United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2010-F-0190

MAY 13 2010

Ms. Sharon Thomas
Environmental Protection Specialist
Department of Energy
Washington, DC 20585

Subject: Formal Endangered Species Section 7 Consultation on the U.S. Department of Energy Federal Loan Guarantee to Kahuku Wind Power, LLC, Oahu, Hawaii

Dear Ms. Thomas:

This transmits the biological opinion of the U.S. Fish and Wildlife Service (USFWS) on the potential impacts of the Department of Energy's (DOE) proposed issuance of a federal loan guarantee to Kahuku Wind Power, LLC, for the construction and operation of a 30 megawatt (MW) wind power generation facility in Kahuku, Oahu, Hawaii, pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531, *et seq.*). The USFWS received your March 5, 2010, letter requesting initiation of consultation on March 9, 2010, with the attached Kahuku Wind Power Habitat Conservation Plan (HCP) pursuant to Hawaii Revised Statutes (HRS) §195D and the DOE draft Environmental Assessment (DOE/EA-1726) pursuant to the National Environmental Policy Act (NEPA) (42 USC 4321, *et seq.*).

The proposed project consists of twelve 2.5 MW wind turbine generators (WTGs), an operations and maintenance building, one permanent unguyed meteorological (met) tower, one on-site and two off-site microwave towers, an electrical substation, Battery Energy Storage System (BESS), re-configuration of overhead transmission lines, an underground collection system, and a network of unpaved service roadways. Based on the information you provided and pertinent information in our files, this consultation will address the effects of the proposed action to the federally endangered Hawaiian stilt or aeo (*Himantopus mexicanus knudseni*), Hawaiian coot alae keokeo (*Fulica alai*), Hawaiian moorhen or alae ula (*Gallinula chloropus sandvicensis*), and Hawaiian duck or koloa (*Anas wyvilliana*), Hawaiian hoary bat or opeapea (*Lasiurus cinereus semotus*), and Hawaiian petrel or uau (*Pterodroma sandwichensis*); and the threatened Newell's shearwater or ao (*Puffinis auricularis newelli*).

Plant Critical Habitat within HCP Mitigation Areas

Makamakaole

Designated critical habitat of two endangered plants, *Cyrtandra munroi* and *Clermontia oblongifolia* ssp. *mauiensis*, occurs in the vicinity of the Makamakaole site proposed as seabird mitigation under the HCP. It is unknown whether individuals of these plant species actually occur in the area, however, fence construction and monitoring, predator control, social attraction studies, and habitat management activities may adversely affect listed plants and their designated critical habitat. We estimate that fence construction and monitoring may impact up to three acres of plant critical habitat. Overall, up to137 acres (ac)(52 hectares (ha)) of *Cyrtandra munroi* and 95 ac (38 ha) of *Clermontia oblongifolia* ssp. *mauiensis* critical habitat may be affected. See Table 1 below for approximate area of critical habitat for each species that may be impacted.

In order to avoid and minimize impacts to listed plants and critical habitat, Kahuku Wind Power will hire a qualified botanist to survey the area and proposed fenceline prior to construction and implementation of management activities. Any listed or candidate plant species discovered in the area would be clearly flagged, and appropriate protocols would be used to avoid direct or indirect impacts to listed plants. Fence contractors will be educated regarding the sensitivity of this project including working in critical habitat. To minimize soil erosion and impacts to the habitat, only the minimal amount of clearing will be done in order for the fence to be built. Common species of native plants will be removed only when necessary, and removal of native plants greater than 6 inches in diameter will be avoided as much as possible. Cut vegetation will be left to decompose. Gear-cleaning procedures to reduce the introduction of noxious plant seeds and propagules, as well as arthropods such as exotic ants will be strongly enforced for biologists and/or contractors.

We expect the disturbance to be short-term as native vegetation will regenerate post construction, and at least 100 acres will be protected by the fence providing benefits such as reduced herbivory and trampling by feral pigs. By implementing the measures described above, adverse impacts to listed plant species and their critical habitat will be insignificant. Impacts of fence construction and monitoring, and habitat management are not anticipated to adversely affect designated critical habitat at Makamakaole and, therefore, are not analyzed further in this opinion.

Haleakala National Park

Designated critical habitat for the threatened Haleakala silversword or *Argyroxiphium sandwicense* spp. *macrocephalum* occurs in the vicinity of the proposed mitigation site for the Hawaiian petrel at Haleakala National Park. Predator control activities such as placement of traps and bait stations, as well as increased foot traffic through the area for deployment of monitoring of traps may adversely impact the silversword and its critical habitat. Approximately, 219 ac (86 ha) of silversword critical habitat may be affected. In order to avoid and minimize impacts, all listed individuals in the vicinity would be clearly flagged, and appropriate protocols would be used to avoid direct or indirect impacts to listed plants. Gear-cleaning procedures to reduce the introduction of noxious plant seeds and propagules, as well as arthropods such as exotic ants will be strictly enforced for biologists and/or contractors.

By implementing the measures described above, adverse impacts to the threatened Haleakala silversword and its critical habitat will be insignificant. Impacts of predator control and monitoring are not anticipated to adversely affect designated critical habitat at Makamakaole and, therefore, are not analyzed further in this opinion.

Polipoli – Kula Forest Reserve

Designated critical habitat of several plant species, *Argyroxiphium sandwicense* ssp. *macrocephalum*, *Bidens micrantha* ssp. *kalealaha*, *Clermontia lindseyana*, *Diellia erecta*, and *Geranium arboretum* occurs in the vicinity of the Polipoli section of Kula Forest Reserve proposed as mitigation for the Hawaiian hoary bat. Increased foot traffic and the potential introduction of non-native species associated with the proposed mitigation (supplemental planting to replace seedling mortality, implementation of rodent control, weed control and fertilization programs to enhance tree seedling survival and forest establishment) may adversely impact the listed species and their critical habitat.

In order to avoid and minimize impacts to listed plants and critical habitat, all restoration materials will be certified weed-free and appropriate BMPs would be implemented by the contractor during the native plant restoration. Gear-cleaning procedures to reduce the introduction of noxious plant seeds and propagules, as well as arthropods such as exotic ants will be strongly enforced for biologists and/or contractors.

By implementing the measures described above, adverse impacts to listed plant species and their critical habitat will be insignificant. Instead forest restoration activities are expected to improve habitat quality for listed species, therefore, the impacts of the proposed mitigation at Polipoli are not anticipated to adversely affect designated critical habitat and, therefore, are not analyzed further in this opinion.

Table 1. Estimate of Designated Plant Critical Habitat within HCP Mitigation Areas

SPECIES NAME	Acres	Hectares
Makamakaole		
Clermontia oblongifolia ssp. *mauiensis*	95.0	38.0
Cyrtandra munroi	127.0	52.0
Haleakala		
Argyroxiphium sandwicense spp. *macrocephalum*	219.0	86.6
Kula Forest Reserve		
Argyroxiphium sandwicense ssp. *macrocephalum*	486.4	196.8
Bidens micrantha ssp. *kalealaha*	44.7	18.1
Clermontia lindseyana	148.3	60.0
Diellia erecta	5.5	2.2
Geranium arboreum	1,228.9	497.3
TOTAL	**2,354.8**	**951.1**

This consultation is based on information gained through meetings, site visits, telephone conversations, electronic mail, References (see Consultation History) and other information available to us. A full administrative record is available at Pacific Islands Fish and Wildlife Office (PIFWO).

CONSULTATION HISTORY

In November 2007, the USFWS was contacted by a representative of UPC Wind, LLC, on behalf of Kahuku Wind Power, LLC, regarding a potential wind energy generation project in Kahuku, Oahu, Hawaii. Initially, PIFWO began working with biologists of the State of Hawaii Division of Forestry and Wildlife (DOFAW) to assist Kahuku Wind Power, LLC with the development of an HCP for the issuance of both a federal incidental take permit under section 10(a)(1)(B) of the ESA and an incidental take license under HRS §195D to address impacts to state and federally listed species. However, upon selection of Kahuku Wind Power, LLCs application for the proposed federal loan guarantee and subsequent discussions amongst the agencies, it was decided that DOE is required to consult with the USFWS under section 7 of the ESA to address impacts to federally listed species. Since then PIFWO has continued to work with DOFAW to assist Kahuku Wind Power, LLC with the development of an HCP that meets requirements of State law (HRS §195D), but also addresses potential impacts to federally listed species. The final Kahuku Wind Power Habitat Conservation Plan (March 2010) and Draft Environmental Assessment for the Department of Energy Loan Guarantee to Kahuku Wind Power, LLC for Construction of the Kahuku Wind Power Facility in Kahuku, Oahu, Hawaii (DOE/EA-1726), are hereby incorporated as the Biological Assessment for this consultation.

November 2007 to October 2008 – PIFWO and DOFAW staff participated in meetings, site visits, and review of preliminary biological data and reports provided by Kahuku Wind Power, LLC.

November 2008 – Kahuku Wind Power, LLC, submitted a pre-application to the DOFAW to initiate the State HCP process.

April 29, 2009 –Joseph Marhamati, NEPA Specialist, DOE Loan Guarantee Program Office (DOE), contacted James Kwon, Fish and Wildlife Biologist, Pacific Islands Fish and Wildlife Office (PIFWO) via electronic mail inquiring about the status of a draft environmental assessment submitted with Kahuku Wind Powers DOE Loan Guarantee application.

May 22, 2009 – DOEs Loan Program Guarantee Office notified Kahuku Wind Power, LLC that the project was selected for due diligence review.

June 19, 2009 – Ling Ong, Fish and Wildlife Scientist, SWCA (Steve W. Carothers and Associates (SWCA) Environmental Consultants on behalf of Kahuku Wind Power, LLC, emailed the PIFWO and DOFAW notifying the agencies that the revised draft Habitat Conservation Plan was available on the SWCA FTP website.

July 16, 2009 – The State Endangered Species Recovery Committee (ESRC) approved the draft HCP and submitted its recommendation for release for public review to the State Board of Land Natural Resources (BLNR). The PIFWO is one of seven members of the ESRC. State law requires consultation with the ESRC prior to issuance of a temporary license as part of a Habitat Conservation Plan which may authorize incidental take of threatened and endangered species.

August 2009 – Sharon Thomas, Environmental Protection Specialist (DOE), emailed James Kwon (PIFWO) inquiring about the participation of the USFWS in the environmental review process for DOEs proposed loan guarantee to Kahuku Wind Power, LLC.

August 24, 2009 – James Kwon (PIFWO) emailed Sharon Thomas (DOE) declining the role of USFWS as a Cooperating Agency under NEPA, supporting DOEs role as the lead Federal agency, requesting the opportunity to review the sections of the DOEs NEPA document relevant to fish and wildlife resources and their habitats.

August 27, 2009 – James Kwon (PIFWO) and Sharon Thomas (DOE) participated in a conference call and discussed the formal consultation process under Section 7 of the ESA.

November 4, 2009 – State of Hawaii Department of Land and Natural Resources conducted a public meeting for the draft Kahuku Wind Power HCP in Haleiwa, Oahu.

November 12, 2009 – James Kwon and Jeff Newman (PIFWO) presented comments on the draft HCP to Ling Ong and Tiffany Thair (SWCA), and Dave Cowan and Greg Spencer (Kahuku Wind Power, LLC).

November 13, 2009 – DOE sent a letter notifying the State of Hawaii Office of Environmental Quality Control (OEQC) of the decision to prepare an Environmental Assessment in accordance with NEPA.

December 4, 2009 – Norma Bustos, Lauren Goodmiller, Jason Misaki (DOFAW); James Kwon (PIFWO); and Ling Ong and Steve Mosher (SWCA) met and discussed a preliminary draft of a mitigation plan for endangered waterbirds.

December 23, 2009 – Dave Cowan (Kahuku Wind Power, LLC) transmitted via email a revised version of the draft HCP to DOFAW for submittal to the State ESRC for review.

January 12, 2010 – Sharon Thomas (DOE); Dave Cowan (Kahuku Wind Power, LLC); Kim McCormick (Environmental Permitting Counsel to Kahuku Wind Power, LLC); James Kwon, Jeff Newman, Patrice Ashfield (PIFWO); and Tiffany Thair and Ling Ong (SWCA) participated in a conference call to discuss the formal consultation process.

January 22, 2010 – Norma Bustos, Lauren Goodmiller, Jason Misaki (DOFAW); James Kwon (PIFWO); and Ling Ong and Steve Mosher (SWCA) met and discussed revisions to the Waterbird Mitigation Plan proposed in the draft HCP.

February 7, 2010 – Ling Ong (SWCA) emailed PIFWO and DOFAW notifying the agencies of the availability of a revised version of the draft HCP on the SWCA FTP site.

February 12, 2010 – Jeff Newman and James Kwon (PIFWO); Scott Fretz and Lauren Goodmiller (DOFAW) discussed outstanding issues in the draft HCP.

February 17, 2010 – Dave Cowan and Greg Spencer (Kahuku Wind Power); Jeff Newman (USFWS); Ling Ong (SWCA) met prior to and during the ESRC site visit to Kahuku Wind Power.

February 18, 2010 – ESRC approved a recommendation with contingencies for the draft HCP to be recommended for final approval by the BLNR.

February 23, 2010 – Representatives of Kahuku Wind Power, LLC, DOFAW, and PIFWO met to discuss the HCP conservation program.

February 25, 2010 - Ling Ong (SWCA) emailed PIFWO and DOFAW notifying the agencies of the availability of a revised version of the draft HCP on the SWCA FTP site.

February 25, 2010 – James Kwon (PIFWO) sent additional comments on the HCP via electronic mail to SWCA and Kahuku Wind Power, LLC.

February 26, 2010 – DOE sent a letter notifying OEQC of the availability of the draft Environmental Assessment for the proposed loan guarantee to Kahuku Wind Power, LLC

March 1, 2010 – Ling Ong (SWCA) emailed PIFWO and DOFAW notifying the agencies of the availability of the final version of the draft HCP for submission to the BLNR on the SWCA FTP site.

March 9, 2010 – The PIFWO received DOE's March 5, 2010, letter requesting initiation of formal consultation.

March 11, 2010 – The BLNR approved the HCP pending review by the State of Hawaii Attorney Generals Office.

March 18, 2010 – Ling Ong (SWCA) posted an updated version of Final HCP with minor revisions on the SWCA FTP site.

March 31, 2010 – The PIFWO sent a letter to DOE acknowledging that their request contained all the required information to initiate consultation pursuant to 50 CFR §402.14.

April 1, 2010 – Sharon Thomas (DOE), Ling Ong and Tiffany Thair (SWCA), Dave Cowan (Kahuku Wind Power), Megan Laut and James Kwon (PIFWO) met to discuss USFWS comments on the draft EA. It was also determined that the proposed HCP mitigation areas overlap with designated plant critical habitat of several plant species on Maui.

Background

The Energy Policy Act of 2005 established a federal loan guarantee program for eligible energy projects that employ innovative technologies. In February 2009, Kahuku Wind Power, LLC, submitted an application for a loan guarantee in response to DOEs June 2008 solicitation for proposals. Kahuku Wind Power, LLC is proposing to integrate installation of Xtreme Powers Battery Energy Storage System (BESS) and the Clipper Liberty™ wind turbine generators

(WTGs), two new or significantly improved technologies compared to commercial technologies currently available in the U.S.

Kahuku Wind Power, LLC is a subsidiary of First Wind, a Boston-based wind energy generation firm, and was created for the express purpose of developing a new wind generation facility in Kahuku, Oahu. First Wind is also the parent company of Kaheawa Wind Power, LLC (KWP), which operates a 30 MW wind energy facility at Kaheawa Pastures, Maui, and Kaheawa Wind Power II, LLC (KWPII), which has proposed a 21 MW wind energy facility immediately adjacent. KWP is operating in Year 4 of 20 of the Kaheawa Pastures Wind Energy Facility HCP and State Incidental Take License (ITL-08) and Federal Incidental Take Permit (TE-118901-0) which include measures to avoid, minimize, and mitigate impacts to Hawaiian petrel, Newell's shearwater, Hawaiian hoary bat, and the Hawaiian goose or nene (*Branta sandvicensis*).

BIOLOGICAL OPINION

Description of the Proposed Action

Wind Energy Facility Project Design and Components

The DOE proposes to issue a Federal loan guarantee to Kahuku Wind Power, LLC in support of construction and operation of the proposed 30 MW Kahuku Wind Power facility in Kahuku, Oahu, Hawaii. The area of the proposed wind energy facility is approximately 578 ac (234 hectares (ha) in the community of Kahuku in the Koolauloa District on the northeastern portion of Oahu. The project area includes two parcels (Tax Map Key (TMK) 5-6-005:007 and 5-6- 5:014) owned by Kahuku Wind Power, LLC, located roughly 0.2 miles (mi) (0.3 kilometers (km)) mauka (inland) of Kamehameha Highway, 1.25 mi (2 km) northwest of Kahuku Town, and 1.2 mi (2 km) southeast of the entrance to Turtle Bay Resort (Figure 1). The project area is accessible via Charlie Road off Kamehameha Highway. It is bounded on the east by pasture and agricultural lands along the Kamehameha Highway and on the west and south by agricultural land owned by the State of Hawaii. The north and northwestern portions abut a ti (*Cordyline fruticosa*) plantation and a training facility for the Union of Operating Engineers. The southwest portion of the project area is bordered by federal land including the U.S. Army Kahuku Training Range. The James Campbell National Wildlife Refuge (NWR) lies nearby to the east (makai or seaward) of Kamehameha Highway. The two off-site microwave tower sites are located in the Waialua District on the northern portion of Oahu.

The proposed facility would consist of 12 Clipper Liberty™ 2.5-MW WTGs, an operations and maintenance building, one permanent unguyed met tower, seven microwave dishes, one on-site and two off-site microwave towers, an electrical substation, a Battery Energy Storage System (BESS), reconfiguration of existing overhead electrical lines, and a network of unpaved service roadways. Each turbine pad is approximately 1.78 ac (0.72 ha) in size. Each turbine site would consist of a pad-mounted transformer, power distribution panel, turbine tower, and gravel access drive and buffer area. An additional 1.30 ac (0.53 ha) surrounding each turbine site would be temporarily disturbed during construction and revegetated following completion of the turbine components.

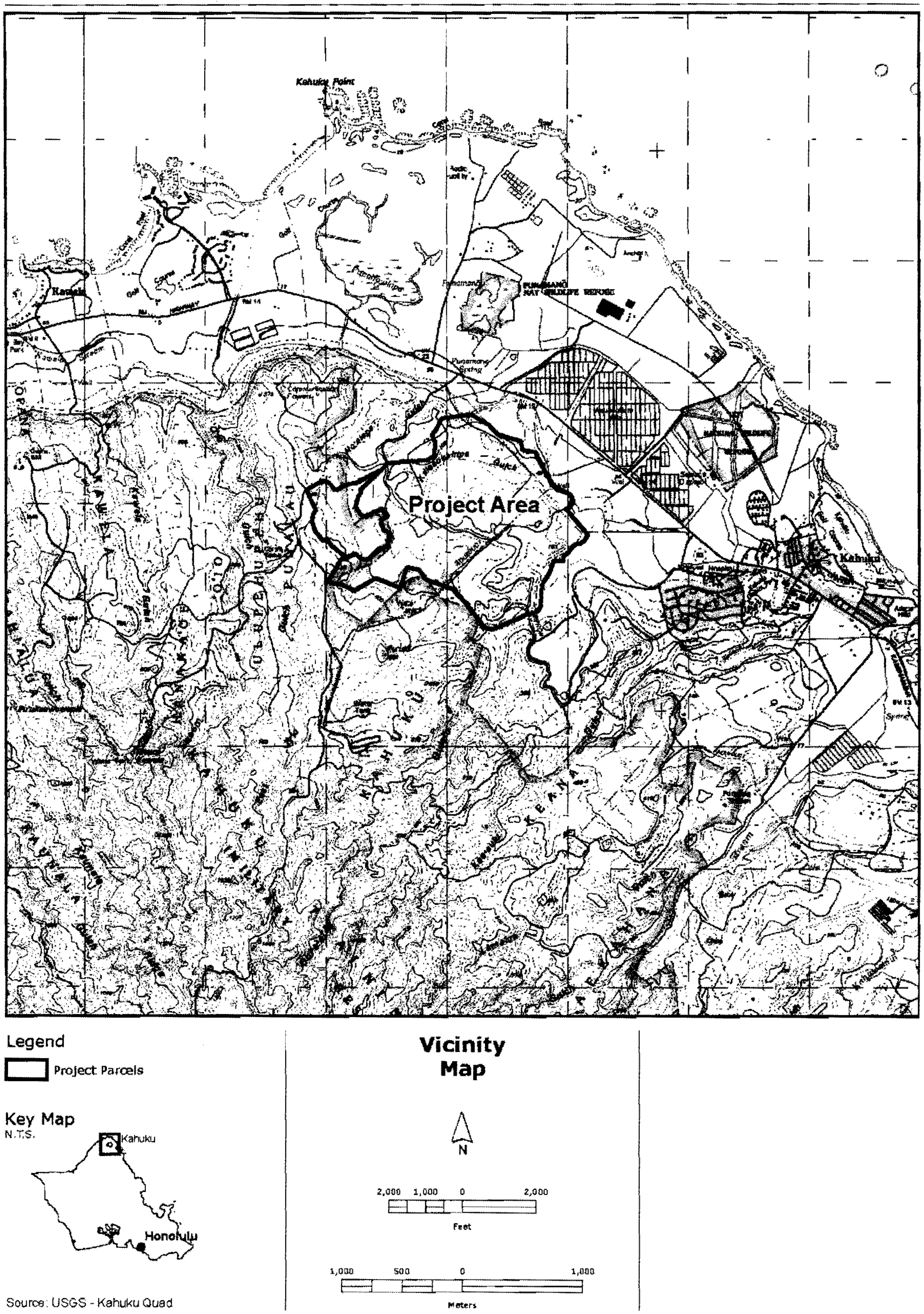

Figure 1. Kahuku Wind Power Project Location (Source: Draft DOE/EA-1726)

The towers proposed for the project are approximately 262 ft (80 m) in height. The proposed rotor blades are approximately 153 ft (47 m) in length. Thus, the maximum height of the turbines from tower base to highest blade tip would be 420 ft (128 m). The turbines would be arranged in four arrays consisting of three in each row (Figure 2). Prior to construction, three temporary met towers will be present on site for a period of up to four months for power-curve testing[1] and dismantled prior to the erection of the turbines. All temporary met towers are guyed. One permanent unguyed 262 ft (80 m) tall met tower would be erected during construction and remain for the duration of the project. This permanent met tower will have a concrete foundation approximately 625 ft^2 (58 m^2) in area.

The proposed project would include construction of a fenced base yard, which would contain three structures – the operations and maintenance (O&M) building, Battery Energy Storage System (BESS) enclosure, and the electrical substation. The single-story O&M building would house operation personnel, wind generating facility controls, and maintenance equipment and spare parts. This building would be 7,000 ft^2 (650 m^2) and have a maximum height of 29 ft (8.8 m). The electrical substation would feed electricity into an existing Hawaiian Electric Company (HECO) electrical transmission line and would consist of a control building, 34-kilovolt (KV) column/recloser, transformer, and an "A" frame circuit breaker. The proposed BESS enclosure would be built immediately adjacent to the substation and consist of a 10,675 ft^2 (992 m^2) building roughly 25 ft (7.6 m) high to house the components of the BESS and the HECO Control Room.

The proposed action would involve building three new microwave towers in separate locations to provide secure high-speed communications between Kahuku Wind Power and HECOs system on Oahu. One of the three towers would be built on-site for transmitting data, control, and protective relaying functions to the HECO substations. This tower would be approximately 30 ft (9.1 m) tall and built on a concrete foundation approximately 144 ft^2 (13.5 m^2) in area.

Two other microwave towers would be erected off-site (Figure 3). One tower would be located at the HECO Waialua Substation in Haleiwa at 66-011 Waialua Beach Road in a rural residential area in Haleiwa. This site is roughly 11.1 mi (17.8 km) from the Kahuku project area. This tower would be approximately 60 ft (18 m) in height and built on a concrete foundation approximately 169 ft^2 (16 m^2) in area. The second new microwave tower would be located on agricultural land at "Flying R Ranch" in Waialua. This site is owned by Waialua Ranch Partners. The Flying R Ranch site is located 13.6 mi (21.9 km) southwest of the Kahuku project area and 2.6 mi (4.2 km) southwest of the Waialua. The height of the Flying R R
would be approximately 40 ft (12 m). Similar to the Waialua microwave tower, t
be built on a 169 ft^2 concrete foundation. Approximately 1,000 linear ft (305 m) of overhead cable, supported on wooden poles approximately 50 ft (15 m) high, would be required to transmit electricity from the nearest existing HECO electrical distribution line to the proposed Flying R Ranch microwave tower. This overhead line will be installed, owned and maintained by HECO. Once the installation of both microwave towers are completed, HECO will assume the ownership and maintenance of both off-site microwave towers.

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[1] Power curve testing is a process by which the future performance of individual turbines is predicted by correlating the overall wind measurements at the site over a year or more, to temporary met towers erected at specific turbine sites for a shorter time period, usually on the order of 2-4 months.

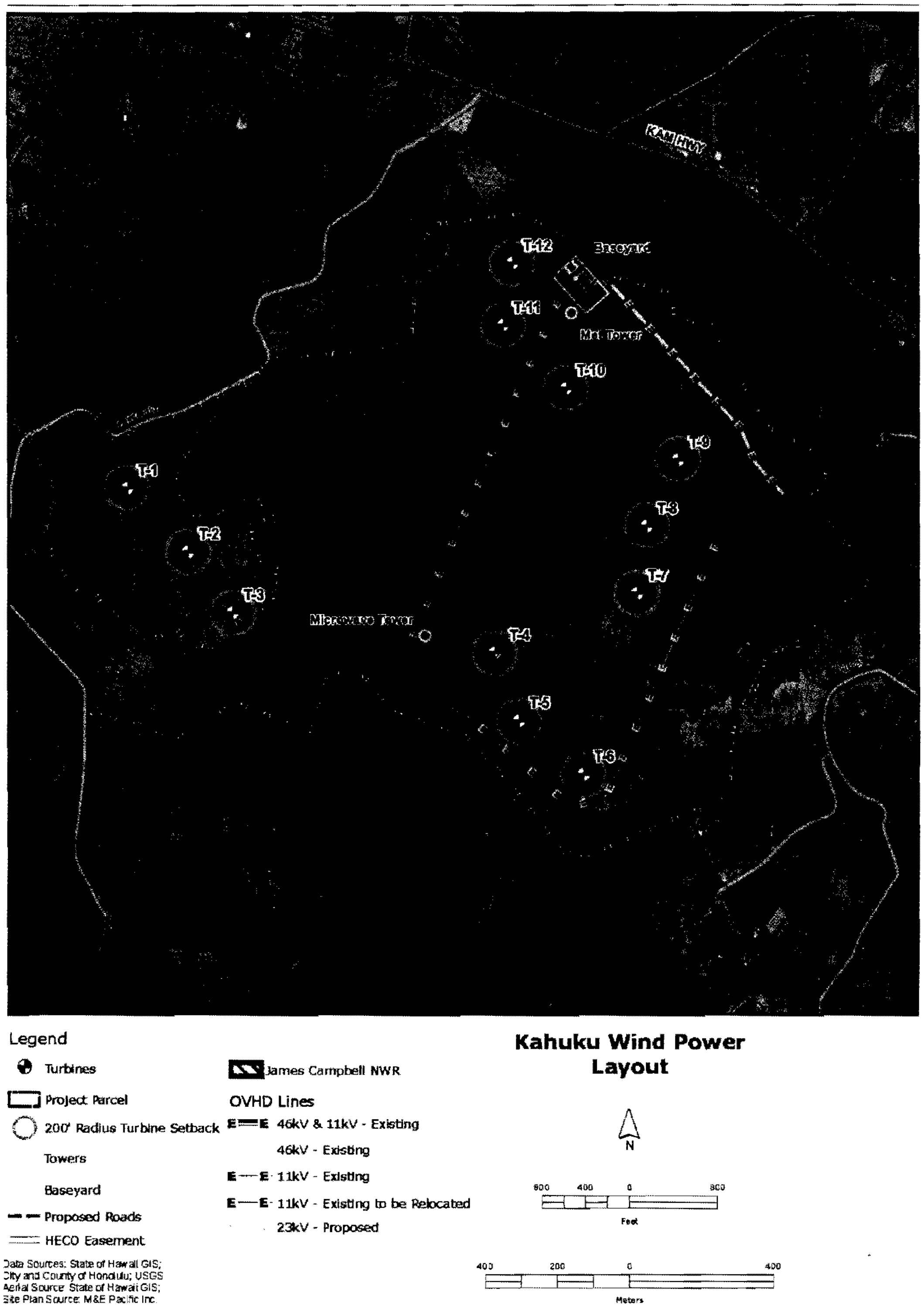

Figure 2. Kahuku Wind Power Project Site Layout (Source: Draft DOE/EA-1726)

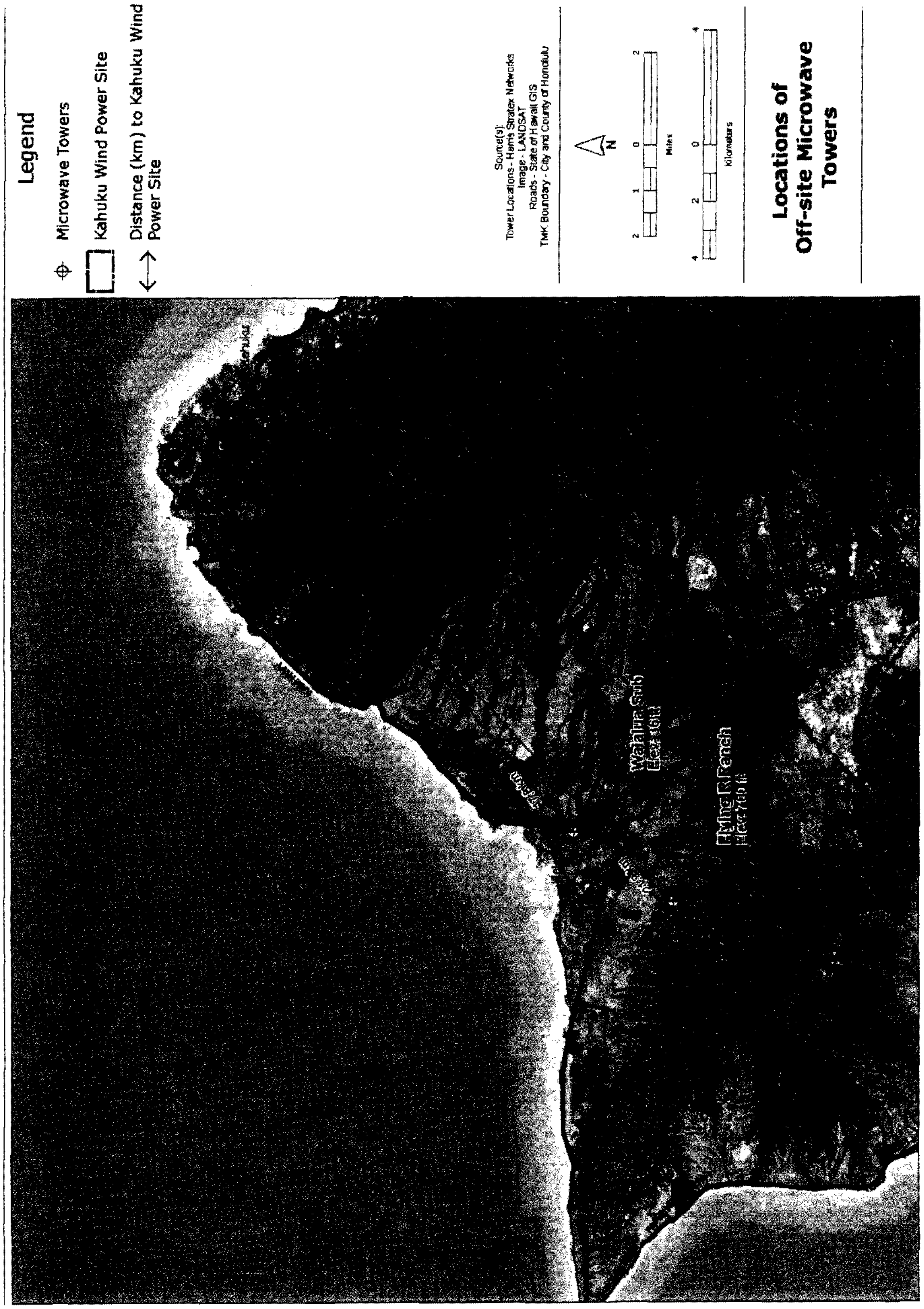

Figure 3. Off-site Microwave Tower Locations (Source: Draft DOE/EA-1726)

Electrical power generated by the WTGs would be transformed and collected through a network of underground and overhead collection circuits. The underground collection cables would total approximately 11,000 linear ft (3,353 m) and would be buried in trenches approximately 3.0 ft (0.9 m) wide and 4.0 ft (1.2 m) deep and backfilled to finish grade. Disturbed areas would be reveg etated following excavation and burying of cables.

The overhead segment of the collection system would bring electrical output from the furthest six WTGs to the substation. This segment is overhead rather than underground because of the difficult terrain of the area and the presence of Kalaeokahipa Gulch, which is subject to discretionary U.S. Army Corps of Engineers jurisdiction. The overhead cable would be approximately 3,000 linear ft (914 m) and would be supported on approximately 15 new wooden utility poles roughly 45 ft (14 m) in height (Figure 1).

No new transmission lines would be constructed as part of the project; however, HECO will relocate an existing 11-kV electrical distribution line toward the southwestern boundary of the project area to accommodate construction of the WTGs (Figure 1). This existing line is 2,937 linear ft (895 m) long and the relocated line will be 4,217 linear ft (1,286 m) long, approximately 1,280 linear ft (390 m) longer than the existing line. Similar to the existing line, the relocated line will be supported on wooden poles. The relocation of the distribution line will be cleared of vegetation to a width of approximately 15 ft (4.5 m). All existing transmission lines and distribution lines (including the relocated line) will be owned and maintained by HECO. The collection lines for the WTGs mentioned in the previous paragraph will be owned and maintained by Kahuku Wind Power LLC.

Habitat Conservation Plan

DOE's proposed issuance of the Federal loan guarantee incorporates the Kahuku Wind Power Habitat Conservation Plan and State Incidental Take License (ITL-10) (hereafter "HCP"). Kahuku Wind Power, LLC is responsible for implementing the terms and conditions of the HCP and Implementing Agreement over the 20-year license term. The HCP addresses potential impacts to the federally endangered Hawaiian stilt or aeo (*Himantopus mexicanus knudseni*), Hawaiian coot alae keokeo (*Fulica alai*), Hawaiian moorhen or alae ula (*Gallinula chloropus sandvicensis*), and Hawaiian duck or koloa (*Anas wyvilliana*), Hawaiian hoary bat or opeapea (*Lasiurus cinereus semotus*), and Hawaiian petrel or uau (*Pterodroma sandwichensis*); the threatened Newell's shearwater or ao (*Puffinis auricularis newelli*); and state endangered pueo or Hawaiian owl (*Asio flammeus sandwichensis*) (hereafter "covered species") as a result of construction and operation of the proposed 30 MW wind power facility (Table 2).

Table 2. Impacts to listed species authorized by the Kahuku Wind Power HCP (March 2010).

Common Name	Scientific Name	Mitigation Tier	Annual Take Limit	Five (5) Year Take Limit	Twenty (20) Year Take Limit
Uau (Hawaiian petrel)	*Pterodroma sandwichensis*	***Baseline***	*4*	*8*	*8*
		Higher	*8*	*12*	**12**

Common Name	Scientific Name	Mitigation Tier	Annual Take Limit	Five (5) Year Take Limit	Twenty (20) Year Take Limit
Ao (Newell's shearwater)	*Puffinus auricularis newelli*	***Baseline***	*3*	*9*	*12*
		Higher	*6*	*12*	**18**
Koloa maoli (Hawaiian duck)	*Anas wyvilliana*	***Baseline***	*4*	*12*	*16*
		Higher	*8*	*16*	**24**
Aeo (Hawaiian stilt)	*Himantopus mexicanus knudseni*	***Baseline***	*3*	*9*	*12*
		Higher	*6*	*12*	**18**
Alae keokeo (Hawaiian coot)	*Fulica alai*	***Baseline***	*3*	*9*	*12*
		Higher	*6*	*12*	**18**
Alae ula (Hawaiian moorhen)	*Gallinula chloropus sandvicensis*	***Baseline***	*4*	*10*	*14*
		Higher	*7*	*14*	**20**
Opeapea (Hawaiian hoary bat)	*Lasiurus cinereus semotus*	***Baseline***	*7*	*18*	*21*
		Higher	*14*	*21*	**32**

The HCP provides measures to avoid and minimize impacts to covered species as well as a tiered mitigation program that is expected to result in a net benefit to the covered species. The HCP includes monitoring and reporting, adaptive management, and measures to address changed circumstances. Finally, the HCP provides funding assurances to ensure implementation of the afore-mentioned HCP-related actions.

Avoidance and Minimization Measures

Kahuku Wind Power, LLC has incorporated several measures to avoid and minimize the risk of project impacts to covered and other wildlife species, and to minimize impact on the human environment at the proposed wind energy facility in Kahuku, Hawaii. These measures include, but are not necessarily limited to:

- Using "monopole" steel tubular turbine towers rather than lattice towers. Tubular towers are considerably more visible than lattice towers and should reduce collision risk;
- The use of an unguyed instead of a guyed permanent met tower for the project site;
- Marking guy wires on temporary certification met towers (scheduled to be in place for approximately four months) with high visibility bird diverters made of spiraled PVC and twin 12 inch white poly vinyl marking tape to improve the visibility of the wires;
- Utilizing a rotor with a significantly slower rotational speed (9.6 – 15.5 rpm) compared to

older designs (28.5 - 34 rpm). This increases the visibility of turbine blades during operation and decreases collision risk;

- Placing new power collection lines underground to the extent practicable to minimize the risk of collision with new wires. All overhead collection lines will be spaced according to Avian Power Line Interaction Committee ((Avian Powerline Interaction Committee (APLIC) 1994)) guidelines to prevent possible electrocution of the Hawaiian short-eared owl. The horizontal spacing will be at least 30 inches (75 cm, based on estimated wrist-to-wrist distance), the vertical spacing at least 15 inches (38 cm, head-to-foot length) with adequate spacing between the conductors. Any jumper wires will be insulated;

- Improving drainage in areas to eliminate the accumulation of standing water after a period of heavy rains to minimize potential of attracting waterbirds to the site;

- Where feasible, minimizing night-time construction activities to avoid the use of lighting that could attract seabirds and possibly bats. If night-time lighting for construction activities is required, a biologist will be provided on-site to monitor for seabird and bat activity;

- Refraining from clearing of trees for construction at the times of the year when non-volent Hawaiian hoary bats juveniles may be present on the project site (June to August);

- Use of minimal on-site lighting at buildings and using shielded fixtures that will be utilized only on infrequent occasions when workers are at the site at night;

- A speed limit of 10 miles per hour will be observed while driving on site, to minimize collision with covered species, in the event they are found to be utilizing habitat on site or injured.

HCP Mitigation Program

The Kahuku Wind Power HCP contains a mitigation program expected to result in a net environmental benefit, as defined by HRS §195D, for each listed species. Because of the uncertainty and assumptions of the models used to estimate expected species impacts and actual impacts observed, coupled with need to meet the State's statutory requirement to achieve a net benefit for each listed species, Kahuku Wind Power has developed a tiered mitigation program in consultation with the USFWS and DLNR (HCP Section 7.0).

The HCP identifies three mitigation tiers, Lower, Baseline, and Higher. Initially, Kahuku Wind Power will implement mitigation required to achieve net benefit to offset authorized impacts at the Baseline tier for all species (see Table 2). The overall success of the mitigation at each tier will be determined by evaluating whether the mitigation implemented achieves a net benefit commensurate with the actual mitigation requirement. The mitigation requirement is equal to the impacts observed (direct, indirect) plus any adjustments for unobserved take (based on results of searcher efficiency and carcass removal studies), plus any loss of productivity between the time of impact and actual realized benefit to the species (see HCP Section 7.0). Kahuku Wind Power will implement mitigation at the Higher tiers, commensurate with the level of observed impacts, if necessary.

Waterbird Mitigation

Mitigation actions for the four covered waterbirds, Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, and Hawaiian duck are proposed to be implemented at the Hamakua Marsh State Wildlife Sanctuary. Hamakua Marsh is a 22-ac (8.9-ha) state-owned and managed wetland located on the windward side of Oahu (Figure 4). The marsh is characterized as a seasonal floodplain and is divided into four basins, approximately two to eight acres (0.8 – 3.2 ha) in size. These basins are fed by runoff from the Puu o Ehu hillside adjacent to the wetland. The Hamakua canal that borders three of the four basins also contributes to flooding of the wetland during the rainy season and times of high tidal influx.

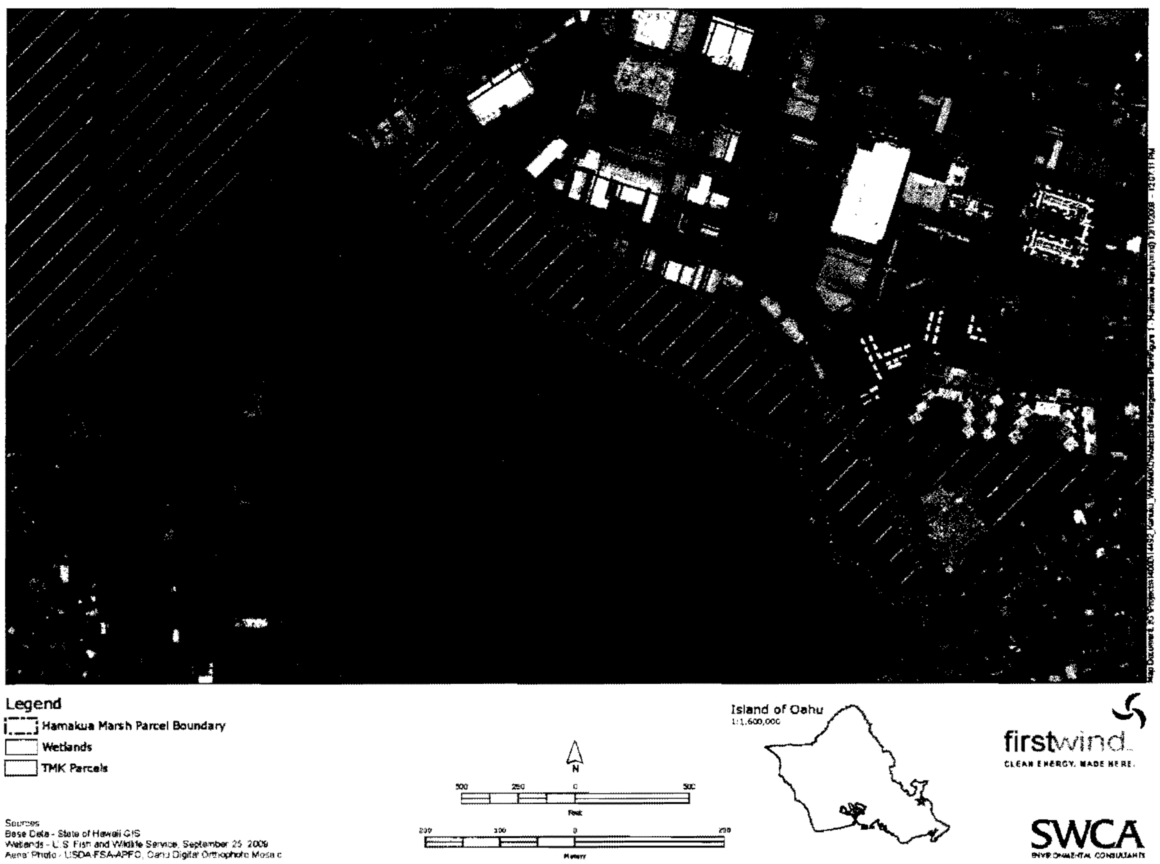

Figure 4. Hamakua Marsh State Wildlife Sanctuary (Source: HCP Appendix 11)

Mitigation efforts will be directed at increasing productivity and mitigation success will be measured in terms of increased fledgling production over baseline productivity (as defined in HCP Appendix 11, Environmental Baseline section) at the end of the reproductive season each year for the coot, moorhen, and stilt. At this time, because it is unlikely that pure Hawaiian ducks occur on Oahu, mitigation for Hawaiian ducks will consist of removal of feral ducks, mallards and Hawaiian duck hybrids at Hamakua Marsh. Please see the draft Waterbird Management Plan for Hamakua Marsh State Wildlife Sanctuary (HCP Appendix 11) for more details. An outline of the management plan is provided below. Kahuku Wind Power, LLC will implement the following:

- Funding toward purchase of a truck and monitoring equipment;
- Year-round predator trapping and baiting to remove predators (e.g. cats, mongoose, rats, dogs), and removal of predators by hunting, as appropriate;
- Removal of feral ducks, mallards and Hawaiian duck hybrids by trained and authorized personnel;
- Removal of undesirable plant species and establishment of native marsh plant species to enhance waterbird nesting habitat using mechanical, chemical, and manual methods, as appropriate;
- Monitoring and reporting results of management activities (predator control, predator activity, waterbird nesting activity, and waterbird reproductive success);
- Banding of the Hawaiian stilt, Hawaiian moorhen, and Hawaiian coot, as practicable;
- Proper handling, release, and/or rehabilitation of non-target or covered species that may be affected by management activities;
- Consultation with DOFAW and the USFWS annually to evaluate management implemented and if necessary, develop management response pursuant to the HCP;
- Provide initial funding at baseline tiers and availability of funding at higher tiers and contingency funds to ensure achieve net benefit to the covered species over the 20-year project duration.

Initial mitigation efforts will be implemented until a net benefit above the baseline tier of required mitigation is documented for each covered waterbird species. If necessary, additional mitigation efforts will be implemented to achieve a net benefit commensurate with the tier of impacts observed.

Seabird Mitigation

Alternative 1 – Makamakaole Site

Kahuku Wind Power will implement mitigation for both covered seabird species (Hawaiian petrel and Newell's shearwater) at a seabird colony on Maui, Kauai or elsewhere. Currently, the preferred mitigation site is situated on West Maui at Makamakaole in the West Maui Forest Reserve (Figure 5).[2] Mitigation will consist of colony enhancement via fencing (if determined to be feasible), eradication and control of predators, an effort to study social attraction techniques and/or installation of artificial burrows. As described below, Kahuku Wind Power will implement the following measures expected to achieve a net benefit for the two covered seabird species commensurate with impacts authorized in State ITL-10 over the project's 20-year duration:

- Complete a feasibility assessment for proposed fencing and management activities at Makamakaole by September 1, 2010;
- If fencing is determined to be feasible, obtain all permits and approvals for fence construction and maintenance, and related management activities;
- Construct and maintain a cat-proof fence of sufficient size to encompass an area (approximately 100 to 160 ac (40 to 65 ha)) with the target number of burrows necessary to achieve mitigation requirements for Kahuku Wind Power, Kaheawa Wind Power, and Kaheawa Wind Power II;
- Conduct predator control to eradicate cats and mongoose, and control rat populations within the fenced area, and regular monitoring of predator populations within the fenced area;
- Monitor seabird survival and productivity within the enclosure;
- Conduct a study of social attraction techniques for a minimum of five years following completion of fence and/or install artificial burrows within the fenced area;
- Conduct fence maintenance and if predator monitoring indicates the need, conduct additional eradication of cats and mongoose within the fenced area.

Mitigation efforts provided by Kahuku Wind Power will contribute to habitat and colony enhancement, and the control of predator populations and thus are anticipated to provide a net benefit to, and aid in the recovery of, the two seabird species. Even if the conservation at Makamakaole does not replace more Newell's shearwaters or Hawaiian petrels than authorized, the value of completing a social attraction study will be considered a net benefit to the covered seabird species due to the inherent value of the knowledge gained for seabird conservation actions. This is so because while social attraction methods appear to hold great promise, they have not been proven in Hawaii, and the results from these mitigation efforts will assist the agencies in determining the next steps to take to promote the recovery of the Hawaiian petrel and Newell's shearwater.

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[2] Implementation of mitigation at this site will accommodate seabird mitigation requirements for the Kahuku Wind Power HCP, Kaheawa Wind Power HCP, and Kaheawa Wind Power II HCP, and therefore, funding will be provided by the three entities (see HCP Appendix 14). Certain management activities at this site have been initiated and consist of trapping of cats and mongoose by Kaheawa Wind Power (Kaheawa Wind Power LLC, 2009).

Alternative 2 – Haleakala National Park + Island of Kauai

Under this alternative, Kahuku Wind Power will implement mitigation for Hawaiian petrel on lands managed or otherwise controlled by Haleakala National Park (HALE). HALE has indicated that an approximately 220 ac (89 ha) area with approximately 100 burrows are protected from habitat damage by feral goats and pigs, but are not protected from predators (Figure 6). The National Park Service has indicated a lack of funds to conduct predator control in this area and does not anticipate receiving funds in the near future (HCP, page 83). If this alternative is implemented, Kahuku Wind Power will:

- Contract the labor and purchase equipment (e.g., traps and bait) necessary to conduct predator trapping within an area of sufficient size and of sufficient duration to complete the mitigation required to achieve a net benefit for the species;

- Conduct monitoring to document success in the mitigation area;

- Trapping and monitoring protocols used will closely follow the protocols that have already been established by the National Park Service for managing the rest of the colony (Hodges and Nagata 2001);

- The initial effort will be implemented over a period of five years. If after the initial five years of predator trapping, mitigation is still not at least one fledgling above the required mitigation tier, mitigation will continue until the required mitigation is achieved;

- The area to be treated, need for additional years of treatment and other details of the mitigation efforts will be decided with concurrence of the National Park Service, DOFAW and USFWS;

- If this site were to be used to achieve mitigation for Kaheawa Wind Power and Kaheawa Wind Power II, then the size of the area and duration of effort will be determined with concurrence with DOFAW and USFWS and will be based on protection and management of a number of burrows to achieve the required net benefit.

For Newell's shearwater, Kahuku Wind Power will provide support for colony protection and management on Kauai at a level commensurate with the authorized impacts (including any loss of productivity that may occur in the interim) and estimated to achieve net benefit for the species, as determined by DOFAW and USFWS. This may inlcude:

- Provide funding commensurate with level required of participants in the island-wide HCP (Kauai Seabird Habitat Conservation Plan) being developed for the island of Kauai; OR

- If the island-wide HCP does not come into fruition within 3 years, Kahuku Wind Power will implement colony-based mitigation, either alone or as part of a cooperative effort with another entity;
- The site chosen by Kahuku Wind Power for colony-based mitigation will be selected with the concurrence of the DOFAW and USFWS.

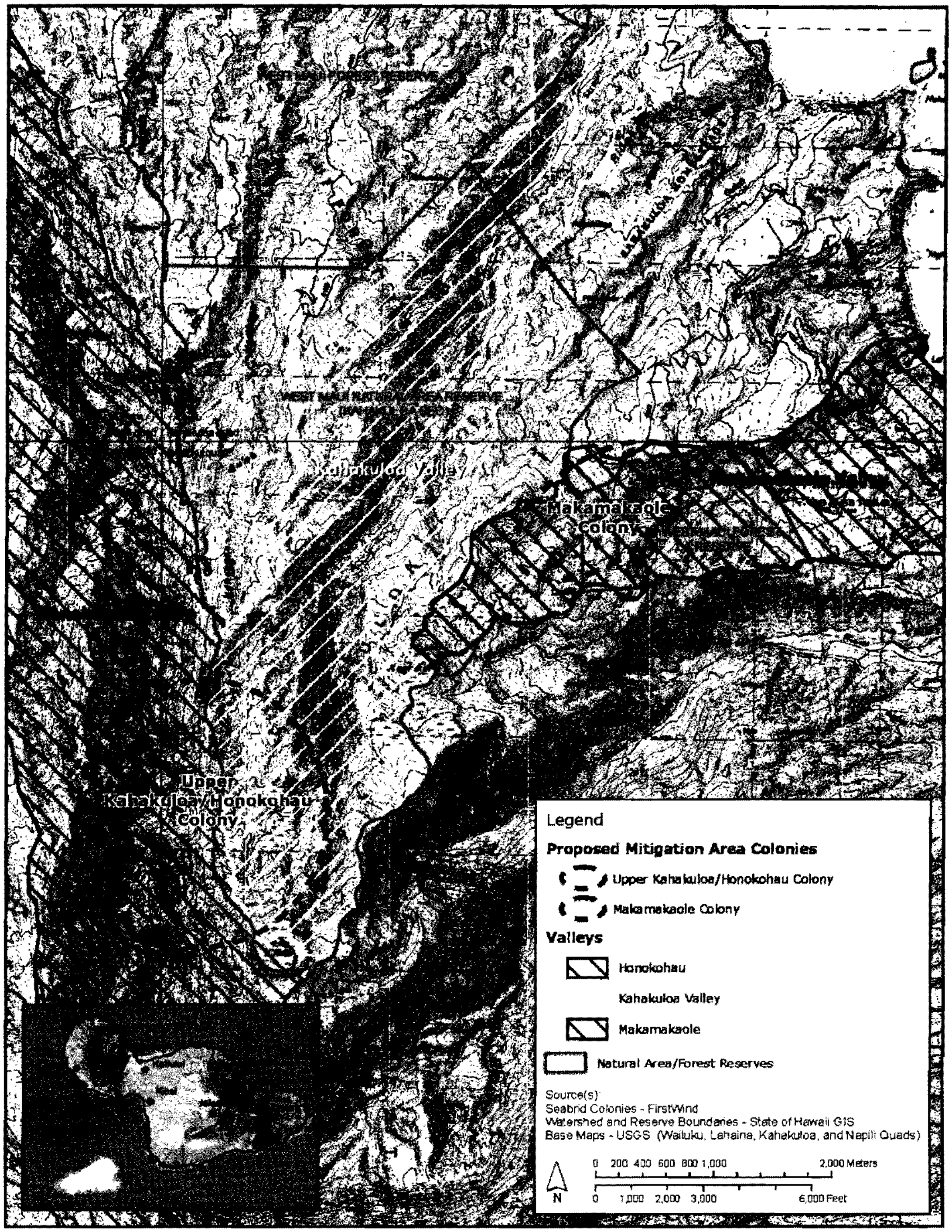

Figure 5. Makamakaole Seabird Mitigation Area, West Maui, (Source: SWCA 2010)

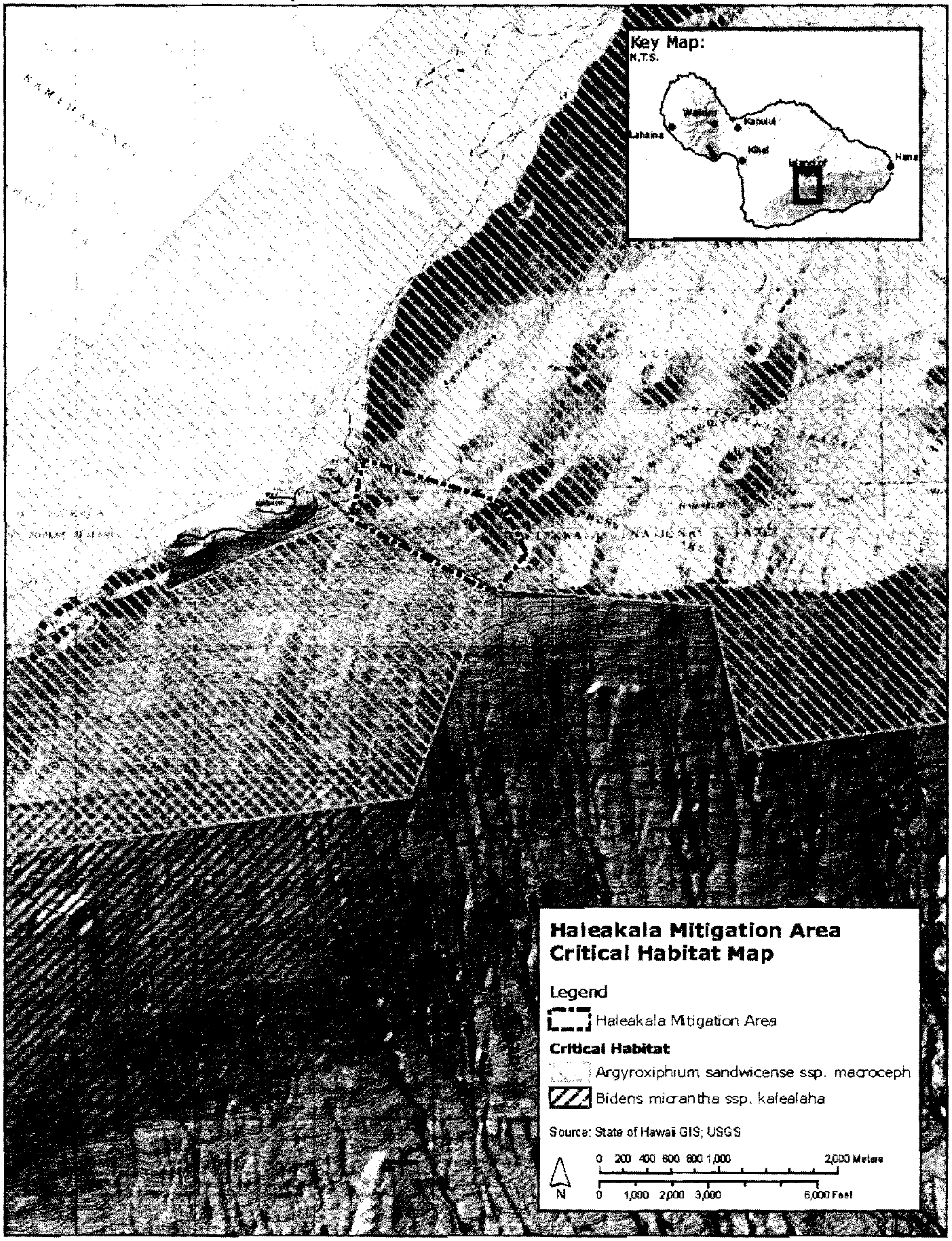

Figure 6. Haleakala National Park Hawaiian Petrel Mitigation Area (Source: SWCA 2010)

If Alternative 2 is chosen, mitigation will be deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. If the mitigation is conducted within a shorter time frame than the project lifetime, models will be used to demonstrate that the mitigation provided will result in a net benefit for the species at the appropriate tier for the entire permit term. The model with be chosen with the concurrence of Kahuku Wind Power, USFWS and DLNR.

Hawaiian Hoary Bat

Mitigation for the Hawaiian hoary bat by Kahuku Wind Power was developed through discussions with USFWS, DOFAW, and scientists of the Hawaii Bat Research Cooperative (HBRC). Based on these discussions, Kahuku Wind Power has proposed to conduct on-site surveys, on-site research, and habitat management to provide a net conservation benefit for the bat.

Bat Habitat Utilization at Kahuku Wind Power and Vicinity

The Kahuku Wind Power will survey and monitor Hawaiian hoary bats within and in the vicinity of the project site. The goal of this research will be to document bat occurrence, habitat use and habitat preferences on site, as well as identify any seasonal and temporal changes in Hawaiian hoary bat abundance. Kahuku Wind Power will implement the following actions:

- At a minimum, conduct on-site surveys using acoustic detectors during the first two years of project operations and during years (Years 6, 11, and 16) when systematic fatality monitoring is scheduled;

- Twelve acoustic detectors will be deployed on-site and at suitable off-site locations with permission of landowners;

- Data will be analyzed to determine seasonal and daily peak periods of activity, and comparison with pre-construction activity levels;

- Incidental observations will be recorded under the Wildlife Education and Observation Program (WEOP).

Research on Bat Interactions with the Wind Facility

In conjunction with the two year study to determine habitat utilization by bats at Kahuku Wind Power and its vicinity, Kahuku Wind Power will conduct additional on-site research that will contribute to identifying areas of potential interactions and vulnerabilities of Hawaiian hoary bats at wind facilities, as follows:

- Thermal imaging or night vision technology will be used to assist acoustic monitoring as trends are detected and would follow similar protocols developed during pre-construction monitoring;

- Incidental bat observations will be recorded under the Wildlife Education Observer Program (WEOP).

Implementation of Habitat Management Measures

Kahuku Wind Power will support native habitat plant restoration in the Polipoli area of the Kula Forest Reserve in East Maui (Figure 7). In 2007, a wildfire burned approximately 2,300 ac (931 ha) of forested public lands, including the Polipoli area. This burn unit was dominated by mature closed canopy forest comprised primarily of pines, cypresses, and redwoods. One of the goals for the restoration of this burned unit is to enhance native species habitat and native ecosystem recovery (DLNR 2007). This unit was known to support a variety of native birds and the Hawaiian hoary bat before the wildfire (Duvall pers. comm.).

Initial reforestation efforts have utilized a mix of native and non-native species in a 1,800 ac (728 ha) reforestation area. Kahuku Wind Power will support native habitat plant restoration for the entire reforestation area by implementing the following:

- Supplemental planting to replace seedling mortality, implementation of rodent control, weed control and fertilization programs to enhance tree seedling survival and forest establishment.

- Native plant habitat restoration will be conducted by a qualified contractor or personnel approved by DOFAW and USFWS.

Mitigation for Higher Rates of Impacts to Hawaiian Hoary Bat

Should project impacts exceed the baseline tier of mitigation, Kahuku Wind Power will immediately implement low wind-speed curtailment by increasing the cut-in speed of all turbines (or a subset of turbines if so determined by DOFAW and USFWS) from their normal operation to 5m/s during periods when bats are active, approximately from dusk till sunrise. Low wind speed curtailment will be implemented unless there is strong evidence that the observed fatalities are a result of some other factors. The times of the year when curtailment is implemented (i.e. year-round or seasonal) at Kahuku Wind Power will be decided based on bat detection data on site, seasonal distributions of observed fatalities on site, and best available science, with concurrence from USFWS and DLNR. The final determination of whether to implement low wind speed curtailment will be made by DLNR and USFWS, in consultation with Kahuku Wind Power.

In addition to the immediate implementation of low-wind speed curtailment, Kahuku Wind Power will review the fatality records to determine whether additional measures can be implemented that will reduce or minimize take. If causes cannot be readily identified Kahuku Wind Power will conduct supplemental investigations that may include but not be limited to:

- additional analysis of fatality and operational data;

- deployment of acoustic bat detectors to identify areas of higher bat activity during periods when collisions are believed to be occurring;

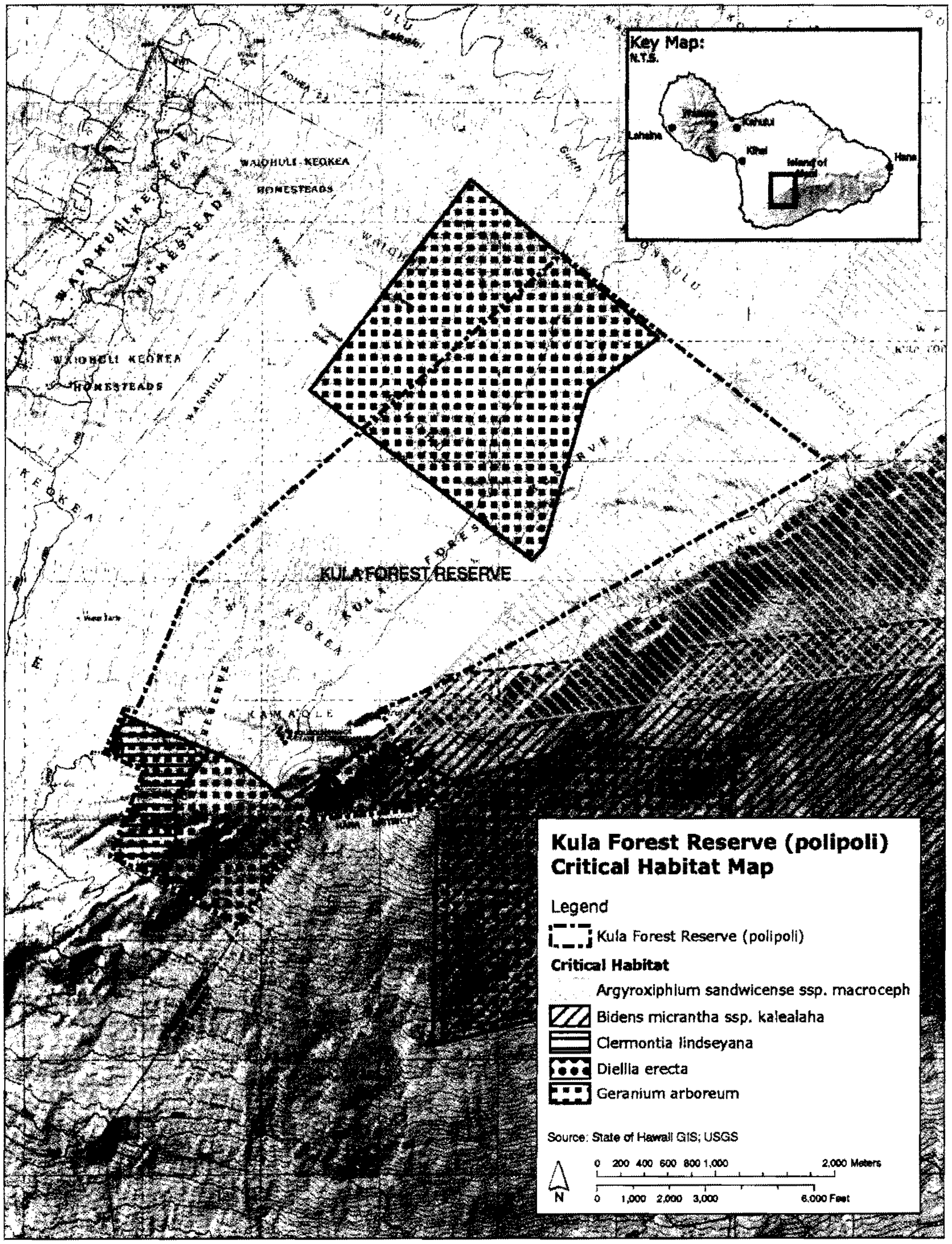

Figure 7. Polipoli Bat Mitigation Area, Kula Forest Reserve, Maui (Source: SWCA 2010).

- using thermal imaging or night vision equipment to document bat behavior;
- determining whether certain turbines are causing most of the fatalities or if fatality rates are related to specific conditions (e.g., wind speed, other weather conditions, season);
- modifying structures and lighting, and
- implementing measures to repel or divert bats from areas of high risk without causing harm if practicable.

These data may also be used to refine low-wind speed curtailment options, such as determining the times of year when curtailment is mandatory, or if curtailment can be confined to a subset of "problem" turbines. These additional measures will be implemented by Kahuku Wind Power with the concurrence of USFWS and DLNR.

Monitoring and Reporting

Kahuku Wind Power is required to report impacts to covered and non-covered species that may occur as a result of the proposed action. The Wildlife Education and Observation Program (WEOP) will be conducted for all on-site staff (HCP Section 7.2.1, Appendix 6). Kahuku Wind Power will also implement a post-construction monitoring program to document all downed wildlife and conduct Searcher Efficiency (SEEF) and Carcass Removal (CARE) studies to estimate the potential occurrence of any unobserved wildlife impacts (HCP Section 8.2, Appendix 7). Search plots around each turbine will be mowed monthly out to 75 percent of turbine height and maintained as such throughout the life of the project. The search plot around the permanent met tower will be mowed monthly out to 100 percent of the tower height and maintained throughout the life of the project. Initial sampling design and protocols are described in the HCP and any modifications will require the approval of DLNR and USFWS.

Kahuku Wind Power will report the total impact to covered species by incorporating the total direct (observed + unobserved) impacts and indirect impact to each species. Unobserved impacts will be calculated using an estimator approved by the USFWS and DOFAW (HCP Section 6.3, Appendix 9). Indirect impacts to covered species will be calculated using the proposed methods which incorporate best available information on the maturity, fecundity, sex, and likely breeding stage at the time of observed take (HCP Section 6.0 to 6.3).

Kaheawa Wind Power will submit annual reports to DLNR and USFWS no later than August 1st each year containing the following deliverables (summarized from HCP Section 8.2.2):

- actual frequency of monitoring of search plots;
- directly observed and adjusted levels of take for each species;
- whether there is a need to modify the mitigation for subsequent years;
- efficacy of monitoring protocols and whether monitoring protocols need to be revised;

- results of mitigation efforts conducted as part of the HCP;
- recommended changes to mitigation efforts if any;
- all HCP related expenditures for the previous year; and
- evidence of Kahuku Wind Power's ability to fulfill funding obligations.

Electronic copies of all HCP-related data will be submitted along with the annual report.
Adaptive Management

The proposed action includes a tiered approach to mitigation designed to be adaptive because of the inherent uncertainties in the estimated and actual level of impact, as well as uncertainties in the success of the proposed mitigation measures.

If the take of any of the Covered Species exceeds that Baseline level of impacts authorized by the ITL but remains within the range identified in Section 6.0 of the HCP as the "Higher" rate for that species, the Kahuku Wind Power will increase the mitigation effort for that species as prescribed in Section 7.0. Kahuku Wind Power will also promptly discuss this situation with USFWS and DLNR to review the total impact for that species recorded to date for the proposed action and the mitigation performed to date on behalf of that species, and to identify whether mitigation performed to date has compensated for the Higher rate of take, or whether changes in mitigation are needed to compensate for the Higher rate of take. The Kahuku Wind Power will also consider whether changes in operational practices may reduce impacts to the species in question. Any changes to the mitigation efforts would be made only with the concurrence of the Applicant, USFWS, and DLNR, and within the mitigation budget established for the project.

Monitoring of seabird and waterbird mitigation efforts is intended to inform Kahuku Wind Power, USFWS, and DLNR whether these efforts are adequately compensating for impacts to covered species. If monitoring reveals that a particular mitigation effort is not achieving the necessary level of success, the Kahuku Wind Power will consult with USFWS and DLNR to develop and implement a revised mitigation strategy to meet mitigation requirements. As long as impacts remain at or below the Higher tier identified in Section 6.3, any actions performed in response to this adaptive management process would be performed under the proposed mitigation program. Any changes in the mitigation effort will be made only with the concurrence of USFWS and DLNR.

Funding

Kahuku Wind Power will provide initial funding in the amount of $2.74 million (2010 dollars) to fund implementation of all HCP required activities at the Baseline tier level, and would provide additional funding at higher tier levels if necessary, and as described in the HCP. In addition, Kahuku Wind Power will establish contingency funds for each species at the initial amounts of $150,000 for the two seabird species, $150,000 for the four waterbird species, and $100,000 for the Hawaiian hoary bat. Each fund will be compounded at 2.5% annually over the 20-year project. An estimate of the costs of funding the proposed mitigation plan is presented in HCP Appendix 8.

Funding for the implementation of the HCP will be provided by Kahuku Wind Power as an annual operating expense paid pari passu with other operating expenditures (operation and maintenance costs, insurance, payroll, lease payments to the State of Hawai'i, audit costs, and agency fee costs) and most importantly, ahead of both debt service to lenders and dividends to equity investors.

Assurances that adequate funding will be available to support the proposed monitoring and mitigation measures will be provided by Kahuku Wind Power in the form of a bond, letter of credit or similar instrument naming the DLNR as beneficiary. As currently proposed, Kahuku Wind Power will provide a rolling letter of credit (LC) or bond in the amount of $500,000, which will be available to fund mitigation in the unlikely event of a revenue shortfall or, in the worst case scenario, bankruptcy. The LC will be automatically renewed prior to expiration, unless it is determined to no longer be necessary by the USFWS and DLNR. In the event of a revenue shortfall or bankruptcy the LC could be drawn upon by the USFWS or DLNR to fund any outstanding mitigation obligations of the project.

The Applicant will establish an additional, single bond or letter of credit for the value of the four contingency funds which start at $475,000. The amount of the bond will increase at 2.5% annually over the term of the HCP. If contingency funds are used, the amount of the bond would be reduced accordingly, and the net amount would continue to increase at a 2.5% annual rate.

STATUS OF THE SPECIES

Hawaiian stilt or Aeo (*Himantopus mexicanus knudseni*)

Legal Status

The Hawaiian stilt was listed as an endangered species on October 13, 1970 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978, and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. Critical habitat has not been designated for the Hawaiian stilt (USFWS 2005).

Distribution and Abundance

Hawaiian stilts were historically known from all of the major Hawaiian Islands, except Lanai and Kahoolawe (Paton and Scott 1985). The first stilts on Lanai were documented in 1989, at the Lanai City wastewater treatment ponds (Hawaii Division of Forestry and Wildlife 1976 to 2007). Stilts are now found on all of the main Hawaiian Islands except Kahoolawe.

By the early 1940s, statewide population numbers were estimated to be between 200 to 1,000 Hawaiian stilts (Munro 1960, Schwartz and Schwartz 1949). However, these population estimates did not account for the Hawaiian stilts present on Niihau and are therefore considered underestimates. Though Hawaiian stilt census data show high year-to-year variability in the number of stilts observed (Engilis and Pratt 1993), long-term census data indicate that statewide populations have been relatively stable or slightly increasing (Reed and Oring 1993, USFWS

2005). Currently, the population of Hawaiian stilts is estimated to be between 1,200 to 1,600 birds (Griffin *et al.* 1989; Engilis and Pratt 1993, Hawaii Biodiversity and Mapping Program 2007). Hawaiian stilts readily disperse between islands and constitute a homogenous metapopulation (Reed *et al.* 1994; Reed *et al.* 1998).

Habitat Types
Hawaiian stilts use a variety of aquatic habitats but are limited by water depth and vegetation cover. Hawaiian stilts are known to use ephemeral lakes, anchaline ponds, prawn farm ponds, marshlands and tidal flats. Stilts need early successional marshlands or other aquatic habitat with water depth less than 9 in (23 cm), perennial vegetation that is limited and low growing for foraging areas. Native low-growing wetland plants associated with stilt nesting areas include water hyssop (*Bacopa monnieri*), sea purslane (*Sesuvium portulacastrum*), and the sedges makaloa (*Cyperus laevigatus*) and kaluha (*Bolboschoenus maritimus*) (Robinson *et al.* 1999). They may also use taro (*Colocasia esculenta*) ponds where the full-grown vegetation forms a protective canopy.

Breeding
Hawaiian stilts have higher nesting densities on freshly exposed mudflats, interspersed with low growing vegetation (USFWS 1983a). Nesting has also been documented on low relief islands (natural and man-made) in fresh or brackish ponds, man-made floating nest structures, floating wooden platforms, and cleared level areas near foraging habitats (Shallenberger 1977; Morin 1994; Smith 2003). The nest itself is a simple scrape on the ground. They have also been observed using grass stems and rocks for nesting material (Coleman 1981). Stilts defend an area of 66 to 99 ft (20 to 30 m) around the nest and are semi-colonial. The nesting season normally extends from mid-February through August (Robinson *et al.* 1999). Peak nesting varies among years and re-nesting can occur after a loss of a clutch (Robinson *et al.* 1999). Stilts usually lay three to four eggs that are incubated for approximately 24 days (Coleman 1981; Chang 1990). Chicks are precocial, leaving the nest within 24 hours of hatching. Adults with three-day old chicks have been observed to move 0.3 mi (0.48 km) from the nest site (Reed and Oring 1993). Young may remain with both parents for several months after hatching (Coleman 1981).

Diet
Stilts are opportunistic feeders. They eat a wide variety of invertebrates and other aquatic organisms available in shallow water and mudflats. Specific organisms taken include water boatmen (Corixidae), beetles (Coleoptera), possibly brine fly (*Ephydra riparia*) larvae, polychaete worms, small crabs, Mozambique tilapia (*Tilapia mossambica*), western mosquito fish (*Gambusia affinis*), and tadpoles (*Bufo* spp.) (Robinson *et al.* 1999; Shallenberger 1977).

Threats and Recovery Needs
The primary causes of the decline of the Hawaiian waterbirds are the loss of wetland habitat, predation by introduced animals, hunting in the late 1800s and early 1900s, disease, and environmental contaminants. A significant amount of Hawaii's wetlands have been lost due to human activities. Modification of wetlands includes filling and draining for agriculture, houses, hotels and golf courses. The USFWS estimates 22,475 ac (9095 ha) of wetlands existed within the coastal plains of Hawaii circa 1780 (USFWS 1990). In 1990, USFWS estimated only 15,474 ac (6,262 ha) remained, a decrease of 31 percent (USFWS 2005). This loss of suitable wetland habitat is compounded by the alteration of wetland plant communities due to invasion by non-

native plants. Species such as California grass (*Brachiaria mutica*), pickleweed (*Batis maritima*), water hyacinth (*Eichornia crassipes*), Indian fleabane (*Pluchea indica*) and red mangrove (*Rhizophora mangle*) present a serious threat by out-competing more desirable species and eliminating open water habitats. Unmanaged vegetation significantly reduced open water, shallow water, bare ground, and exposed mudflat habitat. All of these habitats are under serious threat without management to control these aggressive plant species (USFWS 2005).

Other major contributors to the decline of endangered Hawaiian waterbirds are introduced predators. Small Indian mongoose, feral cats, and feral dogs (*Canis lupus familiaris*) are all presently found within wetlands and pose a serious threat to Hawaiian waterbird reproductive success. All three of these predatory species are known to take eggs, young birds, and even adults (Hays 2007). Both cats and dogs are of particular concern because of the close proximity of Hawaii wetlands to urban areas. Other species, such as the cattle egret, American bullfrog, and rats have been observed congregating around nesting waterbirds just prior to chicks hatching or in areas where young chicks have suddenly disappeared from nests (Woodside 1997). Oahu National Wildlife Refuge (NWR) staff have documented predation of waterbird chicks by cattle egret and black-crowned night heron (*Nycticorax nycticorax*). A bullfrog was documented preying upon a Hawaiian moorhen chick at Hanalei NWR (Viernes 1995). More recently the Key Predators study of 2003 to 2004 on James Campbell NWR provided the first multiple observations of Hawaiian stilt chick predation by bullfrogs, which accounted for 45 percent of chick losses over the study period (Eijzenga 2005).

Predation by introduced mammals and other native and non-native species is currently the most important factor limiting recovery for the Hawaiian waterbirds (USFWS 2005, Robinson *et al.* 1999, Hays). Recovery of the Hawaiian waterbirds focuses on the following objectives: (1) increase population numbers to a statewide baseline level; (2) establish multiple, viable breeding populations throughout each species historic range; and (3) establish a network of wetlands on the main islands that are protected and managed for waterbirds (USFWS 2005).

Hawaiian coot or Alae keokeo (*Fulica alai*)

Legal Status
The Hawaiian coot was listed as an endangered species on October 13, 1970 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978, and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. Critical habitat has not been designated for the Hawaiian coot (USFWS 2005).

Distribution and Abundance
Hawaiian coot occur in coastal plain wetlands usually below 1,320 ft (402 m) elevation on all the main Hawaiian Islands except for Kahoolawe; however, breeding is restricted to relatively few sites. About 80 percent of the population occurs on Kauai (Hanalei, Huleia, Opaekaa), Oahu (coastal wetlands and reservoirs such as Lake Wilson and Nuuanu Reservoir, Kahuku Point and along the windward shore), and Maui (Kanaha and Kealia Ponds, Nuu Pond) (USFWS 2005). The remaining 20 percent of the population occurs in coastal ponds and playa wetlands, such as Paialoa Pond on Molokai, the Lanai City wastewater treatment, Aimakapa and Opaeula ponds on the Kona Coast, and Waiakea and Loko Waka ponds on the island of Hawaii (USFWS 2005).

Island-wide population, based on bi-annual waterbird counts conducted by DOFAW, suggests that the population is stable and is estimated at between 2,000 and 3,000 individuals.

Habitat Types
Life history and breeding biology are poorly known. The species is somewhat gregarious and uses freshwater and brackish wetlands, including agricultural areas (e.g., taro fields) and aquaculture ponds. Hawaiian coot generally occur in lowland wetland habitats with suitable emergent plant growth interspersed with open water, especially freshwater wetlands, but also freshwater reservoirs, cane field reservoirs, sewage treatment ponds, taro loi, brackish wetlands, and with limited use of saltwater habitats. However, on Kauai, some birds occur in plunge pools above 4,900 ft (1494 m) elevation and on the island of Hawaii, stock ponds up to 6,600 ft (2011 m) elevation. The species typically forages in water less than 12 in (31 cm) deep, but will dive in water up to 48 in deep. Compared to Hawaiian moorhen, Hawaiian coot prefer to forage in more open water. Logs, rafts of vegetation, narrow dikes, mud bars, and artificial island are utilized for resting. Ephemeral wetlands support large numbers during the non-breeding season. Some important habitats are located in National Wildlife Refuges and State sanctuaries and these sites receive management attention. However, other important habitats are not protected. These mostly include wetlands facing development or those used for agriculture or aquaculture. Examples include: playa lakes on Niihau, Opaekaa marsh, Lumahai wetlands on Kauai, Amorient prawn farms, Laie wetlands, Uko, Punahoolapa, and Waihee marshes, Waialua lotus fields, and Waipio Peninsula ponds on Oahu, Paialoa and Ooia playa fishponds on Molokai, and Opaeula, and Waiakea-Loko Waka ponds on the island of Hawaii.

Breeding
Nesting habitat includes freshwater and brackish ponds, irrigation ditches, and taro fields. Floating nests are constructed of aquatic vegetation and found in open water or anchored to emergent vegetation. Open water nests are usually composed of mats of bulrush (*Schoenoplectus* spp.), water hyssop (*Bacopa monniere*) and Hilo grass (*Paspalum conjugatum*). Nests in emergent vegetation are typically platforms constructed from buoyant stems of species such as bulrush (*Schoenoplectus* spp.). Nesting occurs year round. Nest initiation is tied to rainfall as appropriate water levels are critical to nest success. Clutch size range from three to ten eggs, and precocial young hatch after a 25 day incubation period.

Diet
Hawaiian coots are generalists and feed on land, grazing on grass adjacent to wetlands, or in the water. They have been observed grazing from the surface of the water, or foraging by diving to obtain food resources. Food items include seeds and leaves, snails, crustaceans, insects, tadpoles, and small fish. The species will travel long distances, including between islands, when local food sources are depleted.

Threats and Recovery Needs
Detailed threats and recovery needs are outlined for Hawaiian waterbirds in the previous Hawaiian stilt account.

Hawaiian moorhen or Alae Ula (*Gallinula chloropus sandvicensis*)

Legal Status

The Hawaiian moorhen is an endemic subspecies of the North American mainland Common moorhen. The Hawaiian moorhen was listed as an endangered species in 1967 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978, and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. Critical habitat has not been designated for the Hawaiian moorhen (USFWS 2005).

Distribution and Abundance

Hawaiian moorhen generally occur in wetland habitats below 410 ft (125 m) elevation on the islands of Kauai and Oahu, although there have been reports from Keanae Peninsula on Maui and from the island of Hawaii. On Kauai, the largest populations occur in the Hanalei and Wailua river valleys. Hawaiian moorhen also occur in the irrigation canals on the Mana Plains of western Kauai and in taro fields. On Oahu, the species is widely distributed with most birds found between Haleiwa and Waimanalo; small numbers occur at Pearl Harbor and the leeward coast at Lualualei Valley. Historically, Hawaiian moorhen occurred on all the main Hawaiian Islands except for Lanai and Kahoolawe.

No historical population estimates are available for the endemic Hawaiian moorhen. Because they are such secretive birds, it is difficult to conduct population surveys for this species. It is believed that they were common on the main Hawaiian Islands, except Lanai and Kahoolawe, in the 1800s but radically declined by the mid-1900. Surveys from the 1950s through the 1960s estimated only 57 individuals. Currently Hawaiian moorhen inhabit the islands of Kauai and Oahu (USFWS 2005). The State attempted a re-introduction of six moorhen (three females and three males) on May 18, 1983, to the island of Molokai at Kakahaia NWR. One of the banded birds was found dead January 2, 1985 and a local resident mistook the other five for chickens and they were consumed (Dibben-Young 2007). Island-wide population, based on bi-annual waterbird counts conducted by DOFAW, suggests that the population is increasing, but count numbers are variable. Between 1993 and 2003, the average annual number of Hawaiian moorhen observed has been just under 300 individuals. However, these survey numbers are thought to be underestimates because of the moorhens cryptic behavior. Standard survey methods in these counts include visual and aural detection. Recent research conducted by David DesRochers in 2005 through 2007 has shown that passive surveys of cryptic waterbirds underestimate numbers of individuals present in the wetlands. Alternatively, broadcasting vocalizations of cryptic waterbirds to elicit responses increases detection. On average his research has shown, broadcasting calls increased moorhen detection by 30 percent.

Habitat Types

Hawaiian moorhen are the most secretive of the native waterbirds, preferring to forage, nest and rest in dense late succession wetland vegetation. Most birds feeding along the waters edge or in open water will quickly seek cover when disturbed. The preferred habitat for moorhens includes: interspersed dense stands of robust late succession vegetation near open water (approximately 50 percent water to 50 percent vegetation) floating or barely emergent mats of vegetation and water depth less than 3 feet (0.91 m)(USFWS 2005).

Breeding
These birds nest year-round but appear to have two active seasons from November through February and May through August (USFWS 2005). It is believed that the timing of nesting is related to water levels and late succession wetland vegetation. The Hawaiian moorhen usually lays an average of five to six eggs, although clutches have been up to 13 eggs, and incubation is about 25 days (USFWS 2005). Nesting phenology is apparently tied to water levels and the presence of appropriately dense vegetation. Platform nests are constructed in dense vegetation over water or near the waters edge. The particular species of emergent plant used for nest construction is not as important as stem density and vegetation height (USFWS 2005).
Diet
Hawaiian moorhen are opportunistic feeders and their diet likely varies with habitat, but includes algae, grass seeds, insects, snails, introduced fishes, crustaceans, mollusks, emergent grasses, and wetland plants (USFWS 2005).

Threats and Recovery Needs
Detailed threats and recovery needs are outlined for Hawaiian waterbirds in the previous Hawaiian stilt account.

Hawaiian duck or koloa maoli (*Anas wyvilliana*)

Legal Status
The Hawaiian duck was listed as an endangered species in 1967 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978, and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. Critical habitat has not been designated for the Hawaiian duck (USFWS 2005).

Distribution and Abundance
Hawaiian ducks are generally found in wetland habitats from sea level to 9,900 ft (3,017 m) elevation on all the main Hawaiian Islands except for Kahoolawe; populations on all islands except for Kauai originated from re-introduced birds. On Kauai, populations are found in Hanalei NWR and montane streams. On Oahu, populations are found in Kawainui, Hamakua, and Heeia marshes, James Campbell NWR, and in wetland habitats in or near Punahoolapa, Haleiwa, Pearl Harbor, and Lualualei Valley. On Maui, Hawaiian ducks are found in Kahului, Kanaha and Kealia ponds. On the island of Hawaii populations occur in the Kohala Mountains, in Pololu, Waimanu and Waipio valleys, and Mauna Kea. Historically, Hawaiian ducks occurred on all the main Hawaiian Islands except for Lanai and Kahoolawe.

The Hawaiian duck population is estimated to be approximately 2,000 individuals, but this is an estimate, with 80 percent of individuals occurring on Kauai (Engilis et. al 2002). State bi-annual waterbird survey data count numbers range from 300 to 500 individuals. Because of the remoteness and inaccessibility of some habitats, the State waterbird counts are likely an underestimate. Historically, Hawaiian duck were fairly common in natural and agricultural wetland habitats. By 1949, only about 530 individuals remained, with 30 on Oahu and the remainder on Kauai (USFWS 2005).

Habitat Types
Hawaiian ducks occur in a wide variety of natural and artificial wetland habitats including freshwater marshes, flooded grasslands, coastal ponds, streams, montane pools, forest swamplands, taro, lotus, shrimp, and fish ponds, irrigation ditches, reservoirs, and mouths of larger streams (USFWS 2005). Some important habitats are located on National Wildlife Refuges or on State lands and receive management attention. However, other important habitats are not protected. These mostly include wetlands facing development or those used for agriculture or aquaculture. Examples include: playa lakes on Niihau, Opaekaa marsh, Lumahai wetlands on Kauai, Amorient prawn farms, Laie wetlands, Uko, Punahoolapa, and Waihee marshes, Waialua lotus fields, and Waipio Peninsula ponds on Oahu, Paialoa and Ooia playa fishponds on Molokai, and Opaeula, and Waiakea-Loko Waka ponds on the island of Hawaii.

Breeding
Hawaiian ducks nesting biology is poorly understood. Although some pairs nest in lowland habitats on Kauai, Hawaiian ducks have also been observed nesting in the upper Alakai swamp (USFWS 2005). Nesting occurs year round, but most activity occurs between January and May (Engilis et. al 2002). Nests are usually on the ground near water, but few nests are found in areas frequented by humans or areas supporting populations of mammalian predators. Generally eight to ten eggs are laid, and the precocial chicks hatch after an unknown incubation period, but likely less than 30 days.

Diet
Hawaiian ducks forage in a wide variety of freshwater habitats, including artificial wetlands. Movements between feeding and breeding habitats and between Kauai and Niihau commonly occurs, while other inter-island dispersal may occur, but on a more infrequent basis. The species typically forages in shallow water (less than five inches deep). Like mallards, Hawaiian ducks are opportunistic and their diet includes snails, dragonfly larvae, earthworms, grass seeds, green algae, and seeds/leaf parts of wetland plants. Hawaiian ducks are usually found alone or in pairs and are wary, especially when nesting or molting, although during the winter they may gather in larger numbers to exploit abundant food resources (USFWS 2005).

Threats and Recovery Needs
Currently the most important threat to the Hawaiian duck population is hybridization with non-native mallards. This is especially problematic on Oahu where most of the individuals are hybrids. In addition, feral pigs (*Sus scrofa*) and goats (*Capra hircus*) significantly reduce the suitability of nesting habitat for Hawaiian ducks along montane streams (USFWS 2005). Similar to the rest of Hawaiian waterbirds, Hawaiian ducks detailed threats and recovery needs are outlined for Hawaiian waterbirds in the previous Hawaiian stilt account.

Newell's Shearwater or Ao (Puffinus auricularis newelli)

Legal Status
The Newell's shearwater was listed as threatened on October 28, 1975, pursuant to the ESA. A recovery plan was approved for the species in 1983. Critical habitat has not been designated for the Newell's shearwater (USFWS 1983b).

Distribution and Abundance
Ainley et al. (1997) estimated that the Newell's shearwater population was approximately 84,000 birds, with a possible range of 57,000 to 115,000 birds. Since this estimate, the populations seem to be on a steep decline, radar studies on Kauai showed a 63 percent decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003a) or a 75 percent decrease between 1993 and 2008 (KIUC Draft HCP 2009). The largest breeding population of Newell's shearwater occurs on Kauai (Telfer et al. 1987, Day and Cooper 1995, Ainley et al. 1995, 1997, Day et al. 2003a). Pyle and Pyle (2009) estimate the 10,000 pairs or 97 percent of the statewide breeding population on Kauai. Breeding also occurs on Hawaii Island (Reynolds and Richotte 1997, Reynolds et al. 1997, Day et al. 2003a) and almost certainly occurs on Molokai (Pratt 1988, Day and Cooper 2002). Recent radar studies suggest the species may also nest on Oahu (Day and Cooper 2008). On Maui, radar studies and visual and auditory surveys conducted over the past decade suggest that one or more small breeding colonies are present in the West Maui Mountains in the upper portions of Kahakuloa Valley (G. Spencer, pers. comm. 2010).

Habitat Types
Newell's shearwaters typically nest on steep slopes vegetated with uluhe fern (*Dicranopteris linearis*) undergrowth and scattered ohia (*Metrosideros polymorpha*) trees. Currently, most Newell's shearwater colonies are found from 525 to 3,900 ft (160 to 1,200 m) above mean sea level, often in isolated locations and/or on slopes greater than 65 degrees (Ainley et al. 1997).

Breeding
The birds nest in short burrows excavated into crumbly volcanic rock and ground, usually under dense vegetation and at the base of trees. A single egg is laid in the burrow and one adult bird incubates the egg while the second adult goes to sea to feed. Once the chick has hatched and is large enough to withstand the cool temperatures of the mountains, both parents go to sea and return daily to feed the chick. Newell's shearwaters arrive at and leave their burrows after sunset and birds are seldom seen near land during daylight hours. During the day, adults remain either in their burrows or at sea some distance from land.

First breeding occurs at approximately six years of age, after which breeding pairs produce one egg per year. A high rate of non-breeding is found among experienced adults that occupy breeding colonies during the summer breeding season, similar to some other similar-sized seabird species (Ainley et al. 2001). No specific data exist on longevity for this species, but other shearwaters may reach 30 years of age or more (Bradley et al. 1989, del Hoyo et al. 1992).

The Newell's shearwater breeding season begins in April, when birds return to prospect for nest sites. A pre-laying exodus follows in late April and possibly May; egg-laying begins in the first two weeks of June and likely continues through the early part of July. Pairs produce one egg, and the average incubation period is thought to be approximately 51 days (Telfer 1986). The fledging period is approximately 90 days, and most fledging takes place in October and November, with a few birds still fledging into December (Rana Productions and Planning Solutions 2008, SOS Program Data 2009, unpublished).

Diet
Foods are known to include small fish, crustaceans and squid (USFWS 1983b). It is likely that the distribution and abundance of food supply determines the marine distribution of seabirds.

Although little is known about the distribution and density of seabird food supplies, severe alterations could affect the status of seabird populations.

Threats and Recovery Needs
Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997, Mitchell et al. 2005, Hays and Conant 2007).

Hawaiian Petrel or uau (*Pterodroma sandwichensis*)

Legal Status
The Hawaiian petrel was listed on March 11, 1967, pursuant to the Endangered Species Preservation Act of 1966. A recovery plan was approved for the species in 1983. Critical habitat has not been designated for the Hawaiian petrel (USFWS 1983b).

Range and Distribution
The Hawaiian petrel was once abundant on all main Hawaiian Islands except Niihau (Mitchell et al. 2005). The population was most recently estimated to be approximately 20,000, with 4,000 to 5,000 breeding pairs (Mitchell et al. 2005). Today, Hawaiian petrels continue to breed in high-elevation colonies on Maui, Hawaii, Kauai and Lanai (Richardson and Woodside 1954, Simons and Hodges 1998, Telfer et al. 1987, DLNR unpublished data 2006, 2007). Radar studies conducted in 2002 also suggest that breeding may occur on Molokai (Day and Cooper 2002). Breeding is no longer thought to occur on Oahu (Harrison 1990). Survey work at a recently re-discovered Hawaiian petrel colony on Lanai, that had been previously thought to be extirpated, indicates that thousands of birds are present, rather than hundreds of birds as first surmised, and that the size of the breeding colony approaches that at Haleakala, Maui, where as many as 1,000 pairs have been thought to nest annually (Mitchell et al. 2005, Tetra Tech EC, Inc., June 2008). Radar counts of petrels on the perimeter of Maui and recent colony detections by KWP researchers suggest that the Maui population may be much higher than the 1,000 pairs previously estimated (Cooper and Day 2003).

Breeding
Hawaiian petrels are active in their nesting colonies for about eight months each year. The birds are long-lived (ca. 30 years) and return to the same nesting burrows each year between March and April. Present-day Hawaiian petrel colonies are typically located at high elevations above 8,200 ft (2,500 m). The types of habitats used for nesting are very diverse and range from xeric habitats with little or no vegetation, such as at Haleakala National Park on Maui, to wet forests dominated by ohia with uluhe understory as those found on Kauai (Mitchell et al. 2005). Females lay only one egg per year, which is incubated alternately by both parents for approximately 55 days. Eggs hatch in June or July, after which both adults fly to sea to feed and return to feed the nestling. The fledged young depart for sea in October and November. Adult birds do not breed until age six and may not breed every year, but pre-breeding and non-breeding birds nevertheless return to the colony each year to socialize.

Diet
Hawaiian petrels are nocturnal and subsist primarily on squid, fish, and crustaceans caught near the sea surface. On Kauai, Hawaiian petrels move from the sea to the interior portions of the island between sunset and about 60 min after sunset (Day et al. 2003b). Unlike shearwaters, Hawaiian petrels are not known to dive or swim below the surface (Pitman 1986). Foraging may take place thousands of kilometers from their home islands during both breeding and non-breeding seasons (Spear et al. 1995). Recent studies conducted using satellites and transmitters attached to Hawaiian petrels have shown that they can range across more than 6,200 miles (10,000 km) during two-week foraging expeditions (Adams 2008).

Threats and Recovery Needs
The most serious land-based threat to the species is predation of eggs and young in the breeding colonies by introduced mammalian predators such as small Indian mongoose, feral cats, pigs, dogs, and rats. Owls have also been documented as predators of fledglings (Hodges and Nagata 2001). Population modeling by Simons (1984) suggested that this species could face extinction in a few decades if predation is not controlled. Intensive trapping and habitat protection has helped to improve nesting and fledging success (Ainley et al. 1997). Hodges and Nagata (2001) found that nesting activity (signs of burrow activity) in sites protected from predators on Haleakala ranged from 37.25 to 78.13% while nesting activity in unprotected sites ranged from 23.08 to 88.17%. Nesting success (proportion of active burrows that showed signs of fledging chicks) in protected sites ranged from 16.97 to 50.00%, while nesting success in unprotected sites ranges from 0.00 to 44.00% (Hodges and Nagata 2001).

Ungulates can indirectly affect nesting seabirds by overgrazing and trampling vegetation, as well as facilitating erosion. Climatic events such as El Niño can also impact the reproductive success of seabirds (Hodges and Nagata 2001). Other threats include occasional mortality from collisions with power lines, fences, and other structures near breeding sites or attraction to bright lights. In addition, juvenile birds are sometimes grounded when they become disoriented by lights on their nocturnal first flight from inland breeding sites to the ocean. A few, mostly juvenile, Hawaiian petrels have landed in brightly lit areas at scattered locations on Maui most years. The problem is much smaller than the one involving Newell's shearwaters (see prevous section), and Simons and Hodges (1998) conclude that it is probably not a threat to remaining populations. Hawaiian petrels are known to occasionally collide with tall buildings, towers, powerlines, and other structures while flying at night between their nesting colonies and the ocean (USFWS 2004).

Hawaiian Hoary Bat, opeapea (*Lasiurus cinereus semotus*)

Legal Status
The Hawaiian hoary bat was listed as endangered on October 13, 1970 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. A recovery plan was approved for the species in 1998. Critical habitat has not been designated for the Hawaiian hoary bat (USFWS 1998).

The Hawaiian hoary bat has been little studied and information for a comprehensive life history is lacking. Hawaiian hoary bats roost in a variety of tree species during the day and forage in a wide range of habitat types during the night. There is no information on the Hawaiian hoary bats average life span, age at first reproduction, and survivorship, or on how age and reproductive condition affect its food habits, habitat selection, home range size, and movement patterns.

Range and Distribution

The Hawaiian hoary bat is endemic to the State of Hawaii where it is the only existing, native terrestrial mammal. It has been documented historically on the islands of Hawaii, Maui, Molokai, Oahu, Kauai, and possibly Kahoolawe. The bat is now resident only on Hawaii, Maui, and Kauai, with the largest populations probably on Hawaii and Kauai; no evidence of a breeding population (e.g., pregnant or lactating females) has been documented on Maui (USFWS 1998, p. 11). Occasional observations of bats on Oahu and Molokai are considered to be migrant or vagrant individuals from other islands.

Population Densities

There are no population estimates for the Hawaiian hoary bat and few historical or current records. Unsubstantiated population estimates across the State have ranged from hundreds to a few thousand (USFWS 1998, p. 14). Data are limited because no feasible method currently exists for surveying the abundance and distribution of solitary, tree-roosting bats. The Hawaiian hoary bats distribution may be broader than indicated by the current limited information resulting from localized search efforts (USFWS 1998, p. 14).

Hawaiian hoary bats are thought to be most numerous on the island of Hawaii, where they are uncommon but fairly widespread (Jacobs 1994). Bats have been observed year-round in a wide variety of habitats and elevations below 7,500 ft (2,286 m), and a few sightings from limited surveys have been reported as high as 13,199 ft (4,023 m). Hawaiian hoary bats have been detected in both wet and dry areas of Hawaii but seem to be more abundant on the drier leeward side (Jacobs 1994, p. 199) and generally less abundant in wet areas (Kepler and Scott 1990, p. 62). Researchers have examined spatial/temporal variation in occurrence patterns of bats on Hawaii, but with conflicting conclusions about possible altitudinal or regional migration (Tomich 1986b, Jacobs 1994; Menard 2001, Bonaccorso 2009, unpublished).

Habitat Types

A few studies have documented Hawaiian hoary bats in a wide range of locations and habitat types on the island of Hawaii. Bats observed along 611 mi (983 km) of forest bird survey transects and incidentally elsewhere on Hawaii during 1976-1983, at elevations from sea level to 10,007 ft (3,050 m), were more frequently associated with nonnative vegetation (64 percent), such as tall eucalyptus and other exotic plants, than with native vegetation (19 percent) (Kepler and Scott 1990, p. 61). Visual observations and echolocation detections at 22 sites in southeast Hawaii, however, found no significant differences in bat activity among native or nonnative vegetation types (Reynolds et al. 1998, pp. 153-157). In addition, 57 percent of all bat activity was noted at open sites, forest edges, lava flows, volcanic pit craters, residential and agricultural clearings, and roads. In contrast, foraging bats at 14 survey sites over a range of altitudes were more frequently associated with native vegetation (44 percent) than nonnative (16 percent) or mixed (9 percent) vegetation (Jacobs 1993, p. 22). Bats were detected most often in native mesic koa-ohia forest vegetation at 13 sites in, and adjacent to, Hakalau Forest National Wildlife Refuge (Cabrera 1996, p. 238, Bonaccorso 2009, unpublished). All reports of bat occurrences may be biased to varying degrees by sampling efforts concentrated along roads and forest edges.

Roosting habitat for the Hawaiian hoary bat is sparsely documented. However, current research utilizing radio-tracking with more than 30 Hawaiian hoary bats, reveals all the bats studied roost in trees and all roost more than 20 ft off the ground (Bonaccorso 2009a, pers. comm.). North American hoary bats roost 10 to 16 ft (3 to 5 m) above the ground, mostly in hardwood trees (Shump and Shump 1982, p. 3). Hawaiian hoary bats have been observed in a wide variety of trees, including native species (*Metrosideros polymorpha*; *Pandanus tectorius*; *Styphelia tameiameiae*), Polynesian-introduced species (*Aleurites moluccana*), and post-contact introduced species (*Syzygium cumini*) (USFWS 1998, p. 13). Batsalso have been occasionally observed in fern clumps, low scrub, rock crevices, macadamia nut orchards, and buildings (Tomich 1986a). Hawaiian hoary bats forage in a variety of open and vegetated habitats, including open fields, lava flows, open ocean in bays near shore, and streams and ponds. Hawaiian hoary bats on Hawaii forage in both relatively closed habitats near vegetation (such as clearings in lowland mesic ohia forest or town parks) as well as in open habitats and forest edges (Jacobs 1993a; Tomich 1974). Hawaiian hoary bats generally forage 3 to 492 ft (1 to150 m) above the ground or open water, 3 to 50 ft (1 to 15 m) above the ground in closed forest habitats, and up to 100 ft (30 m) and more above tree canopy (USFWS 1998, p. 10).

Breeding

Little is known about the breeding biology of Hawaiian hoary bats. Females of most temperate, autumn-breeding insectivorous bat species become pregnant in the spring by delayed ovulation and fertilization, and young are cared for exclusively by the female. The breeding cycle of the Hawaiian hoary bat on the island of Hawaii consists of pregnancy (April to June), with pups born in May or June; lactation (June through early August and possibly to September); post-lactation, after pups have fledged (September to December); and pre-pregnancy (January to March) (Menard 2001, p. 35). Like North American hoary bats, Hawaiian hoary bat females are believed to give birth to two young at a time. North American hoary bat pups cling to the mother at the roost tree during the day, where she leaves them hanging on a twig while she forages at night (Shump and Shump 1982, p. 3), and Hawaiian hoary bats are presumed to behave similarly. Female North American hoary bats adjust their foraging behavior to meet the increasing energy demands of pregnancy and lactation (Barclay 1989, pp. 31-37). Because newborn bats cannot thermoregulate very well in tree-foliage roosts, the mothers foraging activity may be constrained by the need to roost periodically with her young to keep them warm. Thus, foraging behavior changes with reproductive condition, and females with non-volant young may forage at different times of night and perhaps in different habitats than other bats. Preliminary evidence indicates that pregnant and lactating female Hawaiian hoary bats on Hawaii may prefer roosting in lowland areas rather than in the cooler highlands, perhaps because the warmer lowland environment promotes faster juvenile growth (or, alternatively, because insect food sources may be more readily available) (Menard 2001, pp. 52-105).

Hawaiian hoary bat activity patterns seem to vary seasonally and/or geographically on Hawaii, with most observations occurring during August-September (Jacobs 1993, p. 15-26; Reynolds et al. 1998, pp. 153-159) or August-December (Kepler and Scott 1990, pp. 59-64). Peak observations during August, September, and October may be due to recent recruitment of fledged juveniles (Jacobs 1994, pp. 15-26; Kepler and Scott 1990, pp. 59-64; Reynolds et al. 1998, pp. 153-159). Declines in bat activity generally occur during November-December in the Puna area (Reynolds et al. 1998, pp. 153-159) and during January-March in Kona (Jacobs 1994, pp. 193-200). Seasonal altitudinal differences in bat activity levels have been documented on the island of Hawaii (Menard 2001, pp. 1-149). Among other findings, Menard (2001, pp. 52-105) collected evidence that suggests Hawaiian hoary bats may be capable of torpor, and may migrate seasonally in search of suitable roost sites.

To investigate possible seasonal or altitudinal movements of Hawaiian hoary bats, Menard (2001) reviewed existing published and unpublished information on the Hawaiian hoary bat. Included in her review was an entire year of monthly records collected by the Hawaii Heritage Program at 12 PTA monitoring sites in 1992 and 1993; and unpublished sightings and biological measurements recorded by Dr. P.Q. Tomich of bats collected from the Hamakua and Hilo vicinity of the island of Hawaii from 1960 to 1979. In addition, Menard (2001) monitored activity patterns of Hawaiian hoary bats at 23 sites over a broad geographical and altitudinal range on the island of Hawaii. She found during the breeding period, bats seem to move out of the eastern highlands and into the lowlands and that during the post-lactation period, bats seem to make a partial migration into the eastern highlands and perhaps the central highlands. She also found that during the pre-pregnancy period, Hawaiian hoary bats seem to move out of the lowlands and possibly the central highlands and into the eastern highlands.

Diet

Black (1972) and Whitaker (1972) argued that the North American hoary bat feeds primarily on moths, and Belwood and Fullard (1984) have shown a similar pattern for the Hawaiian hoary bat on Kauai. Barclay (1985) and Whitaker and Tomich (1983), however, found no strong selection for moths in a study in Manitoba, Canada, and on Hawaii, respectively. Bonaccorso (2009b) documented examples of foraging on Lepidoptera (moths), Coleoptera (beetles), and Isoptera (termites).

Threats and Recovery Needs

The major threats to Hawaiian hoary bats are assumed to be the same as those that threaten many bat species in general (Harvey et al. 1999, p. 13; USFWS 1998, p. 15). Bats have the slowest reproductive rate and the longest life-span of all mammals of their size (Barclay and Harder 2003, pp. 209-256). Thus, any mortality of breeding-age adults, particularly females, constrain the recovery of the subspecies. The primary factor limiting recovery is thought to be habitat loss, primarily the availability of roosting sites; suitable roosting habitat is particularly important to pregnant and lactating females and non-volant young. Other possible threats identified in the recovery plan that have not been investigated may include pesticides (directly or by impacts to prey), predation (by native hawks and nonnative feral cats), alteration of prey availability due to introduction of nonnative insects, and roost disturbance. Occasional instances are documented of Hawaiian hoary bats killed by collisions with vehicles and structures (Kepler and Scott 1990, p. 60; Kuhn 2009; Menard 2001, p. 136; Tomich 1986c, p. II-5). There are reported instances of bats becoming impaled on barbed wire in the continental United States (Anderson 2002; Iwen 1958, p. 438; Sarkozi et al. 2003, p. 302; Wisely 1978, p. 53). Barbed wire fences with a top strand of barbed wire are known to kill Hawaiian hoary bats. For fences that have been monitored, estimates of bat mortality range from no bats impales on a 44 mi (71 km) fence at the Hakalau National Wildlife Refuge for the period between 1987 and 2007 to 12 bats caught on a 52 mi (84 km) fence at Haleakala Crater at Haleakala National Park for the period between 1986 and 2004 (Jeffrey 2007, pers. comm.). For the three month period between August 1 and the end of October 2008, The Nature Conservancy reported three dead Hawaiian hoary bats on the top barbed wire strand on their hog wire fences at Kona Hema Preserve (Marshall 2008b, pers. comm.).

The overall recovery strategy for the Hawaiian hoary bat is to rely on research that can provide information on the subspecies abundance and distribution, life history, and habitat associations. The currently available information is so limited that even the most basic management actions cannot be undertaken with any certainty of benefit. Therefore, the primary recovery goal is to conduct research essential to the conservation of the Hawaiian hoary bat. Research should focus on developing standardized survey and monitoring protocols for determining abundance and distribution, roosting habitat associations, basic life history biology, and food habits. Other recovery goals are to protect and manage current populations by identifying and managing threats, including protection of key roosting and foraging areas; conduct a public education program; evaluate progress towards recovery; and revise recovery criteria as necessary (USFWS 1998, p. 18-20).

ENVIROMENTAL BASELINE

General Baseline Description

No federally listed endangered, threatened, or candidate species are known to be resident within the Kahuku Wind Power project area and no portion of the site has been designated as critical habitat for any listed species. The endangered Hawaiian hoary bat has been documented flying over the project area and bat activity has been recorded on the acoustic bat detectors. Newell's shearwaters were detected flying over the Kahuku Wind Power project area during nocturnal radar surveys. No Hawaiian petrels were identified during the radar surveys, but it is believed possible that individuals of this species may occasionally fly over the Kahuku Wind Power project area.

Several federally listed endangered waterbird species occur regularly on adjacent properties and individuals of these species may occasionally transit through the airspace of the proposed Kahuku Wind Power facility. All four covered waterbirds are known to occur regularly in the Kii Unit of the James Campbell National Wildlife Refuge (NWR), which lies nearby the proposed Kahuku Wind Power facility. Of these four species, only Hawaiian ducks or duck hybrids have been observed flying over the project site during the avian surveys conducted by Kahuku Wind Power and SWCA (HCP Appendix 4, SWCA and First Wind 2009).

Status of the Species in the Action Area

Hawaiian stilt

No suitable habitat for Hawaiian stilt occurs on the Kahuku Wind Power project area, and no Hawaiian stilts were seen flying over the proposed Kahuku Wind Power facility during the avian point count surveys conducted by Kahuku Wind Power LLC and SWCA (SWCA and First Wind 2009). One downed individual was found incidentally on site next to a temporary met tower. Post-mortem results by USFWS veterinarians indicated that the bird was emaciated and carried a heavy parasite load. As there were no broken bones or abrasions to indicate a collision with the met tower or guy wires, the bird was determined to likely have died of natural causes. However, since the carcass was found at the base of the met tower, the final cause of death was declared indeterminate and not attributed to the met tower (HCP, p. 22).

Because of the known dispersal capabilities of these birds and their regular occurrence at the nearby Kii Unit of James Campbell NWR, it is expected that individual stilts may fly over the Kahuku Wind Power project area on a very irregular basis while moving between wetlands or islands.

Due to the residential nature of the environment at the HECO Waialua substation microwave tower (asphalt roads, traffic, close proximity to houses), no waterbirds are expected to utilize the site. No habitat suitable for waterbirds occurs at the microwave tower site at Flying R Ranch as well, which consists of non-native forest with no nearby water features. Thus no Hawaiian stilts are expected to be near the vicinity of either off-site microwave tower.

<u>Hawaiian coot</u>
No Hawaiian coots were observed in flight at the Kahuku Wind Power project area during the year-long avian point count survey. In addition, Hawaiian coots prefer open water habitats, and nest in fresh and brackish ponds, and construct floating nests of aquatic vegetation in open water or semi-floating nests anchored to emergent vegetation. No such habitat exists within the project area. However, because Hawaiian coots are known to disperse between islands, there is potential for coots to occasionally fly over the lower elevations of Kahuku Wind Power project area if moving between wetlands or islands.

Due to the residential nature of the environment at the HECO Waialua substation microwave tower (asphalt roads, traffic, close proximity to houses), no waterbirds are expected to utilize the site. No habitat suitable for waterbirds occurs at the microwave tower site at Flying R Ranch as well, which consists of non-native forest with no nearby water features. Thus no Hawaiian coots are expected to be near the vicinity of either off-site microwave tower.

<u>Hawaiian moorhen</u>
No Hawaiian moorhens were detected during the year of avian point count surveys on the Kahuku Wind Power project area or on adjacent wetlands, although the birds are known to occur regularly at the Kii Unit of James Campbell NWR. It is very unlikely that Hawaiian moorhens regularly fly over the Kahuku Wind Power project area; however, given their ability to fly and their regular occurrence at the nearby Kii Unit of James Campbell NWR, it is possible that individual Hawaiian moorhens will occasionally fly over the site, especially the lower elevation eastern portion nearest the adjacent wetlands.

Due to the residential nature of the environment at the HECO Waialua substation microwave tower (asphalt roads, traffic, close proximity to houses), no waterbirds are expected to utilize the site. No habitat suitable for waterbirds occurs at the microwave tower site at Flying R Ranch as well, which consists of non-native forest with no nearby water features. Thus no Hawaiian moorhens are expected to be near the vicinity of either off-site microwave tower. Hawaiian moorhen are the most secretive of the native Hawaiian waterbirds, preferring to forage, nest and rest in dense late serial vegetation. Most birds encountered in open or exposed areas will quickly seek cover when disturbed (USFWS 2005). Because of their secretive nature, observing them in the wild is often difficult.

Hawaiian duck

Ducks resembling Hawaiian ducks (but likely to be hybrids) have been seen flying over the lower elevation eastern portion of the Kahuku Wind Power project area on three occasions during point count surveys and one incidental observation (SWCA and First Wind 2009). These individuals were not observed landing on the site. More recently, a pair of ducks that resembled Hawaiian ducks was observed on-site following a period of heavy rain in a flooded depression in the area where topsoil had been excavated historically (L. Ong, SWCA pers. obs.). Ducks flying over the nearby wetlands have been observed up to heights of approximately 200 ft (60 m). Thus, while flying over the Kahuku Wind Power project area, ducks may be vulnerable to colliding with the WTGs, turbine blades, and met towers. The estimated passage rate of Hawaiian duck-like ducks over the Kahuku Wind Power project area is 0.003 birds/ha/hr or 8.0 birds/day for the entire site (SWCA and First Wind 2009).

Due to the residential nature of the environment at the HECO Waialua substation microwave tower (asphalt roads, traffic, close proximity to houses), no waterbirds are expected to utilize the site. No habitat suitable for waterbirds occurs at the microwave tower site at Flying R Ranch as well, which consists of non-native forest with no nearby water features. Thus no Hawaiian ducks are expected to be near the vicinity of either off-site microwave tower.

Newell's Shearwater

Day and Cooper (2008) conducted surveillance radar and audiovisual sampling at the Kahuku Wind Power project area in fall 2007 and summer 2008. These surveys found a relatively low number of targets exhibiting flight speeds and flight patterns that fit the "shearwater/petrel" category. Over five nights of sampling in fall 2007, two petrels or shearwaters were detected flying inland over the Kahuku Wind Power project area toward the Koolau Range and two were detected flying seaward over the site from the Koolau Range. No petrels or shearwaters were detected flying inland during seven nights of sampling in summer 2008, while seven petrels and/or shearwaters were recorded flying seaward. The estimated passage rate of Newell's shearwater over the Kahuku Wind Power project area is 1.28 birds/day in the spring/summer and 1.91 birds/day in the fall, or 307 birds/year for the entire site (SWCA and First Wind 2009).

No visual identification of these birds was possible, but Day and Cooper (2008) suggested that the individuals were likely Newell's shearwaters and not Hawaiian petrels since all targets were recorded after complete darkness. While the uppermost elevation of the site reaches the lower elevational limit for known nesting by this shearwater, no evidence was obtained to suggest that these birds could be nesting on-site.

As indicated, the Newell's shearwater has not been confirmed as a nesting species on Oahu. Assuming the detected birds were Newell's shearwaters, then their observed behavior of flying to and from the Koolau Range suggests strongly that at least a small number of these birds are breeding or prospecting in these mountains. Because of the few detections obtained during the Day and Cooper study and lack of radar studies from adjacent lands, it is not known whether the Kahuku Wind Power project area lies within the primary corridor used by these few birds as they move between their nesting areas and the ocean. Observations of Newell's shearwaters in the Hawaiian Islands indicate that approximately 65% of shearwaters will fly at or below turbine height (Day and Cooper 2008).

No radar data was conducted at the off-site microwave tower sites because the low heights of the towers (60 ft (18 m) or less) and their small profiles would present minimal collision risk to shearwaters. It is expected that Newell's shearwater individuals could occasionally transit over the off-site microwave tower sites, but at much higher altitudes than the towers themselves (average flight height estimated at 410 ± 13 ft (125 ± 4 m) on Kauai)(Day and Cooper 1995).

Hawaiian Petrel

As discussed in the previous section, several birds that were either Newell's shearwaters or Hawaiian petrels were detected by radar flying over the Kahuku Wind Power project area. No visual identification of these birds was possible, but Day and Cooper (2008) suggested that the individuals were likely Newell's shearwaters and not Hawaiian petrels since all targets were recorded after complete darkness. However, because of a lack of definitive identification of these birds, it is considered possible that a small number of Hawaiian petrels could occasionally fly over the Kahuku Wind Power project area during their nesting season (March through September). Hawaiian petrels fly at higher altitudes than Newell's shearwater on average (191 ± 25 m vs 125 ± 4 m) based on survey data from Kauai (Day and Cooper 1995) and Maui (Cooper and Day 2003) and would be less likely to collide with the wind turbines and blades than Newell shearwater. No radar studies were conducted at the off-site microwave tower sites because the low heights of the towers (60 ft (20 m) or less) and their small profiles would present minimal collision risk to petrels. It is expected that Hawaiian petrel individuals could occasionally transit over the off-site microwave tower sites, but at much higher altitudes than the towers themselves (average flight height estimated at 627 ± 82 ft (191 m ± 24 m) based on survey data from Maui (Cooper and Day 2003).

Hawaiian Hoary Bat

Visual and acoustic observations confirmed the presence of the Hawaiian hoary bat at the Kahuku Wind Power project site. Acoustic surveys utilized data from three to five Anabat detectors simultaneously deployed in various locations at the project site from April 2008 to April 2009. The survey effort included a total of 1,285 detector-nights during which 20 call sequences or 13 bat passes were recorded for a rate of 0.0130 bat passes/detector/night or 0.016 bat call sequences/detector/night (see HCP Appendix 4, SWCA and First Wind 2009). The data suggests that bat activity was highest during the months of June to September, however, it should be noted that overall survey effort was noticeably lower during the months of January, February, and April 2009 (see Table 2 below).

The actual number of bats represented by the detections made by the Anabat detectors on the Kahuku Wind Power site is not known. Day and Cooper (2008) reported a visual observation of a Hawaiian hoary bat in July 2008 incidental to the seabird radar survey effort over seven nights (and mornings) of during the summer of 2008. No bats were sighted at the Kahuku Wind Power project area during a total of 18 hours of nocturnal point count surveys conducted from October 2007 through December 2008.

No surveys were conducted, therefore, no data exists for the Hawaiian hoary bat at either microwave tower site. As bats may forage in a wide variety of habitats, and may congregate near lights, bats may occur at either the HECO Waialua substation microwave tower site located in a rural residential area or the Flying R Ranch site which is primarily agricultural.

Table 2. Hawaiian hoary bat activity at Kahuku Wind Power site April 2008 to April 2009 (HCP Appendix 4, SWCA and First Wind 2009)

Year	Month	Nights per Anabat Detector					Total nights	No. of calls sequences	No. of bat passes (> 2 bat calls)
		A	B	C	D	E			
2008	April	21	21	21	21	21	105	1	1
2008	May	27	1	27	27	27	109	1	0
2008	June	30	0	30	20	30	110	4	1
2008	July	31	0	31	31	31	124	3	3
2008	Aug	31	26	31	31	31	150	3	2
2008	Sept	30	30	30	30	30	150	5	3
2008	Oct	31	6	9	19	31	96	1	1
2008	Nov	30	17	30	11	13	101	1	1
2008	Dec	26	23	31	17		97	0	0
2009	Jan			31			31	0	0
2009	Feb		2	28	2	2	34	0	0
2009	Mar		30	27	31	31	119	1	1
2009	April		2	-	27	30	59	0	0
						Total	**1285**	**20**	**13**

Hamakua Marsh State Wildlife Sanctuary

Hamakua Marsh State Wildlife Sanctuary is a 22 ac (8.9 ha) State-owned and managed wetland located on the windward side of Oahu (Figure 4). Hamakua Marsh is characterized as a seasonal floodplain and is divided into four basins, approximately two to eight acres (0.8 to 3.2 ha) in size. The marsh has been managed by DOFAW since 1995 for the four covered waterbird species: the Hawaiian duck, Hawaiian stilt, Hawaiian coot, and Hawaiian moorhen. Active management of the area began in 2001 with removal of red mangrove (*Rhizophora mangle*), the outplanting of native species within the marsh, and the provision of adequate nesting habitat for endangered waterbird species. All four waterbird species have been documented to be nesting in the area.[3]

Ongoing management at the marsh includes year-round predator control (first started 2003) to control populations of feral cats, rats, mongoose, dogs, feral chickens, Hawaiian duck x mallard hybrids, and other duck hybrids (Shiinoki 2006, Misaki 2007, Kim and Misaki 2008, Metzler 2009). Live trapping, foothold trapping, and firearms have been utilized throughout the nesting season by the United States Department of Agriculture, Wildlife Services for control (Misaki 2009). Vegetation cover and water levels may determine the amount of habitat available for foraging and nesting, the timing and duration of nesting, as well as nest success or failure. In years of below average rainfall, pumping of water into the basins has seemed to increase the chances for fledgling success (Shiinoki 2006, Misaki 2007). Alternatively, flooding of nests has occurred following periods of heavy rainfall. Tilling of *Batis*, done prior to the nesting season was observed to increase the amount of quality nesting areas available for stilts and moorhen (Misaki 2007).

[3] All Hawaiian ducks occurring at Hamakua Marsh State Wildlife Sanctuary and elsewhere on O'ahu are believed to actually be Hawaiian duck x mallard (*Anas platyrhynchos*) duck hybrids.

DOFAW has conducted weekly surveys during the waterbird nesting season (from December to August) to document waterbird nesting success and banding, as practicable, to document the survival and dispersal of birds that fledge from Hamakua Marsh. Monitoring has documented a number of coots ranging from one to 20, moorhen from 14 to 48, and stilts from 10 to 71 during a single visit. However, the number of individuals observed has fluctuated among years and does not exhibit an overall increasing trend. This may indicate a limit of available habitat and/or a tendency for birds to disperse from Hamakua elsewhere. Therefore, based on the best available data, a baseline level of productivity was estimated by taking the average number of fledglings observed at the end of each breeding season from 2005 thru 2009.

Table 3. Estimate of baseline productivity for Hawaiian coot, Hawaiian moorhen, and Hawaiian stilt at Hamakua Marsh

Year	Total fledglings observed		
	Coot	Moorhen	Stilt
2005	1	13	1
2006	0	51	15
2007	1	36	13
2008	5	33	10
2009	4	50	16
Average	2.2	36.6	11

The drainage ditch along the marsh provides the ideal habitat for moorhen. Territories are established on both sides of the canal, which provides adequate protection, and cover from predators (Kim and Misaki 2008). The canal provides approximately 700 m (2,300 ft) in nesting habitat, which is divided into the 17 established territories. The territories have been fairly consistent in size and range throughout the past nesting seasons, although it is unknown if they are permanently established.

Increased water levels may reduce the amount of open mud areas available for suitable stilt nesting. Increased levels of water also may accelerate the growth of *Batis*, which further reduces available nesting habitat (Kim and Misaki 2008). Stilt territories that successfully established were in areas that had little or no vegetation cover and no surface water.

Mortality has been observed due to flooding of nests, predation, lack of available water resources, natural causes, and vehicle collisions. In 2009, two moorhens were hit and killed by vehicles on Hamakua Drive. A third moorhen thought to be hit by an automobile was taken to the Animal Hospital, rehabilitated and released. Following these incidents DOFAW has worked with area businesses to raise awareness and on numerous occasions, birds have had to be coerced to return to the marsh from the street and street-side. This led to a special project in October 2009 to plant over 300 gallon-sized naupaka (*Scaevola taccada*) and over 100 naio (*Myoporum sandwicense*) on the business side of the marsh as a natural barrier to the urban interface. Two months later, over 90 percent of the plants have survived and no bird injuries or deaths have been observed since. It is hoped that by the same time next year, the plants will reach maturity and we can consider expanding this pilot project along more of the *makai* side of the Marsh (Metzler 2009).

Makamakole

In May of 2007, Kaheawa Wind Power biologists identified a potential Hawaiian petrel breeding area in Makamakaole, West Maui (Kaheawa Wind Power 2008). Very low numbers of Newell's shearwaters were subsequently also heard calling at this site, suggesting that this species also may be nesting or prospecting for nesting sites in the area. This area of interest which may support a breeding colony is located primarily within the West Maui Forest Reserve (Figure 5), and probably also extends into Kahakuloa Natural Area Reserve. The area is adjacent to an existing widely spaced housing development. In 2007, DLNR constructed a fence along the border between the West Maui Forest Reserve and Kahakuloa Natural Area Reserve. The purpose of the fence was to exclude vegetation-destroying ungulates from the Natural Area Reserve. A portion of this fence runs along the western edge of the area of interest which may support seabird breeding activity (Figure 5).

Kaheawa Wind Power (2009) developed a document titled "Kaheawa Wind Power Seabird Mitigation in West Maui – 2009 Action Plan for Makamakaole" in May 2009 to satisfy mitigation requirements of the Kaheawa Pastures Wind Energy Generation Facility Habitat Conservation Plan and associated State of Hawaii Incidental Take License (ITL-08) and Federal Incidental Take Permit (TE-118901-0). The plan proposed implementation of the following actions: (1) Remove predators along Makamakaole fenceline and stream corridor access points; (2) Install visibility tape along ungulate fence; (3) Predator Scat Sample Analysis; (4) Necropsies; (5) Colony Mapping; (6) Radar Monitoring; (7) Reporting, Review, and Adaptive Management.

As of January 2010, there had been minimal progress toward implementation of the required management actions. Access to the site was obtained in June 2009, however, traps were first set on September 28, 2009, with limited trapping effort (Table 4). Preliminary investigation has confirmed mongoose are present at the site and probably represent a predation threat to [nesting] seabirds at Makamakaole (G. Spencer, pers. comm. 2010). Radar monitoring and colony mapping efforts are incomplete, therefore, we cannot confirm or estimate the number of breeding pairs of either seabird species.

Table 4. 2009 Predator removal effort at Makamakaole

October		November		December	
Trap days	19	Trap days	15	Trap days	10
Number of Traps	6-11	Number of Traps	8-11	Number of Traps	5-8
Total mongoose	10	Total mongoose	4	Total mongoose	1
Total Cats	0	Total Cats	0	Total Cats	0

EFFECTS OF THE ACTION

Effects of Construction Footprint

No direct impacts to listed species are expected to result from on-site habitat disturbance. The only listed species with potential to occur regularly in the project area is the Hawaiian hoary bat, which have shown very low but regular activity rates on site and could roost in trees on the property. Hawaiian hoary bats are known to breed at low elevations, so it is possible dependent juvenile bats occur in the project area during the months of June to August. In order to avoid potential for harm to non-volent juvenile bats, no clearing of trees for construction will occur when Hawaiian hoary bats are expected to be breeding (June through August).

Direct Effects of Collisions with Project Structures

Construction and operation of the Kahuku Wind Power project with its proposed wind turbine generators (WTGs), on-site and off-site microwave towers, one permanent unguyed met tower, overhead collection lines and relocated distribution line would present the potential for collisions by the four listed waterbirds, two seabirds and one bat species. The potential for each listed species to collide with the project components was identified based on the results of the on-site wildlife surveys and the proposed design (HCP Appendix 3 and 4). Collisions with project structures may result in injury or mortality. When on the ground, injured birds may be subject to predation by mongooses, cats, or dogs, or susceptible to vehicle collisions. However, an enforced speed limit of 10 mph should minimize the potential for such collisions.
Fatality estimate models were developed by Kahuku Wind Power that incorporated rates of species occurrence, observed flight heights, rates of interaction with turbines and met towers, and assumptions regarding the likelihood of collision/avoidance as covered bird species encounter air space occupied by project components. The last factor was then varied in the models to create a range of probabilities of mortality (collision) for each species on an annual basis. Range of expected mortality coincides with the amount of "total direct impacts" expected from construction and operation of the Kahuku Wind Project . Visual avoidance by seabird and waterbird species is not supported by any evidence. Hawaiian petrels fly over 30 mi/hr (48 km/hr) (Day and Cooper 1995) at night time, so are unlikely to be able to effectively avoid objects. We assume that if a petrel is close enough to a tower to collide with it, it has not seen the tower, and is likely to collide with the WTG tower or blades and sustain injury or death.

Indirect Effects of Collisions with Project Structures

In addition to direct impacts such as mortality or injury of listed species resulting from collisions with project components, indirect impacts may also occur. For example, it is possible that adult birds killed through on-site collisions are tending to eggs, nestlings, or dependent fledglings, or adult bats could have been tending to dependent juveniles. The loss of these adults would then also lead to the loss of the eggs or dependent young. Loss of eggs or young would be an indirect impact attributable to the proposed action.

Estimated annual injury or mortality resulting from the Kahuku Wind Project for each of the covered species addressed in the HCP is provided below. Also included for each species is an estimate of indirect take based on expected level of direct take. As discussed in Section 8.2

Monitoring of the HCP, the amount of total impacts attributed to the project (adjusted) will be identified annually. Total impacts will be assessed using observed direct impacts (actual individuals found during post-construction monitoring plus indirect impacts) and an estimate of unobserved direct take based on searcher efficiency and scavenging trial results.[4]

Effects of Predator Control on Hawaiian Moorhen

There is a potential for waterbirds to be accidentally trapped in the predator traps. However, based on past and ongoing work on the Oahu NWR Complex, the Hawaiian coot, Hawaiian stilt, and the Hawaiian duck have never been documented in the traps within the Oahu NWR Complex units, during trapping efforts that have been implemented periodically since 1992. Although the Hawaiian ducks have been caught in live traps on Kauai, based on current Hawaiian duck hybrid studies conducted by Andy Engilis of University California at Davis, it is not likely that a Hawaiian duck will be present within the Kawainui Marsh based on current population levels but still remains a possibility (Engilis et al. 2002, Fowler et al. 2008).

There is a high likelihood that Hawaiian moorhen will be accidentally trapped in the predator live traps due to the higher densities on Oahu and the inquisitive nature of these birds. The trapability of moorhen is further demonstrated by a study conducted in 2005 through 2007, by David DesRochers and Oahu NWR Complex staff, as part of his doctoral program at Tufts University, Massachusetts. The program was designed to begin banding this species for a cooperative project on improving population estimates of Hawaiian moorhen with call response surveys and banding data (DesRochers et al. 2006). Within a two-year time period, 90 Hawaiian moorhen were banded with 162 captures. The birds are naturally attracted to the traps. Therefore, Hawaiian moorhen may be captured in live traps, which could result in injury or mortality.

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[4] This will account for individuals that may be killed or injured by collision with project components but that are not found during the monitoring effort. It is generally accepted that some birds and bats killed through collision with wind turbines are not found by searchers for various reasons, including heavy vegetation cover and scavenging. The terms and equations discussed in HCP Section 6.3 and Appendix 9.

Table 5. Summary of Effects of Wind Energy Facility on Listed Species (HCP, Pages 50-74).

Common Name	Scientific Name	Type	Life Stage	Expected Impact (Annual)	Expected Impact (20-Year)	HCP Authorized Baseline **Higher**
Hawaiian petrel	*Pterodroma sandwichensis*	Direct	Adults/ immature	0.17	4	8
		Indirect	Chicks	0.17	4	**12**
Newell's shearwater	*Puffinus auricularis newelli*	Direct	Adults/ immature	0.34	7	12
		Indirect	Chicks	0.16	4	**18**
Hawaiian duck	*Anas wyvilliana*	Direct	Adults/ immature	0.026	1	16
		Indirect	Ducklings	0.031	1	**24**
Hawaiian stilt	*Himantopus mexicanus knudseni*	Direct	Adults/ immature	0.026	1	12
		Indirect	Ducklings	0.0012	1	**18**
Hawaiian coot	*Fulica alai*	Direct	Adults/ immature	0.026	1	12
		Indirect	Fledglings	0.012	1	**18**
Hawaiian moorhen	*Gallinula chloropus sandvicensis*	Direct	Adults/ immature	0.026	1	14
		Indirect	Fledglings	0.017	1	**20**
Hawaiian hoary bat	*Lasiurus cinereus semotus*	Direct	Adults/ immature	0.19	4	21
		Indirect	Fledglings	0.34	7	**32**

Expected versus HCP Authorized Effects

The HCP and Incidental Take License (ITL-10) (March 2010) issued to Kahuku Wind Power LLC authorize a level of effects at Baseline and Higher tiers above those effects estimated by the HCP applicant's models for each listed species (Tables 2 and 5). The effects authorized by the HCP are at the request of Kahuku Wind Power and their desire to be covered for a level of impacts given the uncertainty surrounding fatality monitoring and the results of carcass removal and searcher efficiency studies which are likely to adjust impacts above 'Expected' levels.

For each species, the annual Baseline level of take was estimated based on the expected average annual mortality identified through the modeling using the most reasonable expectations of avoidance for each species, rounded up to the nearest whole integer, and then adjusted to account for expected levels of unobserved direct take. For example, modeling suggests Newell's shearwater mortality will occur at an average rate of approximately 0.34 adults per year. To identify the annual Baseline level of take requested to be authorized, this was first rounded up to 1 adult per year (i.e., almost 3x). Then, based on assumptions concerning unobserved direct take, it was expected that the discovery of one (1) shearwater mortality or injury in a given year would lead to an requested level of total direct take for that year of 2 shearwaters.

Effects of Waterbird Mitigation at Hamakua Marsh

Year-round predator trapping and baiting to remove predators (e.g. cats, mongoose, rats, dogs), and removal of predators by hunting will reduce the threat of predation on the four covered waterbird species. Removal of undesirable plant species and establishment of native marsh plant species will enhance available nesting habitat for the four covered waterbird species. Removal of feral ducks, mallards and Hawaiian duck hybrids will reduce the likelihood of hybridization with pure koloa in the future.

By reducing predation and enhancing nesting opportunities, mitigation efforts are expected to result in a net increase in productivity, measured in fledgling production, over baseline productivity levels for the stilt, coot, and moorhen (see Table 3). This net increase will meet or exceed the required production of fledglings required to offset the requested impacts for each species at Baseline, and if necessary, Higher tiers (see Table 2 and Table 6). The net increase in productivity of the mitigation program also takes into account fledgling survival to adulthood. For example, if 50% of all Hawaiian stilt fledglings survive to adulthood, the required compensation for the direct take of one adult Hawaiian stilt would be the production of two fledglings so that one can be expected to replace the taken bird. If increased adult survival can be demonstrated, then adults may also be directly replaced by another adult.

The fledgling production requirements assume same-year replacement of covered species impacts by same-year fledgling production. For instance, because Hawaiian coot, Hawaiian moorhen, and Hawaiian stilt have extended breeding periods in Hawaii, it is anticipated that impacts to these covered waterbird species due to Kahuku Wind Power will be mitigated by same year replacement by fledglings produced at Hamakua Marsh. No loss of productivity is added for the Hawaiian coot and Hawaiian moorhen because both species can be expected to reach maturity after one year (fledglings will have matured by the next breeding season). On the other hand, because Hawaiian stilt fledglings first reach maturity in year 2, an additional amount of mitigation (fledgling production) to compensate for the (one year) loss of productivity is required for the one year of lag in replacing adults with fledglings. Table 6 lists the net reproductive success over existing baseline productivity required for each of the listed waterbird species to achieve net benefit at Baseline levels.

Overall, the mitigation program will result in a number of fledglings and/or documented adult survival that exceed the requested impacts for Hawaiian coot, Hawaiian stilt and Hawaiian moorhen, thereby producing a net benefit for these three covered waterbird species over the entire permit term. For the Hawaiian duck, mitigation will remove feral ducks, mallards and Hawaiian duck hybrids as far as practicable, thereby reducing the potential for hybridization and eliminating indirect impacts to the other covered waterbird species such as competition for breeding territories or resource use. For the duration of mitigation at Hamakua Marsh provided for by the HCP, the reduction in predator populations, considered to be a threat to all three waterbird species, is expected to contribute to the overall survival and recovery of the species.

Effects of Seabird Colony Management

If determined to be feasible, construction of a cat-proof fence, eradication of cats and mongoose, and control of rat populations at the Makamakaole site will be implemented. If implemented in an effective manner, these actions are expected to significantly reduce the threat of predation on adults, eggs, chicks, and fledglings of the Hawaiian petrel and Newell's shearwater within a fenced area. Studies of social attraction techniques designed to increase the attractiveness of the mitigation area is anticipated to result in an increase in the numbers of each species prospecting, and potentially utilizing the area for breeding purposes. However, at this time, it should be noted that neither the actual existence or density of burrows on-the-ground has been confirmed, nor the size of the fenced area necessary to achieve mitigation goals has been determined.

If mitigation at Makamakaole is not feasible, predator control will be implemented at a site within Haleakala National Park. Predator trapping and baiting is expected to reduce the threat of predation on the Hawaiian petrel. Because the Newell's shearwater does not occur at this site colony protection and management at a location on Kauai is expected to manage threats and/or contribute to the recovery at a level to compensate for the requested impacts at Baseline, and if necessary Higher tiers.

Table 6. Fledgling production requirements of listed waterbird species at Baseline Tier (HCP, Page 88).

Species	**Baseline take level**			**Fledgling production requirements**	
				Annual Average	**20 Year**
Hawaiian duck	20-year take limit	adults	8		
		fledglings	8		
	annual average	adults	0.4	0.62[1]	
		fledglings	0.4	0.40	
	Total fledglings required			**1.02**	**20.4**
Hawaiian stilt	20-year take limit	adults	8		
		fledglings	4		
	annual average	adults	0.4	0.80[2]	
		fledglings	0.2	0.20	
	loss of productivity**			0.19[3]	
	Total fledglings required			**1.19**	**23.8**
Hawaiian coot	20-year take limit	adults	8		
		fledglings	4		
	annual average	adults	0.4	0.8[2]	
		fledglings	0.2	0.20	
	Total fledglings required			**1.00**	**20**
Hawaiian moorhen	20-year take limit	adults	8		
		fledglings	6		
	annual average	adults	0.4	0.80[2]	
		fledglings	0.3	0.30	
	Total fledglings required			**1.10**	**22**

[1]Annual survival of Hawaiian duck fledgling to adulthood = 0.65
[2]Annual survival of Hawaiian stilt, Hawaiian coot and Hawaiian moorhen fledgling to adulthood = 0.50
[3]Annual productivity for Hawaiian stilt is 0.47 fledglings per adult

It is assumed that predator control and social attraction techniques will be implemented at an intensity, duration, and overall effectiveness to provide a net increase over existing conditions to offset impacts of the proposed action to the two covered seabird species at the Baseline tier levels, and if necessary, Higher tier levels. The net increase in productivity and/or survival and recovery will compensate for total direct and indirect impacts as well as any loss of productivity.

Hawaiian Hoary Bat Mitigation

On-site acoustic surveys will provide information on Hawaiian hoary bat activity levels and possible habitat utilization within the project area. Standardized survey and monitoring techniques that provide basic information on species distribution and abundance are identified as a priority in the Hawaiian hoary bat recovery strategy. Little is known about the hoary bat on Oahu, and it has been assumed that bats may be migrant or vagrant (USFWS 1998). Thus, although limited in scope, the on-site surveys conducted at regular intervals over the 20-year permit term will contribute to basic species information on the island of Oahu.

Table 7. Baseline mitigation required for Hawaiian petrel and Newell's shearwater (HCP, Page 80).

Species	**Baseline take level**			**Average annual fledgling production requirement**
Hawaiian petrel	20-year take limit	Adults	4	
		Fledglings	4	
	Annual average	Adults	0.2	0.67 (=0.2 / 0.30[a])
		Fledglings	0.2	0.2
	Total fledglings			**0.87**
	Total loss of productivity (years 1 and 2)			0.23 (=0.2 x 0.89[b] x 0.93[c] x 0.7[d] x 2)
	Total loss of productivity (years 3 and 4)			0.12 (=0.2 x 0.89[b] x 0.93[c] x (0.7[d]/2) x 2)
	Total fledglings required per year			**1.22**
Newell's shearwater	20-year take limit	Adults	8	
		Fledglings	4	
	Annual average	Adults	0.4	1.67 (=0.4 / 0.24[a])
		Fledglings	0.2	0.20
	Total fledglings			**1.87**
	Total loss of productivity (years 1 and 2)			0.23 (=0.40 x 0.46[b] x 0.90[c] x 0.7[d] x 2)
	Total loss of productivity (years 3 - 5)			0.17 (=0.40 x 0.46[b] x 0.90[c] x (0.7[d]/2) x 3)
	Total fledglings required per year			**2.27**

[a] fledgling survival to adulthood [b] percentage of the adult population breeding per year [c] yearly adult survivorship [d] reproductive success of a pair

Completion of restoration of a 1,800 ac burn area, previously forested and known to support bats, with native species and invasive species management may be expected to restore former Hawaiian hoary bat roost and/or foraging sites. In general, the availability of roost sites rather than food availability is believed to be the primary limitation in the distribution and abundance of many bat species (USFWS 1998). In addition, because the decline of the Hawaiian hoary bat has been attributed to reduction in tree cover in historic times, restoration of this forested area is expected to minimize the further decline of the species and thereby contribute survival and recovery of the bat. At this time, it is not possible to estimate the number of bats that may be supported by this restoration effort because any estimates of home range, core area, and long axis across home range reflect very short time periods in the annual cycle of bats and were studied only in the Hamakua Coast/Hilo area of Hawaii Island (F. Bonaccorso, pers. comm. 2010).

At the Higher tier, implementation of increased cut-in speed for WTGs is expected to result in a reduction of bat fatalities at Kahuku Wind Power. Additional habitat management will provide additional bat roosting and/or foraging opportunities. These two measures are expected to minimize the decline and contribute to the overall survival and recovery of the bat.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act. Future State restoration and management actions are using Federal funding and are subject to section 7 consultation.

Two wind energy generating facilities are proposed on the island of Oahu, the 30 MW Na Pua Makani wind facility project in Kahuku and the 50 to 75 MW Kawailoa wind facility project in Haleiwa. We anticipate that both have the potential to result in incidental take of the endangered Hawaiian hoary bat and endangered Hawaiian petrel and threatened Newell's shearwater from collisions with project structures. However, it is expected if either or both projects are constructed and operational, any impacts to listed species will be addressed pursuant to HRS §195D and the ESA, thereby resulting in a net benefit to the species.

If Alternative 1 (Makakaole Site) for seabird mitigation is determined to be feasible, management at the site includes actions funded and implemented under the existing Kaheawa Pastures Wind Energy Generation Facility (KWP) Habitat Conservation Plan and proposed Kaheawa Wind Power II (KWP II) Wind Energy Generation Facility Habitat Conservation Plan. Actions will be similar to what is proposed under the mitigation program for Kahuku Wind Power and can be expected to increase seabird productivity and knowledge of social attraction techniques via fencing, predator control and completion of a social attraction experiment.

In the future, it is reasonable to expect DOFAW will continue predator control and habitat management at Hamakua Marsh for the benefit of the four listed waterbird species. In addition to its benefits for endangered species recovery, its location in a highly populated urban area creates high visibility and potential for excellent outreach opportunities. Therefore, DOFAW is committed to the long-term management and success of the area, subject to the availability of funds (Scott Fretz, pers. comm.).

At a broader scale, it is reasonable to expect that Oahu will likely continue to experience increasing human population growth and real estate development. Some of the causes of decline of the species addressed in this Biological Opinion (such as mammal predation, light disorientation, pesticide use, and loss of nesting or roosting habitats) may increase due to this growth. In general, it is assumed that future development projects will be conducted in compliance with all applicable local, State, and Federal environmental regulations.

Conclusion

Hawaiian Stilt

Oahu supports 35 to 50 percent of the Hawaiian stilt population with approximately 450 to 700 birds present on the island. The effects to stilts at the Baseline and Higher tiers, 12 stilts and 18 stilts, respectively, over 20 years is not expected to substantially impact the population of the stilt on Oahu. Levels of take may negatively impact the species due to its small population numbers, however, these impacts are expected to be temporary. The proposed mitigation for both Baseline and Higher tiers is expected to offset the anticipated impacts and contribute to the species' recovery by providing a net conservation benefit. For these reasons, no decline in the overall species survival or recovery is anticipated. Thus, we believe the proposed project will not jeopardize the survival and recovery of the Hawaiian stilt in the wild.

Hawaiian Coot

Oahu supports between 500 to 1,000 coots, or up to 33 percent of the total population. The effects to stilts at the Baseline and Higher tiers, 12 coots and 18 coots, respectively, over 20 years is not expected to substantially impact the population of the coot on Oahu. Levels of take may negatively impact the species due to its small population numbers, however, these impacts are expected to be temporary. The proposed mitigation for both Baseline and Higher tiers is expected to offset the anticipated impacts and contribute to the species' recovery by providing a net conservation benefit. For these reasons, no decline in the overall species survival or recovery is anticipated. Thus, we believe the proposed project will not jeopardize the survival and recovery of the Hawaiian coot in the wild.

Hawaiian moorhen

Biannual waterbird surveys record an average of 341 moorhens throughout the state (USFWS 2005). This average is likely an inaccurate estimate of true population size as common moorhens are secretive and difficult to census (USFWS 2005). The effects to moorhen at the Baseline and Higher tiers, 14 moorhen and 20 moorhen, respectively, over 20 years is not expected to substantially impact the population of the moorhen on Oahu. Levels of take may negatively impact the species in the short-term due to its small population numbers, however, these impacts are expected to be temporary. The proposed mitigation for both Baseline and Higher tiers is expected to offset the anticipated impacts and contribute to the species' recovery by providing a net conservation benefit. For these reasons, no decline in the overall species survival or recovery is anticipated. Thus, we believe the proposed project will not jeopardize the survival and recovery of the Hawaiian stilt in the wild.

Hawaiian Duck

An estimated 300 hybrid Hawaiian ducks are present on Oahu (Engilis et al. 2002, USFWS 2005a). Because it is anticipated that all hybrid Hawaiian ducks on Oahu will ultimately be removed or relocated to allow for the reintroduction of pure Hawaiian ducks, loss of hybrid ducks as a result of operation of the Kahuku Wind Project is beneficial. In addition, removal of Hawaiian duck hybrids via implementation of the HCP is also beneficial to the recovery of the

Hawaiian duck. For these reasons, we believe the proposed project will not jeopardize the survival and recovery of the Hawaiian duck in the wild.

Newell's Shearwater

The most recent population estimate of Newell's shearwater was approximately 20,000 birds (Pyle and Pyle 2009). Radar studies and population modeling have indicated that the population of Newell's shearwater has likely been on a decline especially on Kauai (Ainley et al. 2001, Day et al. 2003a). Contributing factors to this decline such as loss of nesting habitat, predation by introduced mammals (feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting are expected to continue to impact Newell's shearwater populations (Ainley et al. 1997, Mitchell et al. 2005, Hays and Conant 2007).

The effects at the Baseline tier (12 shearwaters/20 years) represents approximately 0.06 percent, and the Higher tier (18 shearwaters / 20 years = 0.9 adults or juveniles per year) represents approximately 0.09 percent of the estimated Newell's shearwater population. The Higher tier may present a greater risk for the subset of the species range that breeds on Maui, which is poorly known but presumed small. However, the effects of these impacts are expected to be temporary, but can expected to persist until the surviving member of a breeding pair is able to find a mate, or the net increase in fledglings produced achieve reproductive status (a minimum of 6 years). The overall mitigation program provided in the HCP is expected to provide a net benefit to the recovery of the species. Thus, given the low percentage of the species impacted and temporary duration of impacts, we believe the proposed project will not jeopardize the survival and recovery of the Newell's shearwater in the wild.

Hawaiian Petrel

The current population of Hawaiian petrel is estimated to be approximately 20,000 birds, with 4,000 to 5,000 breeding pairs (Mitchell et al. 2005). Thus, effects at the Baseline tier (8 petrels/20 years) represents approximately 0.04 percent, and the Higher tier (12 petrels/20 years = 0.6 adults or juveniles per year) represents approximately 0.06 percent of the estimated Hawaiian petrel population. The Hawaiian petrel colony at Haleakala, Maui, is composed of as many as 1,000 nesting pairs or approximately one-fifth to one-quarter of the total breeding population (Mitchell et al. 2005). The number of birds breeding in West Maui is not known. The Higher tier could represent up to 1.2 percent of the minimum (1,000 pairs) Maui population if all birds taken were breeding birds rather than non-breeding visitors to their colonies. The effects of these impacts are expected to be temporary, but can expected to persist until the surviving member of a breeding pair is able to find another mate, or the net increase in fledglings produced achieve reproductive status (a minimum of 7 years). The overall mitigation program provided in the HCP is expected to provide a net benefit to the recovery of the species. Thus, given the low percentage of the species impacted and temporary duration of impacts, we believe the proposed project will not jeopardize the survival and recovery of the Hawaiian petrel in the wild.

Hawaiian hoary bat

No reliable population estimate exists for the Hawaiian hoary bat, therefore, it would be difficult to estimate effects of the proposed project at the Baseline and Higher tiers, 21 and 32 bats, respectively. However, the bat is currently known on Kauai, Oahu, Molokai, Maui, and potentially widely distributed on Hawaii Island. The level of occupancy, distribution, and abundance of the bat on Oahu is also unknown. On-site surveys conducted over the 20-year project duration will provide information likely to benefit bat recovery. The proposed mitigation will likely increase the amount of available roosting habitat and foraging opportunities statewide. For these reasons, no decline in the overall species survival or recovery is anticipated. Thus, we believe the proposed project will not jeopardize the survival and recovery of the Hawaiian hoary bat in the wild.

After reviewing the current status of the species, the environmental baseline for species in the action area, and the effects, construction impacts and management activities, including the cumulative effects, it is our biological opinion that implementation of the proposed action is not likely to jeopardize the survival and recovery of the Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, Hawaiian duck, Newell's shearwater, Hawaiian petrel, or Hawaiian hoary bat. No critical habitat has been designated for these species; therefore, none will be affected.

Incidental Take Statement

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) by the USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the USFWS (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by DOE and Kahuku Wind Power, based on commitments described in the project description, so that they become binding conditions in order for the exemption in section 7(o)(2) to apply. DOE has the continuing duty to regulate the activity covered by this incidental take statement. If DOE (1) fails to assume and implement the terms and conditions or (2) fails to require Kahuku Wind Power to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or contract, then the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the DOE must report the progress of the action and its impact on the species, or ensure that Kahuku Wind Power provides such reports to the USFWS as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Amount or Extent of Take

The USFWS anticipates that take will occur in the form of harm, harassment, and mortality as a result the proposed action as described in this Biological Opinion.

Up to eighteen (18) Hawaiian stilt adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites;

Up to eighteen (18) Hawaiian coot adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites;

Up to twenty (20) Hawaiian moorhen adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites;

Up to twenty-four (24) Hawaiian duck adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites;

Up to eighteen (18) Newell's shearwater adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites;

Up to twelve (12) Hawaiian petrel adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites;

Up to thirty-two (32) Hawaiian hoary bat adults or juveniles over the 20-year permit term, may be incidentally taken in the form of harm (injury or mortality) as a result of collision with project structures or at project mitigation sites.

Effect of Take
In this Biological Opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy of the Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, Hawaiian duck, Newell's shearwater, Hawaiian petrel, or Hawaiian hoary bat, and no critical habitat has been designated for these species so no adverse modification of critical habitat is possible.

Reasonable and Prudent Measures

No reasonable and prudent measures beyond the conservation measures described in the Kahuku Wind Power HCP have been identified to minimize incidental take.

Terms and Conditions

No additional terms and conditions are necessary as no Reasonable and Prudent Measures have been identified.

Conservation Recommendations

Section 7(a)(1) of the Endangered Species Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the USFWS requests notification of the implementation of any conservation recommendations.

1. We recommend if Hawaiian moorhen are captured in live traps, attempts should be made to band individual birds. DOFAW biologist will be contacted immediately, and if available, will band the birds. Birds should be banded with color bands and U.S. Geological Services aluminum bands. Banding information will yield important life history information that will aid in recovery of the species.

2. We recommend Kahuku Wind Power conduct acoustic monitoring for the Hawaiian hoary bat at the proposed habitat mitigation site to document activity levels and habitat preference pre- and post-implementation of habitat management actions. Survey data will assist the Hawaii Bat Research Cooperative and contribute to island-wide surveys designed to establish overall population trends. Acoustic data may also provide a measure of success for the habitat management activities at the mitigation site.

3. We recommend that Kahuku Wind Power maintain close coordination and work cooperatively with the staff of James Campbell National Wildlife Refuge and share relevant project information, expertise, and biological data to benefit listed wildlife in the Kahuku Wind Power project area and adjacent properties.

Reinitiation Statement

This concludes formal consultation on the proposed project described in this biological opinion. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law), and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease pending reinitiation. Should there be a failure to carry out any or all of the described measures, or if the measures are not effective or are modified in any way without Service coordination, reinitiation of consultation will be required. If you have any questions regarding this Biological Opinion, please contact Consultation and HCP Program Leader Patrice Ashfield (808) 792-9400.

Sincerely,

Loyal Mehrhoff
Field Supervisor

REFERENCES

Adams, J. 2008. "Petrels in the Pacific: Tracking the Far-ranging Movements of Endangered 'Ua'u (Hawaiian Petrel)." US Geological Survey, Western Ecological Research Center. Available at: www.microwavetelemetry.com/newsletters/spring_2007Page4.pdf. Accessed February 11, 2008.

Ainley, D.G., L. DeForest, N. Nur, R. Podolsky, G. Spencer and T.C. Telfer. 1995. Status of the threatened Newell's Shearwater on Kaua'i: Will the population soon be endangered?

Ainley, D.G., T.C. Telfer, and M.H. Reynolds. 1997. Townsend's and Newell's Shearwater (*Puffinus auricularis*). In: The Birds of North America, No. 297. (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Ainley, D.G., R. Podolsky, L. DeForest, G. Spencer, and N. Nur. 2001. The status and population trends of the Newell's Shearwater or Kauz'i: insights into modeling. Studies in Avian Biology No. 22: 108-123.

Anderson, S.K. 2002. "*Lasiurus cinereus*" (On-line), Animal Diversity Web. Available online at http://animaldiversity.ummz.umich.edu/site/accounts/information/Lasiurus_cinereus.html.

Avian Powerline Interaction Committee (APLIC) (1994). Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Washington, D.C., Edison Electric Institute: 78.

Barclay, R.M.R. 1989. The effect of reproductive condition on the foraging behavior of female hoary bats, *Lasiurus cinereus*. Behavioral Ecology and Sociobiology 24(31-37).

Barclay, R.M., and L.D. Harder. 2003. Life Histories of Bats: Life in the Slow Lane. In: Bat Ecology. Kunz, T., and B. Fenton (eds). University of Chicago Press, pp. 209-256.

Belwood, J.J. and J.H. Fullard. 1984. Echolocation and foraging behavior in the Hawaiian hoary bat, *Lasiurus cinereus semotus*. Canadian J. Zool. 62:2113-2120.

Black, H. 1972. Differential exploitation of moths by the bat *Eptesicus fuscus* and *Lasiurus cinereus*. J. Mamm. 53:598-601.

Bonaccorso, F. 2009a. U. S. Geological Survey-Biological Resources Discipline. Hawaiian hoary bat roosting data.

Bonaccorso, F. 2009b. Paper presented at The Hawaiian hoary bat climate change workshop, Hilo, Hawaii, 27 February 2009.

Bonaccorso, F. 2010. USGS PIERC, Kilauea Field Station. Hawaiian hoary bat home range and core areas.

Bradley, J.S., R.D. Wooller, I.J. Skira, and D.L. Serventy. 1989. Age-dependent survival of breeding short-tailed shearwaters *Puffinus tenuirostris*. Journal of Animal Ecology 58:175–188.

Cabrera, T.A. 1996. Occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) on the island of Hawaii. Pacific Science 50:238.

Chang, P. R. 1990. Strategies for managing endangered waterbirds on Hawaiian National Wildlife Refuges. M.S. Thesis, Univ. of Massachusetts, Dept. of Forestry and Wildlife. Management., Amherst, MA. 87 pp.

Coleman, R. A. 1981. The reproductive biology of the Hawaiian subspecies of the black-necked stilts, *Himantopus mexicanus knudseni*. Ph.D. diss., Pennsylvania State Univ. 106 pp.

Conant, S. 1981. A survey of the waterbirds of Kawainui Marsh. Prepared for Hawaii Department of Land and Natural Resources. 63 pp.

Cooper, B.A. and R.H. Day. 2003. Movement of the Hawaiian Petrel to Inland Breeding Sites on Maui Island, Hawaii. Waterbirds 26(1):67-71.

Day, R.H., and B.A. Cooper. 1995. Patterns of movement of dark-rumped petrels and Newell's shearwater on Kauai. Condor 97:1011-1027.

Day, R.H., and B.A. Cooper. 2002. Petrel and shearwater surveys near Kalaupapa, Molokai Island, June 2002. Unpublished report prepared for National Park Service, Hawaii National Park, HI, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK, and Forest Grove, OR. 17 pp.

Day, R.H. and B.A. Cooper. 2008. Results of Endangered Seabird and Hawaiian Hoary Bat Surveys on Northern Oahu Island, Hawaii, October 2007 and July 2008. Prepared by ABR, Inc., Forest Grove, OR and Fairbanks, AK for FirstWind, LLC.

Day, R.H., B.A. Cooper, and T.C. Telfer. 2003a. Decline of Townsend's (Newell's) Shearwaters (Puffinus auricularis newelli) on Kauai, Hawaii. Auk 120:669-679.

Day, R.H., B.A. Cooper, Brian A.; Blaha, Richard J. 2003b. Movement Patterns of Hawaiian Petrels and
Newell's Shearwaters on the Island of Hawai'i. Pacific Science 57(2):147-159.

Del Hoyo, J., A. Elliott and J. Sargatal. 1992. The Handbook of the Birds of the World, Volume I. Ostrich to Ducks. Lynx Edicions, Barcelona.

Department of Forestry and Wildlife (DLNR) 2007b. Proposed Hazard Reduction and Reforestation in the Aftermath of the Upper Waiohulu Wildfire. Available at: http://www.state.hi.us/dlnr/dofaw/pubs/KFRproposal-03.27.0761_full.pdf

DesRochers, David 2006. The first accurate census of the endangered Hawaiian Moorhen *(Gallinula chloropus sandvicensis*, unpublished.

DesRochers, David W., Michael D. Silbernagle, Aaron Nadig, J. Michael Reed. 2006. Improving population estimates of Hawaiian Moorhen *(Gallinula chloropus sandvicensis)* with call response surveys and banding data, unpublished.

Dibben-Young, Arleone. 2007. Draft Review of Thirty Years of Banding Hawaiian Coot and Hawaiian Moorhen, 1977 to 2007; report compiling available data and anecdotal information, unpublished.

Eijzenga, Jaap. 2005. Draft Key Predators study of 2003 to 2004 on James Campbell National Wildlife Refuge, unpublished.

Engilis A. Jr., Uyehara K.J., J.G. Giffin. 2002. Hawaiian duck (Anas wyvilliana). In: Poole A, Gill F (eds) The Birds of North America, No. 694. The Birds of North America, Inc., Philadelphia

Engilis, A., Jr. and T. K. Pratt. 1993. Status and population trends of Hawaiis native waterbirds, 1977-1987. Wilson Bull. 105(1):142-158.

Engilis, A. 1988. *Waterbird status in Kawainui Marsh.* State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife. #17711(21). Unpublished. 3 pp.

Fowler, A. C., J. M. Eadie, A. Engilis Jr. 2008. Identification of endangered Hawaiian ducks (*Anas wyvilliana*), introduced North American mallards (*A. platyrhynchos*) and their hybrids using multilocus genotypes. Conservation Genetics. Published online December 20, 2008.

Griffin, C. R., R. J. Shallenberger, and S. I. Fefer. 1989. Hawaiis endangered waterbirds: a resource management challenge. Pp. 1165-1175 in Freshwater Wetlands and Wildlife. Department of Energy symposium no. 61 (R.R. Schwartz and Gibbons, eds.). U.S. Department of Energy, Oakridge, TN.

Harrison, C. 1990. Seabirds of Hawaii. Natural History and Conservation. Cornell University Press, Ithaca.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission and United States Fish and Wildlife Service, Little Rock, Arkansas.

Hawaii Biodiversity and Mapping Program. 2007. Formerly Hawaii Natural Heritage Program. Hawaii Natural Heritage Program database, unpublished, Center for Conservation Research and Training (CCRT), Pacific BioSciences Research Center (PBRC), University of Hawaii.

Hawaii Division of Forestry and Wildlife. 1976-2007. Biannual Hawaiian waterbird survey data. Summarized by Hawaii Natural Heritage Program and Pacific Islands Fish and Wildlife Office, Honolulu, HI.

Hays, Warren S.T., Sheila Conant. 2007. Biology and Impacts of Pacific Island Invasive Species. 1. A Worldwide Review of Effects of Small Indian Mongoose, *Herpestes javanicus*. Pacific Science (2007), vol. 61, no. 1:3-16. University Press, Honolulu, Hawaii.

Hodges, C.S.N. and R.J. Nagata. 2001. Effects of Predator Control on the Survival and Breeding Success of the Endangered Hawaiian Dark-rumped Petrel. Studies in Avian Biology 22: 308-318.

Iwen, F.A. 1958. Hoary bat the victim of a barbed wire fence. Journal of Mammology 39(3):438.

Jacobs, D.S. 1993. Character release in the endangered Hawaiian hoary bat, *Lasiurus cinereus semotus*. Dissertation for Ph. D. University of Hawaii Manoa, Honolulu.

Jacobs, D.S. 1994. Distribution and Abundance of the Endangered Hawaiian Hoary Bat, *Lasiurus cinereus semotus*, on the Island of Hawaii. Pacific Science 48(2):193-200.

Jeffrey, J. 2007. Hakalau National Wildlife Refuge. Hawaiian hoary bat mortality per mile of fence.

Kaheawa Wind Power. 2008. Kaheawa Pastures Wind Energy Generation Facility Habitat Conservation Plan, Year 2 HCP Implementation July, 2007 – June, 2008.

Kaheawa Wind Power. 2009. Seabird Mitigation in West Maui – 2009 Action Plan for Makamakaole, May 18, 2009.

Kepler, C.B., and J.M. Scott. 1990. Notes on distribution and behavior of the endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*), 1964-1983. Elepaio 50(7):59-64.

Kim, J. and J. Misaki. 2008. 2008 Waterbird Nesting Activity: Pouhala Marsh and Hamakua Marsh. Prepared for: Division of Forestry and Wildlife, Oahu District.

KIUC (Kauai Island Utility Cooperative) 2009. Short-term Seabird Habitat Conservation Plan. Kauai Island Utility Cooperative. Prepared by Planning Solutions, Inc., RANA Biological Consulting, Inc., and Ebbin, Moser, + Skaggs LLP.s

Kuhn, D. 2009. Mammals in Hawaii, Hawaiian Bat or Opeapea (*Lasiurus cinereus semotus*) Available online at http://www.soundshawaiian.com/Mammals.html.

Marshall, A. 2008. U. S. Fish and Wildlife Service. Report of dead bats on TNC fences at Kona Hema.

Menard, T.C. 2001. Activity patterns of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in relation to reproductive time periods. Unpublished M.S. Thesis, University of Hawaii, Honolulu.

Metzler, K. 2009. 2009 Water bird Nesting Activity: Pouhala Marsh and Hamakua Marsh Island of O'ahu. Prepared for: Division of Forestry and Wildlife, O'ahu District.

Misaki, J. 2007. 2007 Waterbird Nesting Activity: Pouhala Marsh and Hamakua Marsh. Prepared for: Division of Forestry and Wildlife, Oahu District.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaii's Comprehensive Wildlife Conservation Strategy. Department of Land

and Natural Resources. Honolulu, HI. Available at: http://www.state.hi.us/dlnr/DLNR/cwcs/index.html. Accessed August 21, 2008.

Morin, M. P. 1994. Hawaiian fishponds and endangered waterbirds on the Kona coast. Trans. Western Sect. Wildl. Soc. 30:66-71.

Munro, G. D. 1960. Birds of Hawaii. Rutland, Vermont & Tokyo: Charles E. Tuttle Co. 192 pp.

Ong, L. 2009. SWCA Environmental Consultants, Honolulu, HI.

Paton, P. W. and M. J. Scott. 1985. Waterbirds of Hawaii Island. Elepaio 45:69-75.

Pratt, T. K. 1988. Recent observations, March-May 1988. 'Elepaio 48:65–66.

Pratt, H. D., P. L. Bruner, and D. G. Berrett. 1987. A field guide to the Birds of Hawaii and the Tropical Pacific. Princeton: Princeton University Press. 409 pp.

Pyle, R.L., and P. Pyle. 2009. The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status. B.P. Bishop Museum, Honolulu, HI, U.S.A. Version 1 (31 December 2009) http://hbs.bishopmuseum.org/birds/rlp-monograph

Rana Productions, Ltd. and Planning Solutions. 2008. 2007 Save Our Shearwaters Program End of Year Report. Prepared for Kauai Island Utility Cooperative & Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife.

Reed, J. M., and L. W. Oring. 1993. Long-term population trends of the endangered Aeo (Hawaiian stilt, *Himantopus mexicanus knudseni*). Trans. Western Sec. Wild. Soc. 29:54-60.

Reed, J. M., L. W. Oring, and M. Silbernagle. 1994. Metapopulation dynamics and conservation of the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*). Trans. Western Sec. Wildl. Soc. 30:7-14.

Reed, J. M., M. Silbernagle, A. Engilis, Jr., K. Evans, and L. Oring. 1998. Movements of Hawaiian stilts (*Himantopus mexicanus knudseni*) as revealed by banding evidence. Auk 115:791-797.

Reynolds, M.H. and G.L. Richotte. 1997. Evidence of Newell's Shearwater breeding in Puna District, Hawaii. Journal of Field Ornithology 68:26-32.

Reynolds, M.H., B.A. Cooper, and R.H. Day. 1997. Radar study of seabirds and bats on windward Hawaii. Pacific Science 51: 97-106.

Reynolds, M.H., B.M.B. Nielsen, and J.D. Jacobi. 1998. Surveys of the Hawaiian Hoary Bat in the District of Puna, Hawaii Island. Elepaio 57(9):153-159.

Richardson, F. and D.H. Woodside. 1954. Rediscovery of the nesting of the Dark-rumped Petrel in the Hawaiian Islands. Condor 56: 323-327.

Robinson, J. A., J. M. Reed, J. P. Skorupa, and L. W. Oring. 1999. Black-necked stilt (*Himantopus mexicanus*). In The Birds of North America, No. 449 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA. 32 pp.

Sarkozi, D.L., D.M. Brooks, and W.H. Baltosser. 2003. Eastern red bat (*Lasiurus borealis*) impaled by a loggerhead shrike (*Lanius ludovicianus*). The Southwestern Naturalist 48(2):301-303.

Save Our Shearwaters (SOS) Program. 2009 Incidents Update. Unpublished.

Schwartz, C. W. and E. R. Schwartz. 1949. The game birds in Hawaii. Div. Fish & Game and Board Comm. Agric. & For., Honolulu, Hawaii. 168 pp.

Shallenberger, R. J. 1977. An ornithological survey of Hawaiian wetlands. U.S. Army Corps of Engineers Contract DACW 84-77-C-0036, Honolulu, Hawaii. Ahuimanu Productions. 406 pp.

Shiinoki, Ethan K. 2006. Waterbird Nesting Activitiy and Habitat Utilization, Hamakua Marsh and Pouhala Marsh. Prepared for: Division of Forestry and Wildlife, Oahu District.

Shump, K.A., Jr., and A.U. Shump. 1982. *Lasiurus cinereus*. Mammalian Species (185):1-5.

Simons, T.R. 1984. A population model of the endangered Hawaiian dark-rumped petrel. J. Wildl. Mgmt. 48(4) 1065-1076.

Simons, T. R., and C. N. Hodges. 1998. Dark-rumped Petrel (Pterodroma phaeopygia). In The Birds of North America, No. 345 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Smith, David G., John T. Polhemus. 2003. Habitat use and nesting activity by the Hawaiian Stilt *(Himantopus Mexicanus Knudseni)* and Hawaiian Moorhen *(Gallinula Chloropus Sandvicensis)* at the Hamakua Marsh State Wildlife Sanctuary, Kailua, Oahu. Elepaio 63(8):59-62.

SWCA and First Wind 2009. Kahuku Wind Power Wildlife Monitoring Report and Fatality Estimates for Waterbirds and Bats (October 2007 – April 2009).

Swedberg, Gary. 1967. The Koloa - A Preliminary Report on the life history and status of the Hawaiian duck (*Anas wyviliana*). Wildlife Branch Division of Fish and Game, Department of Land and Natural Resources, Honolulu, Hawaii. 56pp.

Telfer, T.C. 1986. Newell's shearwater nesting colony establishment study on the island of Kauai. Final Report, Statewide Pittman-Robertson Program. Department of Lands and Natural Resources, State of Hawaii, Honolulu, HI.

Telfer, T.C., J.L. Sincock, G.V. Byrd, and J.R. Reed. 1987. Attraction of Hawaiian Seabirds to Lights: Conservation Efforts and Effects of Moon Phase. Wildlife Society Bulletin 15:406–413.

Tetra Tech EC, Inc. 2008. Draft Environmental Assessment For Issuance of an Endangered Species Act Section 10 (a)(1)(B) Permit for the Incidental Take of Listed Species for the Lanai Meteorological Towers Project. Castle & Cooke Resorts, LLC. Prepared for U.S. Fish & Wildlife Service.

Tomich, P.Q. 1986a. Hawaiian hoary bat (*Lasiurus cinereus semotus*). Endangered species information system, species workbook. Part I: Species distribution. Part II: Species biology. Unpublished report prepared for U.S. Fish and Wildlife Service, Washington, DC.

Tomich, P.Q. 1986b. Mammals in Hawaii. Bishop Museum Press, Honolulu, Hawaii. 375 pp.

Tomich, P.Q. 1986c. Endangered species information system species workbook. Part II - Species biology. Unpublished U.S. Fish and Wildlife Service Report.

University of Hawaii. 1983. Atlas of Hawaii (2nd ed.). University of Hawaii Press, Honolulu. 238 pp.

U.S. Fish and Wildlife Service. 1970. Conservation of Endangered Species and other Fish or Wildlife: United States List of Endangered Native Fish and Wildlife. Federal Register 35(199)16047-16048.

U.S. Fish and Wildlife Service. 1983a. Master Plan - Hawaiian Wetland National Wildlife Refuge complex (Draft). 2 volumes.

USFWS. 1983b. Hawaiian Dark-Rumped Petrel and Newell's Manx Shearwater Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 57 pp.

U.S. Fish and Wildlife Service. 1990. Amendment letter on Hawaiian wetland status to Dahl. 1990, Honolulu, Hawaii.

U.S. Fish and Wildlife Service. 1998. Recovery plan for the Hawaiian hoary bat (*Lasiurus cinereus semotus*). Portland, Oregon, 50 pp.

U.S. Fish and Wildlife Service. 2004. Environmental Review of Proposed Incidental Take Permit and Habitat Conservation Plan for the Kauai Island Utility Cooperative, Hawaii. 69 (135): 42447-42449.

U.S. Fish and Wildlife Service. 2005. Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Draft of Second Revision. U.S. Fish and Wildlife Service, Portland, Oregon. 155pp.

Viernes, K.J.F. 1995. Bullfrog predation of an endangered Common Moorhen chick at Hanalei National Wildlife Refuge, Kauai. Elepaio 55:37.
Whitaker, J.O., Jr., and P.Q. Tomich. 1983. Food habits of the hoary bat, *Lasiurus cinereus*, from Hawaii. J. Mamm. 64:151-152.

Wisely, A.N. 1978. Bat dies on barbed wire fence. Blue Jay 36:53.

Woodside, David. 1997. Personal communication. U.S. Fish and Wildlife Service, Hawaii and Pacific Islands Complex; Honolulu, Hawaii.

Work, Thierry. 2008. Personal communication. U.S. Geological Service, Biological Resources Division, National Wildlife Research Center, Honolulu, Hawaii.