri	Haiwale	U.S.A. (HI)	Gesneriaceae	E		NA	NA
* * * * * * *							
Isodendrion pyrifolium	Wahine noho kula	U.S.A. (HI)	Violaceae	E	532	17.99(c), (e)(1), (i), and (k)	NA
* * * * * * *							
Mezoneuron kavaiense	Uhiuhi	U.S.A. (HI)	Fabaceae	E	238	17.99(k)	NA
* * * * * * *							
Phyllostegia floribunda	None	U.S.A. (HI)	Lamiaceae	E		NA	NA
* * * * * * *							

Pittosporum hawaiiense	Hoawa	U.S.A. (HI)	Pittosporaceae	E	NA	NA
* * * * * * *						
Platydesma remyi	None	U.S.A. (HI)	Rutaceae	E	NA	NA
* * * * * * *						
Pritchardia lanigera	Loulu	U.S.A. (HI)	Arecaceae	E	NA	NA
* * * * * * *						
Schiedea diffusa ssp. *macraei*	None	U.S.A. (HI)	Caryophyllaceae	E	NA	NA
* * * * * * *						
Schiedea hawaiiense	None	U.S.A. (HI)	Caryophyllaceae	E	NA	NA
* * * * * * *						
Stenogyne cranwelliae	None	U.S.A. (HI)	Lamiaceae	E	NA	NA
* * * * * * *						

* * * * *

4. Amend § 17.99 as follows:

a. By revising the section heading to read as set forth below;

b. By revising the introductory text of paragraph (k) to read as set forth below;

c. By revising the index map at paragraph (k)(1) as set forth below;

d. By redesignating paragraphs (k)(40) through (k)(52) as paragraphs (k)(41) through (k)(53);

e. By adding new paragraph (k)(40) to read as set forth below;

f. By redesignating newly designated paragraphs (k)(46) through (k)(53) as paragraphs (k)(48) through (k)(55);

g. By adding new paragraphs (k)(46) and (k)(47) to read as set forth below;

h. By removing the map in paragraph (k)(97)(ii), and adding in its place the map set forth below;

i. By removing the map in paragraph (k)(100)(ii), and adding in its place the map set forth below;

j. By removing the map in paragraph (k)(101)(ii), and adding in its place the map set forth below;

k. By removing the map in paragraph (k)(102)(ii), and adding in its place the map set forth below;

l. By redesignating paragraphs (k)(104) and (k)(105) as paragraphs (k)(121) and (k)(122);

m. By adding new paragraphs (k)(104), (k)(105), (k)(106), (k)(107), (k)(108), (k)(109), (k)(110), (k)(111), (k)(112), (k)(113), (k)(114), (k)(115), (k)(116), (k)(117), (k)(118), (k)(119), and (k)(120), to read as set forth below;

n. By revising newly designated paragraph (k)(121) to read as set forth below;

o. By removing the entry ''Family Violaceae*: Isodendrion pyrifolium* (wahine noho kula)'' from paragraph (l)(1); and

p. By adding entries for ''Family Asteraceae: *Bidens micrantha* ssp. *ctenophylla*'', ''Family Fabaceae: *Mezoneuron kavaiense*'', and ''Family Violaceae: *Isodendrion pyrifolium''* in alphabetical order by family name to paragraph (l)(1) to read as set forth below:

§ 17.99 Critical habitat; plants on the Hawaiian Islands, HI.

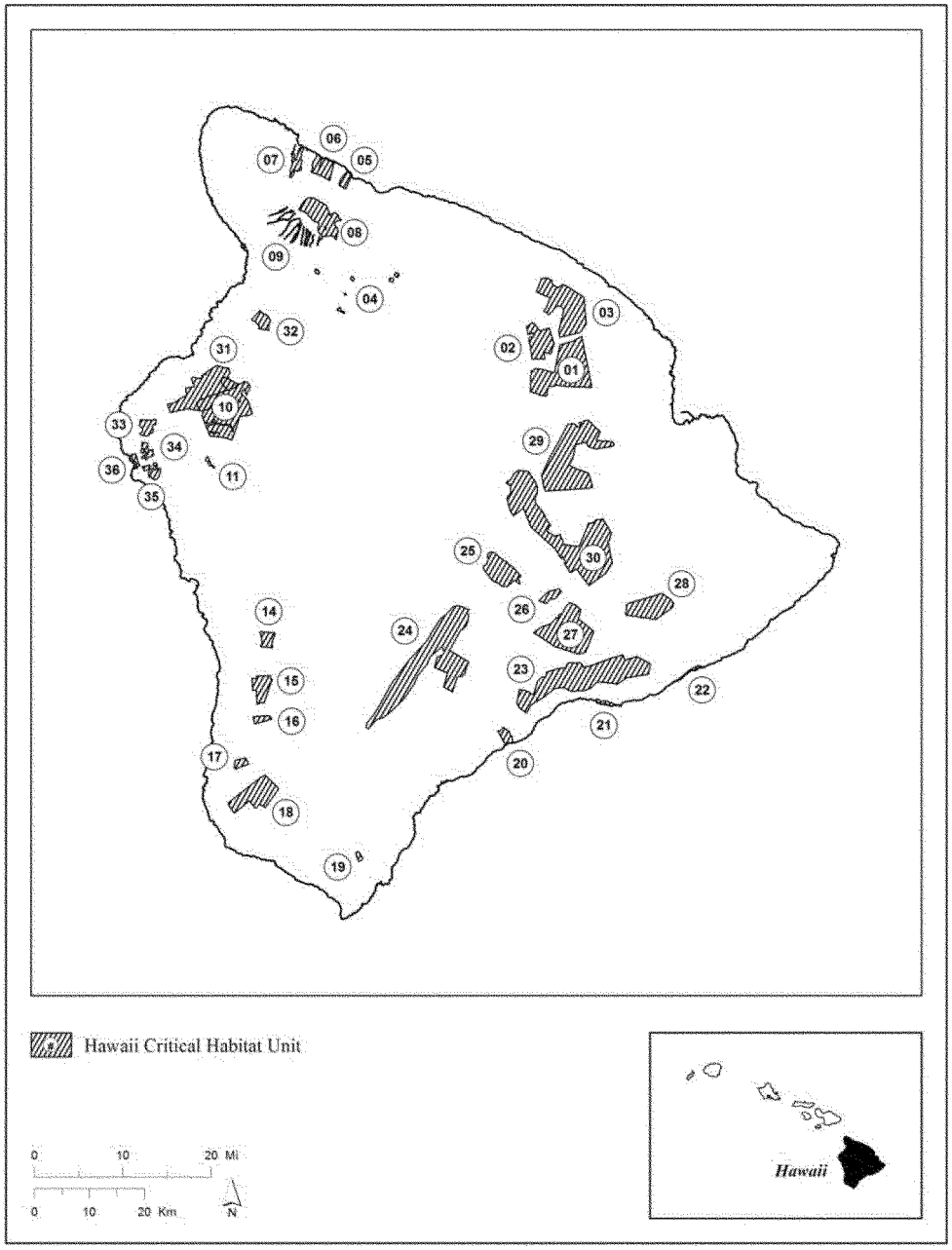
* * * * *

(k) *Maps and critical habitat unit descriptions for the island of Hawaii, HI.* Critical habitat units are described below. Coordinates are in UTM Zone 4 with units in meters using North American Datum of 1983 (NAD83). The following map shows the general locations of the critical habitat units designated on the island of Hawaii. Existing manmade features and structures, such as buildings, roads, railroads, airports, runways, other paved areas, lawns, and other urban landscaped areas, are not included in the critical habitat designation. Federal actions limited to those areas, therefore, would not trigger a consultation under section 7 of the Act unless they may affect the species or physical or biological features in adjacent critical habitat.

(1) **NOTE:** Map 1, Index map, follows:

Map 1

Hawaii Critical Habitat–Island Index Map



* * * * *

(40) Hawaii 10—*Bidens micrantha* ssp. *ctenophylla*–a (1,179 ha; 2,914 ac)

(i) [Reserved for textual description of Hawaii 10—*Bidens micrantha* ssp. *ctenophylla*–a.]. This unit is also critical habitat for Hawaii 10—*Isodendrion pyrifolium*–a and Hawaii 10—*Mezoneuron kavaiense*–a (see paragraphs (k)(46) and (k)(47), respectively, of this section).

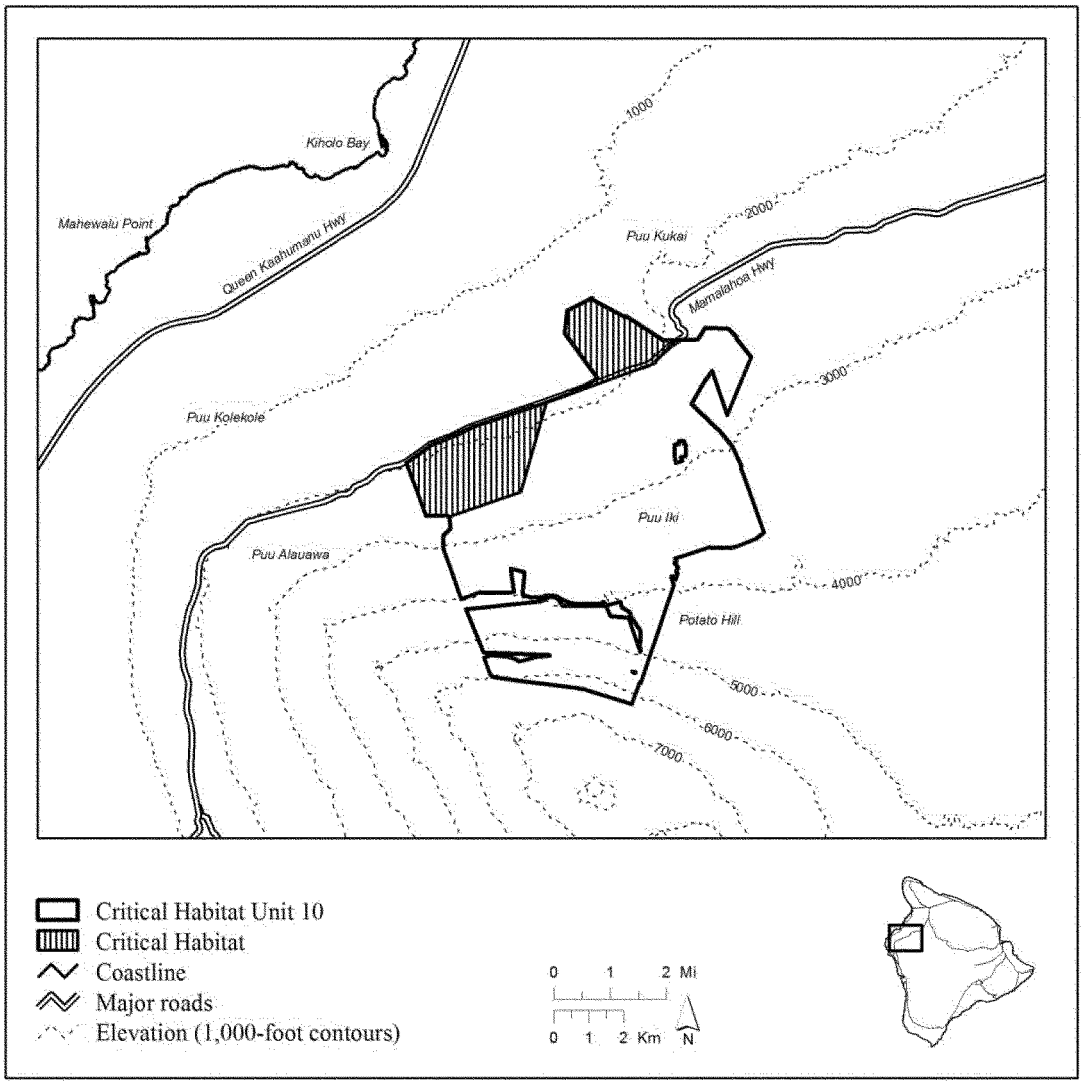
(ii) **NOTE:** Map 39a follows:

MAP 39a

Hawaii 10–*Bidens micrantha* ssp. *ctenophylla*–a, Hawaii 10– *Isodendrion pyrifolium* –a,

Hawaii 10–*Mezoneuron kavaiense*–a

Lowland Dry



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(46) Hawaii 10—*Isodendrion pyrifolium*–a (1,179 ha; 2,914 ac)

(i) See paragraph (k)(40)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(40)(ii) of this section for the map of this unit.

(47) Hawaii 10—*Mezoneuron kavaiense*–a (1,179 ha; 2,914 ac)

(i) See paragraph (k)(40)(i) of this section for the textual description of this unit.

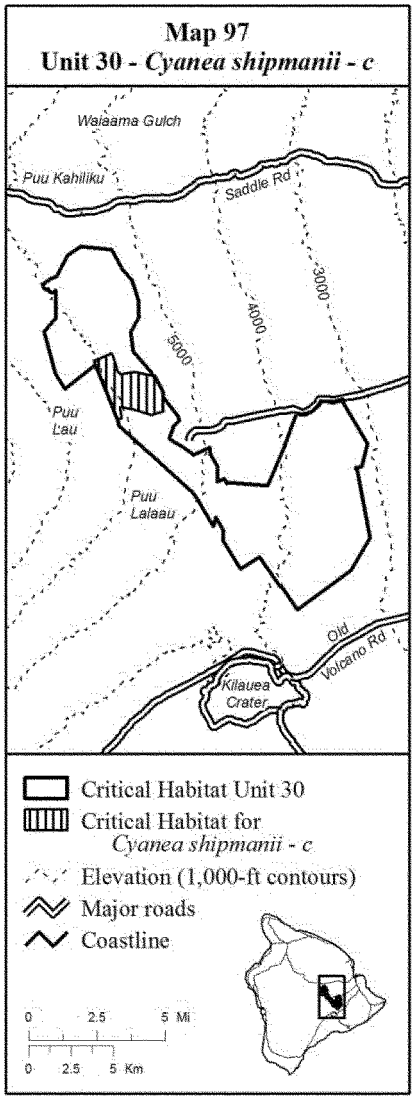
(ii) See paragraph (k)(40)(ii) of this section for the map of this unit.

* * * * *

(97) * * *

(i) * * *

(ii) **NOTE:** Map 97 follows:

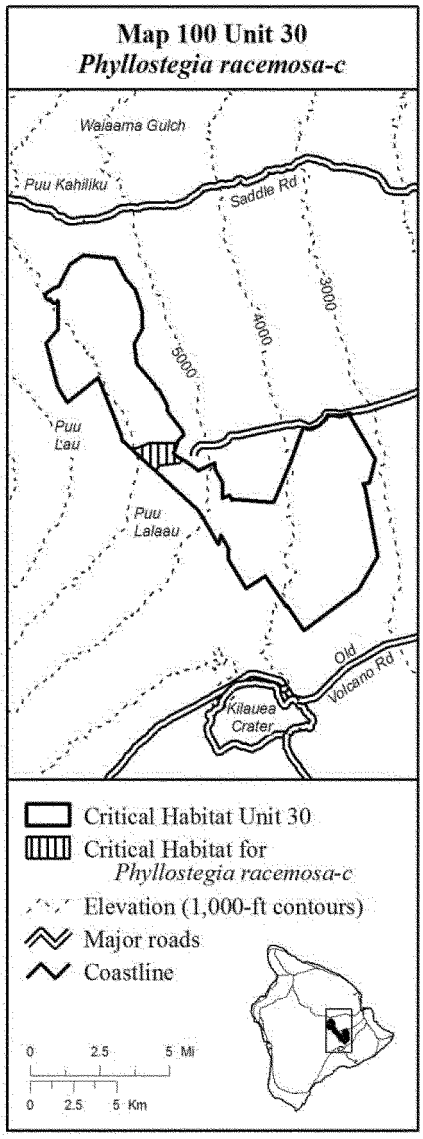


* * * * *

(100) * * *

(i) * * *

(ii) **NOTE:** Map 100 follows:

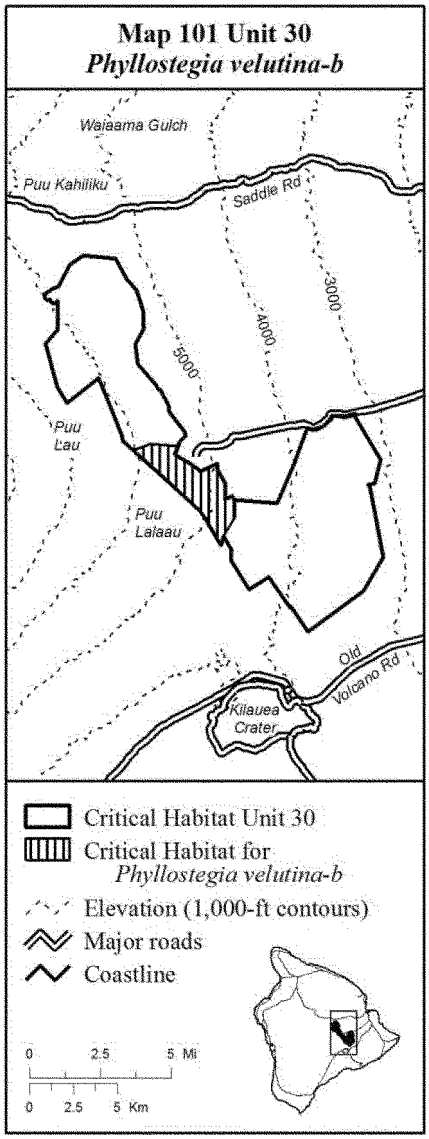


* * * * *

(101) * * *

(i) * * *

(ii) **NOTE:** Map 101 follows:

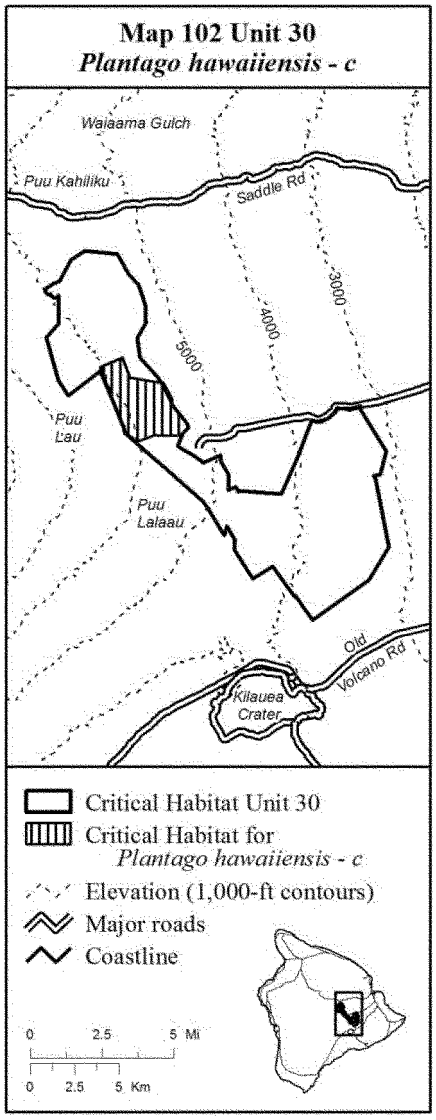


* * * * *

(102) * * *

(i) * * *

(ii) **NOTE:** Map 102 follows:



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(104) Hawaii 31–*Bidens micrantha* ssp. *ctenophylla*–b (9,936 ac; 4,021 ha)

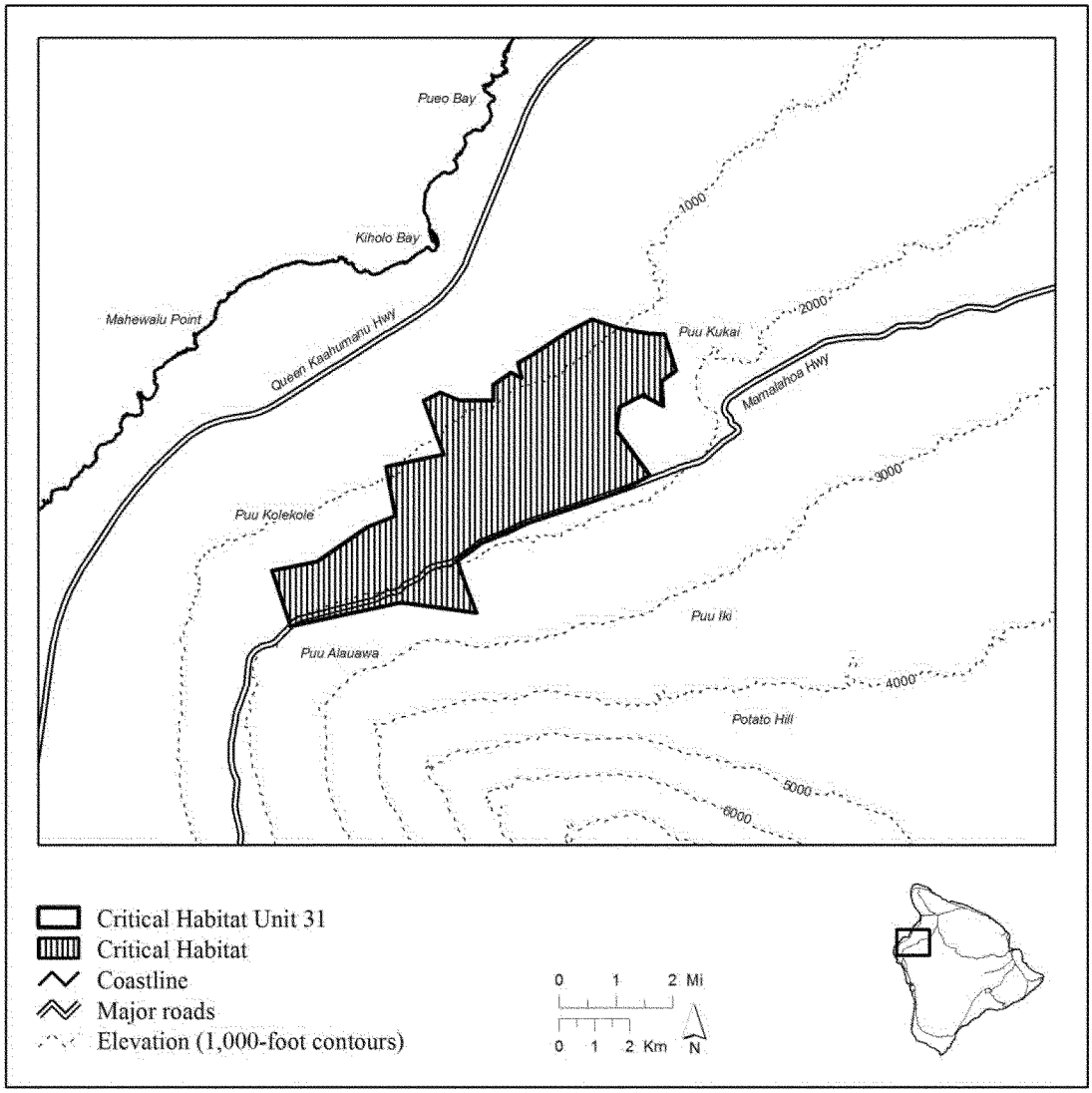
(i) [Reserved for textual description of Hawaii 31–*Bidens micrantha* ssp. *ctenophylla*–b.] This unit is also critical habitat for Hawaii 31–*Isodendrion pyrifolium*–b and Hawaii 31–*Mezoneuron kavaiense*– b (see paragraphs (k)(105) and (k)(106), respectively, of this section).

(ii) **NOTE:** Map 104 follows:

Map 104

Hawaii 31–*Bidens micrantha* ssp. *ctenophylla*–b, Hawaii 31– *Isodendrion pyrifolium*–b, Hawaii 31–*Mezoneuron kavaiense*–b

Lowland Dry



(105) Hawaii 31–*Isodendrion pyrifolium*–b (9,936 ac; 4,021 ha)

(i) See paragraph (k)(104)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(104)(ii) of this section for the map of this unit.

(106) Hawaii 31–*Mezoneuron kavaiense*–b (9,936 ac; 4,021 ha)

(i) See paragraph (k)(104)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(104)(ii) of this section for the map of this unit.

(107) Hawaii 32–*Bidens micrantha* ssp. *ctenophylla*–c (1,779 ac; 720 ha)

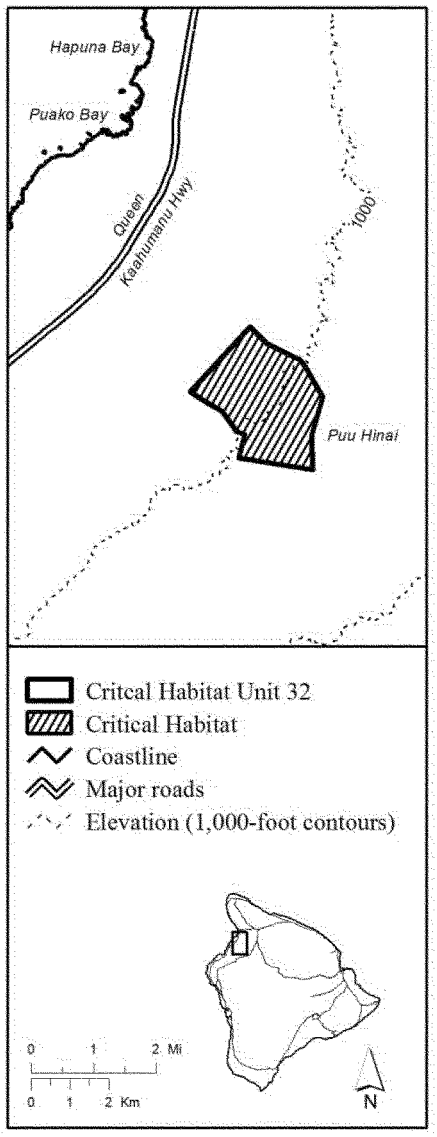
(i) [Reserved for textual description of Hawaii 32–*Bidens micrantha* ssp. *ctenophylla*–c.] This unit is also critical habitat for Hawaii 32–*Isodendrion pyrifolium*–c and Hawaii 32–*Mezoneuron kavaiense*–c (see paragraphs (k)(108) and (k)(109), respectively, of this section).

(ii) **NOTE:** Map 105 follows:

Map 105

Hawaii 32–*Bidens micrantha* ssp. *ctenophylla*–c, Hawaii 32– *Isodendrion pyrifolium* – c, Hawaii 32–*Mezoneuron kavaiense*–c

Lowland Dry



(108) Hawaii 32—*Isodendrion pyrifolium*–c (1,779 ac; 720 ha)

(i) See paragraph (k)(107)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(107)(ii) of this section for the map of this unit.

(109) Hawaii 32—*Mezoneuron kavaiense*–c (1,779 ac; 720 ha)

(i) See paragraph (k)(107)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(107)(ii) of this section for the map of this unit.

(110) Hawaii 33—*Bidens micrantha* ssp. *ctenophylla*–d (1,583 ac; 640 ha),

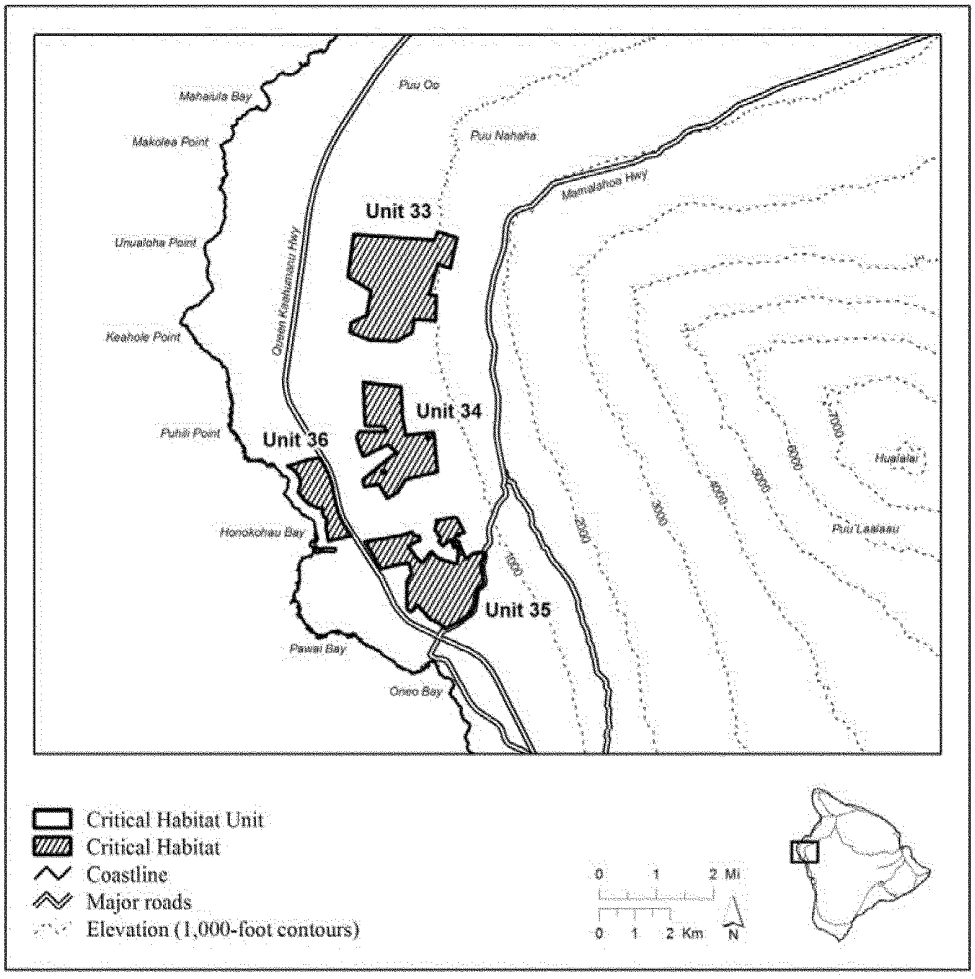
(i) [Reserved for textual description of Unit 33.] This unit is also critical habitat for Hawaii 33—*Isodendrion pyrifolium*–d and Hawaii 33—*Mezoneuron kavaiense*—d (see paragraphs (k)(111) and (k)(112), respectively of this section).

(ii) **NOTE:** Map 106 follows:

Map 106

**Hawaii 33–*Bidens micrantha* ssp. *ctenophylla*–d, Hawaii 33–*Isodendrion pyrifoliu*
**
d, Hawaii 33–*Mezoneuron kavaiense*–d; Hawaii 34–*Bidens micrantha* ssp.
ctenophylla*–e, Hawaii 34– *Isodendrion pyrifolium* –e, Hawaii 34–*Mezoneuron
***kavaiense*–e;**
**Hawaii 35–*Bidens micrantha* ssp. *ctenophylla*–f, Hawaii 35– *Isodendrion pyrifoliu*
**
f, Hawaii 35–*Mezoneuron kavaiense*–f; Hawaii 36–*Bidens micrantha* ssp.
***ctenophylla*–g, Hawaii 36–*Isodendrion pyrifolium*–g**

Lowland Dry



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(111) Hawaii 33—*Isodendrion pyrifolium*–d (1,583 ac; 640 ha)

(i) See paragraph (k)(110)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(112) Hawaii 33—*Mezoneuron kavaiense*–d (1,583 ac; 640 ha)

(i) See paragraph (k)(110)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(113) Hawaii 34—*Bidens micrantha* ssp. *ctenophylla*–e (961 ac; 389 ha)

(i) [Reserved for textual description of Unit 34.] This unit is also critical habitat for Hawaii 34—*Isodendrion pyrifolium*–e and Hawaii 34—*Mezoneuron kavaiense*–e (see paragraphs (k)(114) and (k)(115), respectively of this section).

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(114) Hawaii 34—*Isodendrion pyrifolium*–e (961 ac; 389 ha)

(i) See paragraph (k)(113)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(115) Hawaii 34—*Mezoneuron kavaiense*–e (961 ac; 389 ha)

(i) See paragraph (k)(113)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(116) Hawaii 35—*Bidens micrantha* ssp. *ctenophylla*–f (1,192 ac; 485 ha)

(i) [Reserved for textual description of Unit 35.] This unit is also critical habitat for Hawaii 35—*Isodendrion pyrifolium*–f and Hawaii 35—*Mezoneuron kavaiense*—f (see paragraphs (k)(117) and (k)(118), respectively of this section).

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(117) Hawaii 35—*Isodendrion pyrifolium*–f (1,192 ac; 485 ha)

(i) See paragraph (k)(116)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(118) Hawaii 35—*Mezoneuron kavaiense*–f (1,192 ac; 485 ha)

(i) See paragraph (k)(116)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(119) Hawaii 36—*Bidens micrantha* ssp. *ctenophylla*–g (402 ac; 163 ha)

(i) [Reserved for textual description of Unit 36.] This unit is also critical habitat for Hawaii 36—*Isodendrion pyrifolium*–g (see paragraph (k)(120) of this section).

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(120) Hawaii 36—*Isodendrion pyrifolium*–g (402 ac; 163 ha)

(i) See paragraph (k)(119)(i) of this section for the textual description of this unit.

(ii) See paragraph (k)(110)(ii) of this section for the map of this unit.

(121) Table of Protected Species Within Each Critical Habitat Unit for the Island of Hawaii

Unit name	Species occupied	Species unoccupied
Hawaii 1—*Clermontia lindseyana*–a	*Clermontia lindseyana*	*Clermontia lindseyana.*
Hawaii 1—*Clermontia peleana*–a	*Clermontia peleana*	*Clermontia peleana.*
Hawaii 1—*Clermontia pyrularia*–a		*Clermontia pyrularia.*
Hawaii 1—*Cyanea shipmanii*–a	*Cyanea shipmanii*	*Cyanea shipmanii.*
Hawaii 1—*Phyllostegia racemosa*–a	*Phyllostegia racemosa*	*Phyllostegia racemosa.*
Hawaii 2—*Clermontia lindseyana*–b	*Clermontia lindseyana*	*Clermontia lindseyana.*
Hawaii 2—*Clermontia pyrularia*–b	*Clermontia pyrularia*	*Clermontia pyrularia.*
Hawaii 2—*Phyllostegia racemosa*–b	*Phyllostegia racemosa*	*Phyllostegia racemosa.*
Hawaii 3—*Clermontia peleana*–b	*Clermontia peleana*	*Clermontia peleana.*
Hawaii 3—*Cyanea platyphylla*–a	*Cyanea platyphylla*	*Cyanea platyphylla.*
Hawaii 3—*Cyrtandra giffardii*–a	*Cyrtandra giffardii*	*Cyrtandra giffardii.*
Hawaii 3—*Cyrtandra tintinnabula*–a	*Cyrtandra tintinnabula*	*Cyrtandra tintinnabula.*
Hawaii 3—*Phyllostegia warshaueri*–a	*Phyllostegia warshaueri*	*Phyllostegia warshaueri.*
Hawaii 4—*Isodendrion hosakae*–a		*Isodendrion hosakae.*
Hawaii 4—*Isodendrion hosakae*–b		*Isodendrion hosakae.*
Hawaii 4—*Isodendrion hosakae*–c		*Isodendrion hosakae.*
Hawaii 4—*Isodendrion hosakae*–d		*Isodendrion hosakae.*
Hawaii 4—*Isodendrion hosakae*–e		*Isodendrion hosakae.*
Hawaii 4—*Isodendrion hosakae*–f	*Isodendrion hosakae*	*Isodendrion hosakae.*
Hawaii 4—*Vigna o-wahuensis*–a		*Vigna o-wahuensis.*
Hawaii 4—*Vigna o-wahuensis*–b		*Vigna o-wahuensis.*
Hawaii 4—*Vigna o-wahuensis*–c		*Vigna o-wahuensis.*
Hawaii 5—*Nothocestrum breviflorum*–a		*Nothocestrum breviflorum.*
Hawaii 6—*Nothocestrum breviflorum*–b	*Nothocestrum breviflorum*	*Nothocestrum breviflorum.*
Hawaii 7—*Pleomele hawaiiensis*–a	*Pleomele hawaiiensis*	*Pleomele hawaiiensis.*
Hawaii 8—*Clermontia drepanomorpha*–a	*Clermontia drepanomorpha*	*Clermontia drepanomorpha.*
Hawaii 8—*Phyllostegia warshaueri*–b	*Phyllostegia warshaueri*	*Phyllostegia warshaueri.*
Hawaii 9—*Achyranthes mutica*–a		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–b	*Achyranthes mutica*	*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–c		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–d		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–e		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–f		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–g		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–h		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–i		*Achyranthes mutica.*
Hawaii 9—*Achyranthes mutica*–j		*Achyranthes mutica.*
Hawaii 10—*Argyroxiphium kauense*–a		*Argyroxiphium kauense.*
Hawaii 10—*Bidens micrantha* ssp. *ctenophylla*–a		*Bidens micrantha* ssp. *ctenophylla.*
Hawaii 10—*Bonamia menziesii*–a		*Bonamia menziesii.*
Hawaii 10—*Colubrina oppositifolia*–a	*Colubrina oppositifolia*	*Colubrina oppositifolia.*
Hawaii 10—*Delissea undulata*–a		*Delissea undulata.*
Hawaii 10—*Delissea undulata*–b	*Delissea undulata*	*Delissea undulata.*

Unit name	Species occupied	Species unoccupied
Hawaii 10—*Hibiscadelphus hualalaiensis*–a	*Hibiscadelphus hualalaiensis*	*Hibiscadelphus hualalaiensis*.
Hawaii 10—*Hibiscus brackenridgei*–a	*Hibiscus brackenridgei*	*Hibiscus brackenridgei*.
Hawaii 10—*Isodendrion pyrifolium*–a		*Isodendrion pyrifolium*.
Hawaii 10—*Mezoneuron kavaiense*–a	*Mezoneuron kavaiense*	*Mezoneuron kavaiense*.
Hawaii 10—*Neraudia ovata*–a		*Neraudia ovata*.
Hawaii 10—*Nothocestrum breviflorum*–c	*Nothocestrum breviflorum*	*Nothocestrum breviflorum*.
Hawaii 10—*Pleomele hawaiiensis*–b	*Pleomele hawaiiensis*	*Pleomele hawaiiensis*.
Hawaii 10—*Solanum incompletum*–a		*Solanum incompletum*.
Hawaii 10—*Zanthoxylum dipetalum* ssp. *tomentosum*–a	*Zanthoxylum dipetalum* ssp. *tomentosum*.	*Zanthoxylum dipetalum* ssp. *tomentosum*.
Hawaii 11—*Cyanea hamatiflora* ssp. *carlsonii*–a	*Cyanea hamatiflora* ssp. *carlsonii*	*Cyanea hamatiflora* ssp. *carlsonii*.
Hawaii 11—*Solanum incompletum*–b		*Solanum incompletum*.
Hawaii 14—*Cyanea hamatiflora* ssp. *carlsonii*–b		*Cyanea hamatiflora* ssp. *carlsonii*.
Hawaii 15—*Cyanea hamatiflora* ssp. *carlsonii*–c		*Cyanea hamatiflora* ssp. *carlsonii*.
Hawaii 15—*Cyanea stictophylla*–a	*Cyanea stictophylla*	*Cyanea stictophylla*.
Hawaii 16—*Cyanea hamatiflora* ssp. *carlsonii*–d	*Cyanea hamatiflora* ssp. *carlsonii*	*Cyanea hamatiflora* ssp. *carlsonii*.
Hawaii 16—*Cyanea stictophylla*–b	*Cyanea stictophylla*	*Cyanea stictophylla*.
Hawaii 17—*Diellia erecta*–a	*Diellia erecta*	*Diellia erecta*.
Hawaii 17—*Flueggea neowawraea*–a	*Flueggea neowawraea*	*Flueggea neowawraea*.
Hawaii 18—*Colubrina oppositifolia*–b	*Colubrina oppositifolia*	*Colubrina oppositifolia*.
Hawaii 18—*Diellia erecta*–b	*Diellia erecta*	*Diellia erecta*.
Hawaii 18—*Flueggea neowawraea*–b	*Flueggea neowawraea*	*Flueggea neowawraea*.
Hawaii 18—*Gouania vitifolia*–a	*Gouania vitifolia*	*Gouania vitifolia*.
Hawaii 18—*Neraudia ovata*–d	*Neraudia ovata*	*Neraudia ovata*.
Hawaii 18—*Pleomele hawaiiensis*–c	*Pleomele hawaiiensis*	*Pleomele hawaiiensis*.
Hawaii 19—*Mariscus fauriei*–a	*Mariscus fauriei*	*Mariscus fauriei*.
Hawaii 20—*Sesbania tomentosa*–a	*Sesbania tomentosa*	*Sesbania tomentosa*.
Hawaii 21—*Ischaemum byrone*–a		*Ischaemum byrone*.
Hawaii 22—*Ischaemum byrone*–b	*Ischaemum byrone*	*Ischaemum byrone*.
Hawaii 23—*Pleomele hawaiiensis*–d	*Pleomele hawaiiensis*	*Pleomele hawaiiensis*.
Hawaii 23—*Sesbania tomentosa*–b	*Sesbania tomentosa*	*Sesbania tomentosa*.
Hawaii 24—*Argyroxiphium kauense*–b	*Argyroxiphium kauense*	*Argyroxiphium kauense*.
Hawaii 24—*Asplenium fragile* var. *insulare*–a	*Asplenium fragile* var. *insulare*	*Asplenium fragile* var. *insulare*.
Hawaii 24—*Cyanea stictophylla*–c		*Cyanea stictophylla*.
Hawaii 24—*Melicope zahlbruckneri*–a		*Melicope zahlbruckneri*.
Hawaii 24—*Phyllostegia velutina*–a	*Phyllostegia velutina*	*Phyllostegia velutina*.
Hawaii 24—*Plantago hawaiensis*–a	*Plantago hawaiensis*	*Plantago hawaiensis*.
Hawaii 25—*Argyroxiphium kauense*–c	*Argyroxiphium kauense*	*Argyroxiphium kauense*.
Hawaii 25—*Plantago hawaiensis*–b	*Plantago hawaiensis*	*Plantago hawaiensis*.
Hawaii 25—*Silene hawaiiensis*–a	*Silene hawaiiensis*	*Silene hawaiiensis*.
Hawaii 26—*Hibiscadelphus giffardianus*–a	*Hibiscadelphus giffardianus*	*Hibiscadelphus giffardianus*.
Hawaii 26—*Melicope zahlbruckneri*–b	*Melicope zahlbruckneri*	*Melicope zahlbruckneri*.
Hawaii 27—*Portulaca sclerocarpa*–a	*Portulaca sclerocarpa*	*Portulaca sclerocarpa*.
Hawaii 27—*Silene hawaiiensis*–b	*Silene hawaiiensis*	*Silene hawaiiensis*.
Hawaii 28—*Adenophorus periens*–a	*Adenophorus periens*	*Adenophorus periens*.
Hawaii 29—*Clermontia peleana*–c	*Clermontia peleana*	*Clermontia peleana*.
Hawaii 29—*Cyanea platyphylla*–b	*Cyanea platyphylla*	*Cyanea platyphylla*.
Hawaii 29—*Cyrtandra giffardii*–b		*Cyrtandra giffardii*.
Hawaii 29—*Cyrtandra tintinnabula*–b		*Cyrtandra tintinnabula*.
Hawaii 30—*Argyroxiphium kauense*–d	*Argyroxiphium kauense*	*Argyroxiphium kauense*.
Hawaii 30—*Clermontia lindseyana*–c	*Clermontia lindseyana*	*Clermontia lindseyana*.
Hawaii 30—*Cyanea shipmanii*–b	*Cyanea shipmanii*	*Cyanea shipmanii*.
Hawaii 30—*Cyanea shipmanii*–c		*Cyanea shipmanii*.
Hawaii 30—*Cyanea stictophylla*–d		*Cyanea stictophylla*.
Hawaii 30—*Cyrtandra giffardii*–c	*Cyrtandra giffardii*	*Cyrtandra giffardii*.
Hawaii 30—*Phyllostegia racemosa*–c		*Phyllostegia racemosa*.
Hawaii 30—*Phyllostegia velutina*–b	*Phyllostegia velutina*	*Phyllostegia velutina*.
Hawaii 30—*Plantago hawaiensis*–c	*Plantago hawaiensis*	*Plantago hawaiensis*.
Hawaii 30—*Sicyos alba*–a	*Sicyos alba*	*Sicyos alba*.
Hawaii 31—*Bidens micrantha* ssp. *ctenophylla*–b	*Bidens micrantha* ssp. *ctenophylla*	*Bidens micrantha* ssp. *ctenophylla*.
Hawaii 31—*Isodendrion pyrifolium*–b		*Isodendrion pyrifolium*.
Hawaii 31—*Mezoneuron kavaiense*–b	*Mezoneuron kavaiense*	*Mezoneuron kavaiense*.
Hawaii 32—*Bidens micrantha* ssp. *ctenophylla*–c		*Bidens micrantha* ssp. *ctenophylla*.
Hawaii 32—*Isodendrion pyrifolium*–c		*Isodendrion pyrifolium*.
Hawaii 32—*Mezoneuron kavaiense*–c	*Mezoneuron kavaiense*	*Mezoneuron kavaiense*.
Hawaii 33—*Bidens micrantha* ssp. *ctenophylla*–d		*Bidens micrantha* ssp. *ctenophylla*.
Hawaii 33—*Isodendrion pyrifolium*–d		*Isodendrion pyrifolium*.
Hawaii 33—*Mezoneuron kavaiense*–d	*Mezoneuron kavaiense*	*Mezoneuron kavaiense*.
Hawaii 34—*Bidens micrantha* ssp. *ctenophylla*–e	*Bidens micrantha* ssp. *ctenophylla*	*Bidens micrantha* ssp. *ctenophylla*.
Hawaii 34—*Isodendrion pyrifolium*–e		*Isodendrion pyrifolium*.
Hawaii 34—*Mezoneuron kavaiense*–e	*Mezoneuron kavaiense*	*Mezoneuron kavaiense*.
Hawaii 35—*Bidens micrantha* ssp. *ctenophylla*–f	*Bidens micrantha* ssp. *ctenophylla*	*Bidens micrantha* ssp. *ctenophylla*.
Hawaii 35—*Isodendrion pyrifolium*–f	*Isodendrion pyrifolium*	*Isodendrion pyrifolium*.
Hawaii 35—*Mezoneuron kavaiense*–f	*Mezoneuron kavaiense*	*Mezoneuron kavaiense*.

Unit name	Species occupied	Species unoccupied
Hawaii 36—*Bidens micrantha* ssp. *ctenophylla*–g	*Bidens micrantha* ssp. *ctenophylla*	*Bidens micrantha* ssp. *ctenophylla*.
Hawaii 36—*Isodendrion pyrifolium*–g		*Isodendrion pyrifolium*.

* * * * *

(l) *Plants on Hawaii; Constituent elements.*

(1) *Flowering plants.*

* * * * *

(1) *Plants on Hawaii; Constituent elements.*

(1) *Flowering plants.*

* * * * *

FAMILY ASTERACEAE:

Bidens micrantha ssp. *ctenophylla* (KOOKOOLAU)

Hawaii 10—*Bidens micrantha* ssp. *ctenophylla*–a, Hawaii 31—*Bidens micrantha* ssp. *ctenophylla*–b, Hawaii 32—*Bidens micrantha* ssp. *ctenophylla*–c, Hawaii 33—*Bidens micrantha* ssp. *ctenophylla*–d, Hawaii 34—*Bidens micrantha* ssp. *ctenophylla*–e, Hawaii 35—*Bidens micrantha* ssp. *ctenophylla*–f, and Hawaii 36—*Bidens micrantha* ssp. *ctenophylla*–g, identified in the legal descriptions in paragraph (k) of this section, constitute critical habitat for *Bidens micrantha* ssp. *ctenophylla* on Hawaii Island. In units Hawaii 10–*Bidens micrantha* ssp. *ctenophylla*–a, Hawaii 31—*Bidens micrantha* ssp. *ctenophylla*–b, Hawaii 32—*Bidens micrantha* ssp. *ctenophylla*–c, Hawaii 33—*Bidens micrantha* ssp. *ctenophylla*–d, Hawaii 34—*Bidens micrantha* ssp. *ctenophylla*–e, Hawaii 35—*Bidens micrantha* ssp. *ctenophylla*–f, and Hawaii 36—*Bidens micrantha* ssp. *ctenophylla*–g, the physical and biological features of critical habitat are:

(i) Elevation: Less than 3,300 ft (1,000 m).

(ii) Annual precipitation: Less than 50 in (130 cm).

(iii) Substrate: Weathered silty loams to stony clay, rocky ledges, little-weathered lava.

(iv) Canopy: *Diospyros, Erythrina, Metrosideros, Myoporum, Pleomele, Santalum, Sapindus.*

(v) Subcanopy: *Chamaesyce, Dodonaea, Osteomeles, Psydrax, Scaevola, Wikstroemia.*

(vi) Understory: *Alyxia, Artemisia, Bidens, Capparis, Chenopodium, Nephrolepis, Peperomia, Sicyos.*

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FAMILY FABACEAE:

Mezoneuron kavaiense (UHIUHI)

Hawaii 10—*Mezoneuron kavaiense*–a, Hawaii 31—*Mezoneuron kavaiense*–b, Hawaii 32—*Mezoneuron kavaiense*–c, Hawaii 33—*Mezoneuron kavaiense*–d, Hawaii 34—*Mezoneuron kavaiense*–e, and Hawaii 35—*Mezoneuron kavaiense*–f, identified in the legal descriptions in paragraph (k) of this section, constitute critical habitat for *Mezoneuron kavaiense* on Hawaii Island. In units Hawaii 10—*Mezoneuron kavaiense*–a, Hawaii 31—*Mezoneuron kavaiense*–b, Hawaii 32—*Mezoneuron kavaiense*–c, Hawaii 33—*Mezoneuron kavaiense*–d, Hawaii 34—*Mezoneuron kavaiense*–e, and Hawaii 35—*Mezoneuron kavaiense*–f, the physical and biological features of critical habitat are:

(i) Elevation: Less than 3,300 ft (1,000 m).

(ii) Annual precipitation: Less than 50 in (130 cm).

(iii) Substrate: Weathered silty loams to stony clay, rocky ledges, little-weathered lava.

(iv) Canopy: *Diospyros, Erythrina, Metrosideros, Myoporum, Pleomele, Santalum, Sapindus.*

(v) Subcanopy: *Chamaesyce, Dodonaea, Osteomeles, Psydrax, Scaevola, Wikstroemia.*

(vi) Understory: *Alyxia, Artemisia, Bidens, Capparis, Chenopodium, Nephrolepis, Peperomia, Sicyos.*

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FAMILY VIOLACEAE:

Isodendrion pyrifolium (WAHINE NOHO KULA)

Hawaii 10—*Isodendrion pyrifolium*–a, Hawaii 31—*Isodendrion pyrifolium*–b, Hawaii 32—*Isodendrion pyrifolium*–c, Hawaii 33—*Isodendrion pyrifolium*–d, Hawaii 34—*Isodendrion pyrifolium*–e, Hawaii 35—*Isodendrion pyrifolium*–f, and Hawaii 36—*Isodendrion pyrifolium*–g, identified in the legal descriptions in paragraph (k) of this section, constitute critical habitat for *Isodendrion pyrfolium* on Hawaii Island. In units Hawaii 10—*Isodendrion pyrifolium*–a, Hawaii 31—*Isodendrion pyrifolium*–b, Hawaii 32—*Isodendrion pyrifolium*–c, Hawaii 33—*Isodendrion pyrifolium*–d, Hawaii 34—*Isodendrion pyrifolium*–e, Hawaii 35—*Isodendrion pyrifolium*–f, and Hawaii 36—*Isodendrion pyrifolium*–g, the physical and biological features of critical habitat are:

(i) Elevation: Less than 3,300 ft (1,000 m).

(ii) Annual precipitation: Less than 50 in (130 cm).

(iii) Substrate: Weathered silty loams to stony clay, rocky ledges, little-weathered lava.

(iv) Canopy: *Diospyros, Erythrina, Metrosideros, Myoporum, Pleomele, Santalum, Sapindus.*

(v) Subcanopy: *Chamaesyce, Dodonaea, Osteomeles, Psydrax, Scaevola, Wikstroemia.*

(vi) Understory: *Alyxia, Artemisia, Bidens, Capparis, Chenopodium, Nephrolepis, Peperomia, Sicyos.*

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Dated: September 13, 2012.

Michael Bean,

Acting Principal Deputy Assistant Secretary for Fish and Wildlife and Parks.

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