Kawailoa Wind Power Habitat Conservation Plan
FY 2017 Annual Report

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Incidental Take License ITL 14/ Incidental Take Permit TE59861A-0

EXECUTIVE SUMMARY

This report summarizes work performed by Kawailoa Wind, LLC, owner of Kawailoa Wind Power (Project), during the State of Hawai'i fiscal year 2017 (FY 2017; July 1, 2016 – June 30, 2017) under the terms of the approved Habitat Conservation Plan (HCP), dated October 27, 2011, and pursuant to the obligations contained in the Project's state Incidental Take License ITL-14 (ITL) and federal Incidental Take Permit TE-59861A-0 (ITP). The Project was constructed in 2011 through 2012, and was commissioned to begin operating on November 2, 2012.

Species covered under the HCP include six threatened and endangered birds and one endangered bat. Fatality monitoring at the Project continued throughout FY 2017 within the 35-meter radius circular search plots approved in November 2015 by the U.S. Fish and Wildlife Service (USFWS) and Hawai'i Division of Forestry and Wildlife (DOFAW). These plots are centered on the wind turbine generators (WTGs) and searched twice per week. The mean and standard deviation (SD) for search intervals during FY 2017 at search plots with twice weekly searches was 3.5 days (SD = 0.5 days).

Four 28-day carcass persistence trials were conducted in FY 2017, using 60 bat surrogate and 13 medium-sized bird carcasses (surrogate for Hawaiian short-eared owl, Newell's shearwater, and listed waterbirds). Considering only the first 14 days as the trial length in order to compare current trials to past trials that lasted only 14 days, the FY 2017 mean carcass persistence time and SD for all bat surrogate carcasses is 11.1 days (SD = 4.7 days), and for medium-sized bird carcasses is 13.4 days (SD = 1.6 days); these values are not adjusted to account for right-censored data.

In FY 2017 searcher efficiency trials were conducted over 24 trial days with 71 trial carcasses. The overall searcher efficiencies in FY 2017 for bat surrogate (N = 64) and medium-sized bird (N = 7) carcass trials were 85.9 percent and 100 percent, respectively.

The Project continued the scavenger control program used to increase the probability that fatalities at the wind facility have the opportunity to be discovered by searchers. Trap locations in FY 2017 covered the same general area where traps were deployed at the end of FY 2106. Twenty-four DOC-250s and 21 A24 self-resetting traps were used in FY 2017. Overall, the scavenger control program documented the removal of 203 mongooses, 55 rats, and one cat in FY 2017 at the Project.

Two Hawaiian hoary bat fatalities were found in FY 2017. The Project's total observed bat take from November 2012 through FY 2017 is 30. Two of these bats were found outside of fatality search plots and classified as incidental observations. The total of 30 bat fatalities accounts for the reclassification of a desiccated carcass that was thought to be a bat when found on June 4, 2015. That carcass was examined by Corrina Pinzari, U.S. Geological Survey (USGS), when collecting tissue samples for genetic testing of bat carcasses. She determined the carcass was a small bird rather than a bat. As a result, data used to estimate bat fatalities have been adjusted to 28 bats. No bird species covered by the ITP and/or ITL were found.

The fatality estimate for 28 non-incidental observed bats using the Evidence of Absence estimator (Dalthorp et al. 2017) at the upper 80 percent credibility level is 53 and the total indirect take for this estimate is seven adult equivalents. Combining these values provides an upper credible limit of

60 adult Hawaiian hoary bats at the 80 percent credibility level for the Project. In other words, there is an approximately 80 percent chance that actual take of Hawaiian hoary bats at the Project was less than or equal to 60 adults.

Bird fatalities found at the Project in FY 2017 included three species protected by the Migratory Bird Treaty Act (MBTA), including one introduced species, and 8 non-native introduced species that are not protected by the MBTA. MBTA-protected species observed as fatalities were white-tailed tropicbird (2 birds), Pacific golden-plover (6 birds), and cattle egret (1 bird). Bird species observed as fatalities that are not covered by the MBTA were: rock dove (1 bird) spotted dove (10 birds), scaly-breasted munia (3 birds), common myna (18 birds), Japanese white-eye (1 bird), common waxbill (21 birds), ring-necked pheasant (1 bird) and zebra dove (5 birds).

Wildlife Acoustics SM2BAT+ ultrasonic detectors each with one SM3-U1 microphone were located 6.5 meters above ground at each Project WTG at the start of FY 2017. In the second quarter of FY 2017 detector numbers were reduced to four detectors located at WTG's 1, 10, 21, and 25. Between July 2016-June 2017, Hawaiian hoary bats were detected on 173 of 1378 detector nights (12.6 percent of detector nights).

The ʻUkoʻa Wetland mitigation program for Tier 1 mitigation continued for waterbirds and bats through FY 2017 including vegetation maintenance, predator trapping, fence maintenance, bat lane construction, and insect assessments. Tier 2 and 3 bat mitigation research projects, which are being conducted by USGS and WEST, were also initiated. Tier 1 seabird mitigation was completed in FY 2015. For Tier 1 pueo or Hawaiian short-eared owl mitigation, $12,500 was donated to Hawai'i Wildlife Center in FY 2012, prior to the initiation of commercial operations, per the approved HCP, and an additional $12,500 to fulfill Tier 1 mitigation obligations was provided in FY 2017.

Wildlife Education and Observation Program (WEOP) trainings continue to be conducted on an as-needed basis to provide on-site personnel with the information they need to be able to respond if they observe a listed species or encounter a fatality while on-site. Twenty-one WEOP trainings were conducted in FY 2017.

Kawailoa Wind, LLC and Tetra Tech conducted six meetings with USFWS and DOFAW staff in FY 2017. The purposes of these meetings varied, and included discussions regarding the Project's mitigation approach and implementation at ʻUkoʻa Wetland, as well as the HCP amendment. In addition, Tetra Tech and DESRI met with the Endangered Species Recovery Committee (ESRC) on November 2, 2016 to review the 2016 annual report. On December 8, 2016, DESRI, Tetra Tech, The Trust for Public Lands, and Department of Land and Natural Resources made a joint informational presentation to the ESRC on the proposed acquisition of the Helemano Wilderness Area as Tier 4 mitigation for the Hawaiian hoary bat under the HCP amendment.

Federal and state collection permits for the Project were renewed in the third quarter of FY 2017. A Protected Wildlife Permit was issued by DOFAW on February 23, 2017, and will remain valid until February 23, 2019. A Migratory Bird Special Purpose Utility Permit was issued by USFWS on February 2, 2017. This permit became effective February 14, 2017 and expires March 31, 2019.

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1.0 Introduction

The Habitat Conservation Plan (HCP) for the Kawailoa Wind Power Project (Project) was approved by the Hawai‘i Division of Forestry and Wildlife (DOFAW) in 2012. A state Incidental Take License (ITL) and federal Incidental Take Permit (ITP) were issued for the Project to cover the construction and operation of the Project in December 2011 and January 2012 for a 20 year permit term, respectively. The ITP and ITL cover the incidental take of six federally-listed threatened and endangered species and one state-listed endangered species: the Hawaiian stilt or ae‘o (*Himantopus mexicanus knudseni*), Hawaiian coot or ‘alae ke‘oke‘o (*Fulica alai*), Hawaiian duck or koloa maoli (*Anas wyvilliana*), Hawaiian gallinule or ‘alae ‘ula (*Gallinula chloropus sandvicensis*), Newell’s shearwater or ‘a‘o (*Puffinus newelli*), Hawaiian hoary bat or ‘ope‘ape‘a (*Lasiurus cinereus semotus*), and the state-listed Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*). The Project was commissioned for operation on November 2, 2012.

The Project was initially developed by First Wind (which became SunEdison, LLC [SunEdison]) and then became a wholly-owned subsidiary of DESRI IV, LLC, which is an investment fund managed by D.E. Shaw Renewable Investments, LLC (DESRI). SunEdison managed Project operations and HCP compliance through May 2016. In June 2016, EDF Renewables took over management of wind farm operations, and Tetra Tech, Inc. (Tetra Tech) began managing HCP compliance for DESRI. The HCP, ITL, and ITP remain unchanged and in the Project owner’s name, Kawailoa Wind, LLC.

This report summarizes work performed for the Project during the State of Hawai‘i 2017 fiscal year (FY 2017; July 1, 2016-June 30, 2017) pursuant to the terms and obligations of the approved HCP, ITL, and ITP.

2.0 Fatality Monitoring

In FY 2017, all wind turbine generator (WTGs) were searched for fatalities twice per week and the two met towers were searched once per week. Search plots consist of a 35-meter radius circular plot centered on each WTG and 50-meter radius plot centered on the two unguyed met towers. The FY 2017 mean search interval was 3.50 days for WTGs (standard deviation [SD] = 0.50 days) and 7.0 days for met towers (SD = 0.73 days).

The search plots were primarily searched by trained dogs accompanied by their handlers. When conditions limited the use of dogs (e.g., weather, injury, availability of canine search team, etc.), search plots were visually surveyed by Project staff. Vegetation was managed to maximize searcher efficiency.

3.0 Carcass Retention Trials

Four 28-day carcass persistence trials were conducted in FY 2017 using 60 bat surrogate (black rat) and 13 medium-sized bird (Wedge-tailed shearwater) carcasses. The medium-sized bird carcasses act as surrogates for listed bird species covered in the HCP (Newell's shearwater, Hawaiian waterbirds, and Hawaiian short-eared owls). Carcass persistence trial numbers were increased in FY 2017 from six carcasses per trial, including one medium-sized bird carcass and 5 bat surrogate carcasses, to 18 carcasses per trial, including three medium sized birds and 15 bat surrogate carcasses. Carcass persistence trials prior to FY 2014 only lasted for 14 days. Trial lengths were standardized to 28 days in FY 2014. Because all carcass persistence trials lasted at least 14 days, for comparison, 28-day trials were converted to 14-day trials by truncating the trial data set at 14 days, and the mean and SD are reported; reported values are not adjusted to account for right-censored data. However, when estimating fatalities, data from the full carcass persistence trials were used.

Using the converted carcass persistence trial data for comparison purposes, overall FY 2017 bat surrogate carcass persistence is 11.1 days (SD = 4.7 days) and medium-sized bird carcass persistence is 13.4 days (SD = 1.6 days). Carcass persistence times significantly exceed the search interval and were longer in FY 2017 than any previous year with the exception of medium birds in FY 2015, which had a mean carcass persistence time of 14.0 days.

4.0 Searcher Efficiency Trials

In all, 71 searcher efficiency trials were administered by independent Tetra Tech personnel (non-searchers) on 24 trial days during FY 2017. Wedge-tailed shearwaters were used as surrogates for birds (Hawaiian waterbirds, Newell's shearwaters, and Hawaiian short-eared owls), and black rats were used as surrogates for bats. Searcher efficiency trials occurred throughout the year and both human searchers and canine search teams were tested in approximate proportion to the number of searches conducted by human searchers and canine search teams. Vegetation category (short vs medium) was documented when the carcasses were placed and when they were found. The overall searcher efficiencies in FY 2017 for bat surrogate (N = 64) and medium-sized bird (N = 7) carcass trials, combining both vegetation classes, were 86.0 percent and 100.0 percent, respectively.

The mean searcher efficiencies in FY 2017 for bat surrogate (N = 46) and medium-sized bird (N = 6) carcass trials in short vegetation were 87.0 percent and 100.0 percent, respectively. The mean searcher efficiencies in FY 2017 for bat surrogate (N= 18) and medium-sized bird (N= 1) carcass trials in medium vegetation were 83.3 percent and 100.0 percent, respectively.

Searcher efficiencies of both canine teams and human searchers were tested in approximate proportion to the number of searches conducted by each group throughout FY 2017 although the majority of searching was done by canines. Of the seven medium-sized bird carcasses, six (85.7 percent) were tested on canine teams. Both human searchers alone and canine teams found 100

percent of medium-sized bird carcasses. Of 64 bat surrogate carcasses, 55 were tested on canine teams (85.9 percent). Human searchers and canine teams found 33.3 and 92.6 percent of bat surrogate carcasses, respectively. Overall, canine teams conducted 87.4 percent of the searches in FY 2017.

5.0 Vegetation Management

Vegetation in the search plots consists mainly of Guinea grass (*Megathyrsus maximus*), Bermuda grass (*Cynodon dactylon*), and sensitive plant (*Mimosa pudica*). All fatality monitoring plots around the WTGs and met towers are mowed regularly to increase visibility during fatality searches. All plots are mowed to a height of 3 to 4 inches, depending on the type of mower used and are cut every 3 to 4 weeks. There are no unsearchable areas or rock lined swales within the 35-meter radius search plots.

6.0 Scavenger Trapping

Active trap locations in FY 2017 covered the same general area where traps were deployed at the end of FY 2106. The scavenger control program documented the removal of 203 mongoose, 55 rats, and 1 cat in FY 2017. Trap types deployed at the Project in FY 2017 included Doc-250 and GoodNature A24; however, the number and types of traps deployed varied throughout the fiscal year. Twenty-four Doc-250 and 21 GoodNature A24 traps were active in FY 2017. GoodNature A24 traps where deployed in July through October of 2016; all Doc-250 traps were active throughout all of FY 2017 and remained in the same locations that they were deployed at the end of FY 2016.

7.0 Documented Fatalities

The Hawaiian hoary bat is the only Covered Species with observed take in FY 2017. Two Hawaiian hoary bat fatalities were documented during FY 2017 (see Table 1 and Appendix 1). A total of 30 Hawaiian hoary bat fatalities have been observed at the Project site since operations began on November 2, 2012. These include fatalities in each year since the initiation of commercial operations: FY 2013 (5), FY 2014 (9), FY 2015 (9), FY 2016 (5), and FY 2017 (2). The total of 30 bat fatalities accounts for the reclassification of a fatality that was found on June 4, 2015 and classified as a bat. During a site visit by Corrina Pinzari (U.S. Geological Survey [USGS]) on January 20, 2017, she observed that this significantly decomposed fatality was a small bird, rather than a bat. Agency records have been updated and this information was incorporated into the cumulative take analysis.

Table 1. Observed Fatalities of Hawaiian Hoary Bats at the Project in FY 2017.

Age	Sex	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)
Adult	Unknown	November 14, 2016	6	10.0	170
Adult	Unknown	December 30, 2016	17	30.4	255

Sixty-nine bird fatalities representing 11 species were documented at WTGs at the Project site in FY 2017. No fatalities have been observed at either of the two met towers. None of the observed bird fatalities in FY 2017 are species listed as state or federally endangered or threatened. Three of the species observed in FY 2017 are protected by the Migratory Bird Treaty Act (MBTA): Pacific golden-plover (6 birds; *Pluvialis fulva*), white-tailed tropicbird (2 birds; *Phaethon lepturus*), and cattle egret (1 bird; *Bubulcus ibis*). In addition, 60 fatalities of non-native introduced birds without MBTA protection were documented: common waxbill (21 birds; *Estrilda astrild*), common myna (18 birds; *Acridotheres tristis*), spotted dove (10 birds; *Spilopelia chinensis*), zebra dove (5 birds; *Geopelia striata*), scaly-breasted munia (3 birds; *Lonchura punctulata*), rock dove (1 bird; *Columba livia*), Japanese white-eye (1 bird; *Zosterops japonicus*), and ring-necked pheasant (1 bird; *Phasianus colchicus*). For a complete list of fatalities for FY 2017 see Appendix 1.

7.1 Hawaiian Hoary Bat Take Estimate

An upper credible limit of take is estimated from three components: (1) observed direct take (ODT) during protocol surveys, (2) unobserved direct take (UDT), and (3) indirect take. Dalthorp et al. (2017), the agency-approved analysis tool for analyzing direct take, uses results from bias correction trials and ODT to generate an upper credible limit (UCL) of direct take (i.e., ODT + UDT). The USFWS and DOFAW have requested that these calculations be reported at the 80 percent upper credible limit. Values from this analysis can be interpreted as: there is an 80 percent probability that actual direct take at the Project over the analysis period was less than or equal to the 80 percent UCL. Associated indirect take is estimated based on observations of the distribution of bat fatalities at the Project and life history characteristics of, or assumed to be representative of, the Hawaiian hoary bat as described in the Project's approved HCP.

The estimated direct take (ODT + UDT) for the 30 Hawaiian hoary bat fatalities found between the start of operation (November 2, 2012) and end of FY 2017 (June 30, 2017) is 53 bats (80 percent UCL; Appendix 2). Because 2 of the 30 observed bat fatalities were found outside of the search areas (i.e., were incidental observations), 28 were used in the analysis, and the 2 incidental observations are accounted for in the estimated value of UDT. The 2 incidental observations were not found during FY 2017.

Indirect take is estimated separately to account for the potential loss of individuals that may occur indirectly as the result of the loss of an adult female during the period that females may be pregnant or supporting dependent young. Previously, calculations of indirect take were based on an approach established in the approved HCP, and were used in the FY 2013 to FY 2016 annual reports. Subsequent to the FY 2016 annual report, the USFWS provided guidance (October 1, 2016)

that defined and standardized the process for estimating direct and indirect observed take. At the request of USFWS, this report has utilized the updated (October 2016) USFWS methodology. Overall indirect take for the Project is calculated as the sum of indirect take resulting from the following components of direct take:

- Observed adult female take occurring during the pup dependency period (April 1 – September 15);
- Observed unknown sex take expected to be female during the pup dependency period; and
- Unobserved take expected to be female and occurring during the pup dependency period.

The methodology used to calculate indirect take was based on the October 2016 USFWS guidance as follows:

- The average number of pups attributed to a female that survive to weaning is assumed to be 1.8.
- The sex ratio of bats taken through UDT is assumed to be 50 percent female, unless there is substantial evidence (10 or more bats) to indicate a different sex ratio.
- The assessment of indirect take to a modeled UDT accounts for the fact that it is not known when the unobserved fatality may have occurred. The period of time from pregnancy to end of pup dependency for any individual bat is estimated to be 3 months. Thus, the probability of taking a female bat that is pregnant or has dependent young is 25 percent.
- The conversion of juveniles to adults is 1 juvenile to 0.3 adults.

Based on the above methodology, the estimate of indirect take for FY 2017 is calculated as:

Total observed female take assumed to have dependent young (April 1 – September 15)

2 (observed females)[1] * 1.8 (pups per female) = 3.6 juveniles direct take based on observed female take

Total observed unknown sex take (April 1 – September 15)[2]

14 (observed unknown sex) * 0.5 (assumed sex ratio) * 1.8 (pups per female) = 12.6 juveniles direct take based on observed unknown sex take

[1] The female Hawaiian hoary bat observed as a fatality on August 12, 2013 had been tagged with a radio-transmitter on June 28, 2013 and had dependent pups at that time. Based on the timing of observations and expert opinion at the time, it was determined that pups were likely independent by the time the female was killed (Kawailoa Wind Power 2014).

[2] Kawailoa Wind Power is awaiting genetic testing results to identify the sex of bat carcasses that were too decomposed to determine sex based on morphology. Indirect take will be adjusted when this information becomes available.

Total unobserved take

(53 [80 percent UCL] – 30 [ODT]) * 0.5 (assumed sex ratio) * 0.25 (proportion of calendar year females could be pregnant or have dependent pups) * 1.8 (pups per female) = 5.2 juveniles direct take based on UDT

Total Juvenile Indirect Take = 21.4 (3.6 + 12.6 + 5.2)

Total Adult Equivalent Indirect Take = 7 (0.3 * 21.4 = 6.4)

Therefore the estimated indirect take based on the UCL of Hawaiian hoary bat direct take at the Project is 7 adults (rounded up from 6.4).

The UCL for Project take of the Hawaiian hoary bat at the 80 percent credibility level is thus 60 adult bats (53 direct take + 7 indirect take). That is, there is an approximately 80 percent probability that actual take at the Project at the end of FY 2017 is less than or equal to 60. This suggests that Hawaiian hoary bat take at the Project is below the authorized take limit, but take is likely within Tier 3, which identifies mitigation obligations for estimated take between 40 and 60 adult bats.

8.0 Wildlife Education and Observation Program

Wildlife Education and Observation Program (WEOP) trainings continue to be conducted on an as-needed basis to provide on-site personnel with the information they need to be able to respond appropriately in the event they observe a listed species or encounter a fatality while on-site. Tetra Tech biologists conducted 21 WEOP trainings in FY 2017.

9.0 Monitoring and Mitigation

9.1 Hawaiian Hoary Bats

The Project mitigation and monitoring requirements are described in the approved HCP. Results of monitoring at the Project are presented in Section 9.1.1. Mitigation is required based on where the estimated Project take falls with respect to tiers identified in the approved HCP. Tier 1 mitigation at ʻUkoʻa Wetland continued during FY 2017. Because the UCL of take (Section 7.1) falls within Tier 3, and USFWS and DOFAW approved implementation of selected research projects in February, Kawailoa Wind, LCC finalized contracts with WEST and USGS to conduct three studies as Tier 2/3 Hawaiian hoary bat mitigation: Modeling Foraging Habitat Suitability of the Hawaiian Hoary Bat (USGS), Hawaiian Hoary Bat Conservation Genetics (USGS), Hawaiian Hoary Bat Acoustic Surveys (WEST). The total funding for the three projects is over $1.6M.

Kawailoa Wind Power is in the process of developing an HCP major amendment. On December 8, 2016, Kawailoa Wind Power briefed the ESRC on its proposal to fund $2,750,000 towards the creation of the Helemano Wilderness Area as Tier 4 Hawaiian hoary bat mitigation covering incidental take of 55 Hawaiian hoary bats. ESRC expressed general approval regarding the

Helemano Wilderness Area mitigation option. In a letter dated January 30, 2017, USFWS concluded that the purchase and management of the Helemano Wilderness Area meets all the criteria outlined in the Hawaiian hoary bat guidance document (DOFAW 2015), and that the ESRC "expressed general approval" of the proposal. DOFAW, similar to the ESRC, also did not voice any major concerns regarding funding the Helemano Wilderness Area for Tier 4 mitigation in their letter dated June 26, 2017, provided that Kawailoa Wind Power "completes the official steps necessary to amend their joint-agency HCP, followed by approval of the HCP amendment by the Board of Land and Natural Resources and their issuance of an amended ITL". Kawailoa Wind Power will fund this mitigation prior to approval of the amendments to the HCP and the ITP/ITL with funds to be provided to the Trust for Public Lands in the first half of FY 2018.

9.1.1 Onsite Acoustic Surveys

Based on commitments in the approved HCP, bat activity was intensively monitored throughout the Project site during the first three years of systematic fatality monitoring (2012–2015). Having identified no significant findings through 3 years of intensive acoustic monitoring at the Project, in the second quarter of FY 2017, Kawailoa Wind Power reduced the acoustic monitoring effort at the Project to four stationary ground-based units distributed throughout the Project site at WTG's 1, 10, 21, and 25 (see Figure 1). These locations were randomly chosen after eliminating detectors with high or low detection rates. Each site contains one Wildlife Acoustics TM SM2BAT+ ultrasonic detector (SM2) with one SM3-U1 ultrasonic microphone located approximately 6.5 meters (21 feet) above ground.

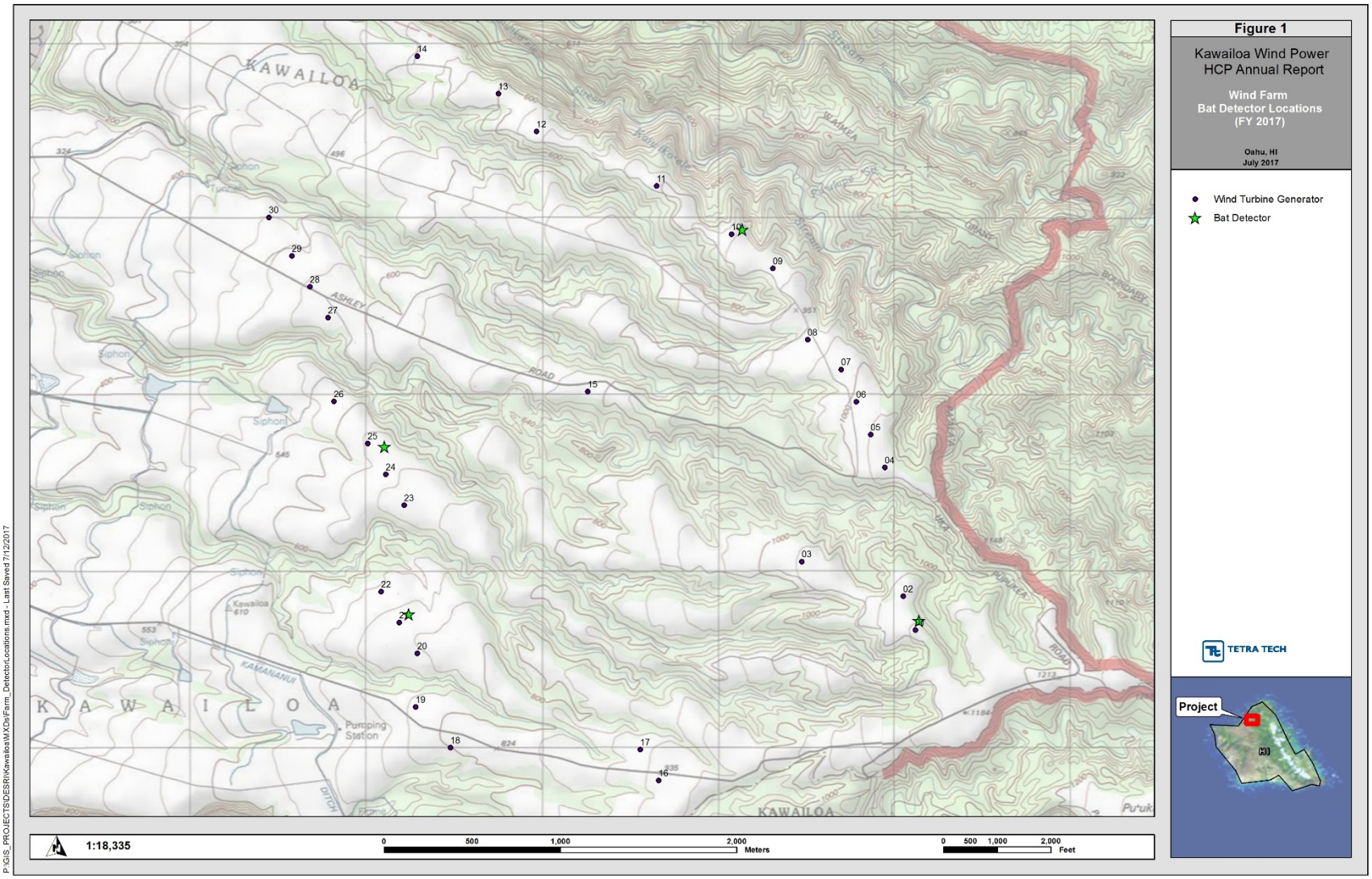


Figure 1: Bat Acoustic Detector Locations throughout the Project site.

In FY 2017, Hawaiian hoary bats were detected on 173 of 1378 detector nights (12.6 percent of detector nights) at these four WTGs (Figure 2). Temporal patterns of ground-based detection rates were relatively similar to previous years (when more detectors were deployed) with elevated activity levels from April through September and depressed activity during October through March (Tetra Tech 2016). Based on previous year's activity, the increased activity in February 2017 appears to be anomalous. Spatially, the majority of bat activity occurs more often at WTGs 21 and 25, compared to the other two locations.

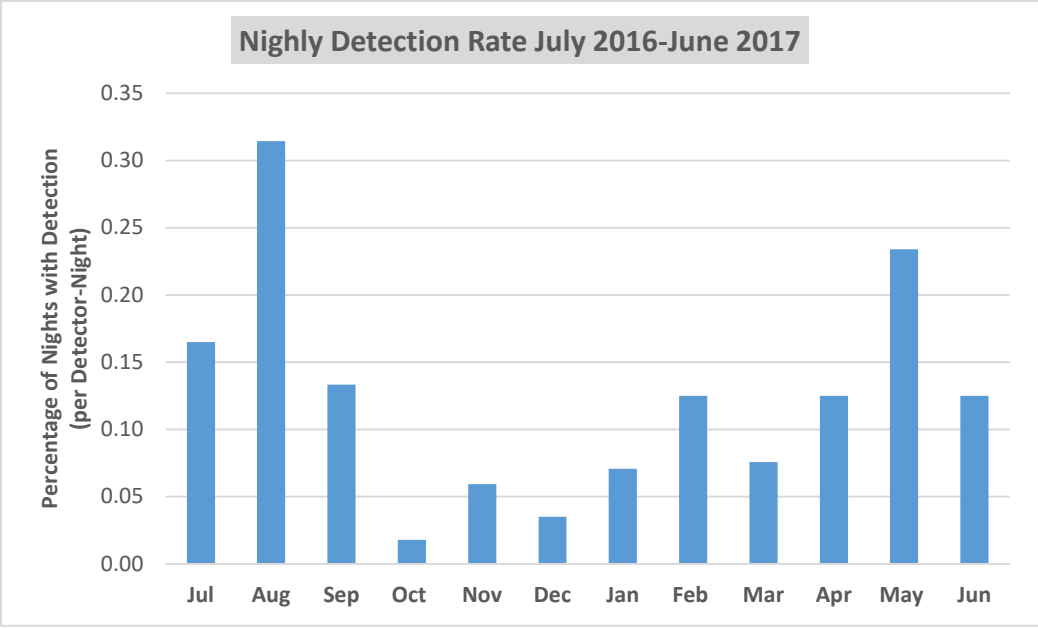


Figure 2: Bat Acoustic Activity at 4 Detectors throughout the Project during FY 2017.

9.1.2 'Uko'a Wetland

Mitigation for bats and waterbirds continued at 'Uko'a Wetland during FY 2017. Activities included: invasive vegetation removal and control, fence maintenance, predator control, monitoring predator presence, bat lane construction, insect assessments, and waterbird surveys. In FY 2016 (March 2016), USFWS and DOFAW provided written confirmation permitting adaptive management for the original bat and waterbird mitigation proposed at 'Uko'a Wetland. This included the following:

1. Reduction from 40 acres of vegetation removal to assumed open water areas, as outlined in Figure 2 of the bat plan.
2. Omit replanting of natives with assumption of natural recruitment after invasive plant species are removed.
3. Omit mosquitofish removal component.
4. Tie success criteria for bats to completion of all other management and monitoring components instead of increased bat activity.

In FY 2017, activities associated with Tier 1 bat mitigation included invasive vegetation removal/control, predator control, fence monitoring and maintenance, bat lane construction, and insect assessments. Additional details for each are provided below. Based on the approved ʻUkoʻa Wetland Hawaiian Hoary Bat Mitigation Management Plan (H.T. Harvey and SWCA 2014), bat acoustic monitoring, insect assessments, and bat habitat assessments will continue for 3 to 5 years post-restoration. Based on the approved ʻUko'a Wetland Management Plan for Waterbirds 2012–2032 (SWCA 2012), vegetation management, predator and ungulate control, and fence maintenance will continue for the permit term (20 years).

Invasive vegetation removal/control: Kawailoa Wind Power initiated invasive vegetation removal at the ʻUkoʻa Wetland Mitigation Area during Quarter 2 of FY 2017. Hapa Landscaping completed invasive vegetation removal, primarily water hyacinth (*Eichhornia crassipes*), from the open water areas at ʻUkoʻa Wetland on January 20, 2017. Water hyacinth was manually removed to have as little impact on water quality at ʻUkoʻa Wetland as possible. Kayaks were used to set up floating gates and rope enclosures. Hyacinth was then corralled and pulled to shore by hand. A mini excavator, located upland of the water's edge, removed hyacinth from the pond and the plant material was then staged to reduce water content and weight. Hyacinth was then moved offsite to a composting area to fully decompose. Figure 3 shows before and after photographs of the vegetation removal areas during FY 2017.

Quarterly maintenance visits will also be conducted to remove any small areas of water hyacinth that have regenerated. In 2017, Hapa Landscaping completed the first quarterly maintenance visit on April 5 – 7, 2017, and the second quarterly maintenance visit occurred June 26 – 28, 2017.

Predator control: The Project contracted Grey Boar Wildlife Services, LLC (Grey Boar) to conduct predator and ungulate removal at ʻUkoʻa Wetland as well as to monitor and repair the fence. Predator control first began at ʻUkoʻa Wetland in June 2014. No trapping occurred for a six month period (June 2016 to November 2016), but the program resumed again in December 2016. Traps used by Grey Boar for this project included 4 pig corral and 2 pig box traps, 100 GoodNature A24s, 12 live cages, 24 Doc-250s and 25 body grip traps (Coni-boxes). In FY 2017, a total of 220 predators were removed from ʻUkoʻa Wetland including 103 pigs, 96 mongoose, 2 cats, 18 rats, and 1 mouse (Grey Boar Wildlife Services LLC 2017a, 2017b).

Tracking tunnels were set on December 10, 2016, before trapping was re-initiated to get a baseline reading, and again on February 11, 2017, April 22, 2017, and June 26, 2017 (after trapping began). Mongoose percent tracking before trapping in December 2016 was 38% and reduced to 0% tracking through June 2017. Rat percent tracking before trapping was 35%, and was reduced to 15% in February, and further reduced to 11.5% in June 2017.

Figure 3: Water Hyacinth within Removal Area before Removal Work was Initiated (Top), and After Removal was Complete (Bottom).

Tracking Tunnel data over the 3 year period shows a general reduction in predator numbers, specifically mongoose, since the predator program was initiated. As shown in Figure 4, there is a sharp decline in mongoose activity following initial predator control in 2014. A similar pattern is evident after the break in predator control in 2016 with recorded activity declining sharply from December 2016 levels upon the re-initiation of trapping.

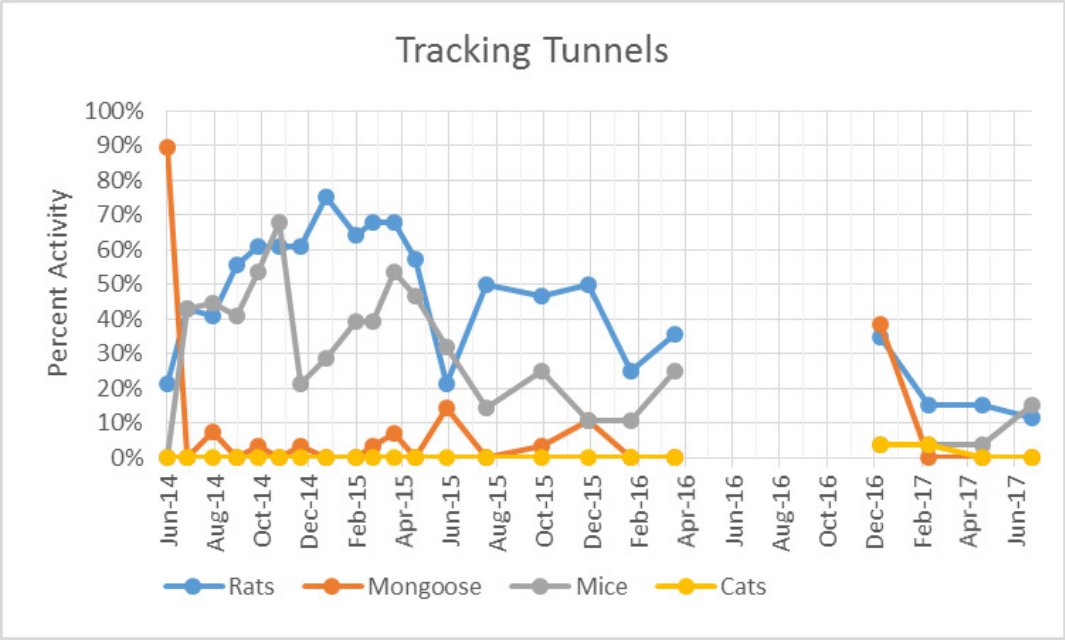


Figure 4: Percent Activity based on Tracking Tunnel at ʻUkoʻa Wetland between June 2014 and June 2017.

Fence monitoring and maintenance: Fence inspections were conducted by Grey Boar while checking traps. The fence was visually inspected for any signs of ungulate disturbance, damage, or vandalism. During FY 2017, several sections of fence were repaired. Causes of the fence damage were vandalism, a fallen tree, and collision by a vehicle.

Bat lane construction: Based on consultation with USFWS and DOFAW, as well as input from Dr. Frank Bonaccorso at the USGS, the original approach to develop bat lanes at ʻUkoʻa Wetland was slightly modified to increase the value of these management actions. Dr. Bonaccorso noted that hoary bats are strongly attracted to corridors as narrow as a two-lane road or even a one car wide fire lane (Dr. Frank Bonaccorso, USGS, pers. comm.). Therefore, the 20 meter wide corridors identified in the approved ʻUkoʻa Wetland Hawaiian Hoary Bat Mitigation Management Plan (H.T. Harvey and SWCA 2014) were not supported by his observations. Based on this information, Kawailoa Wind Power proposed to create approximately 5 meter wide bat lanes within the identified bat lane zones. This approach was approved by USFWS on October 4, 2016 and DOFAW on October 28, 2016.

Oahu Tree Works, LLC began creating the bat lanes in April 2017. Trees were cut down within the lanes, with smaller limbs and branches chipped on-site. Stumps were treated with an herbicide to prevent re-sprouting. A total of 13 bat lanes were created within seven zones at ʻUkoʻa. Figure 5 shows one of the bat lanes constructed at ʻUkoʻa. Bat lane construction ceased prior to the 2017 Hawaiian hoary bat pupping season (June 1, 2017), and will continue again after September 15, 2017.

Figure 5: Bat Lane Constructed at ʻUkoʻa Wetland.

Bat acoustic surveys: The ultrasonic bat detectors originally set up at ʻUkoʻa were removed in October 2015. Ten detectors were re-deployed in late June 2017 (following bat lane construction) in roughly the same locations that were used in baseline surveys. The acoustic survey results from ʻUkoʻa Wetland will be presented in the annual report for FY 2018.

Insect assessments: A SunEdison HCP Mitigation Scientist conducted insect assessments in June-October 2014 and June-October 2015 and submitted samples to Dr. Karl Magnacca for analysis. Prey availability was measured by sampling insects using the following 10 traps distributed throughout ʻUkoʻa Wetland: four Townes Style ez-Malaise Traps (Bugdorm BT1002), two Amphibious Emergence Traps (Bugdorm BT2005, 1.0m x 1.0m), two Universal Black Light Traps (Bioquip 2851A and 2851U), and two Air Intercept Traps (Bioquip 2869) with Malaise Trap Bottom Collectors (Bioquip 2892) attached. In addition to sampling night-flying insect prey available to bats, day-flying mosquitos were also sampled.

Only insects larger than 3.5 millimeters were identified and counted, except for "gelechiid"-type moths which were included down to 3 millimeters since the size range within species spanned 3-3.5 millimeters. The "day" samples were only checked for mosquitos, and no mosquitos were in the samples. The results of insect identifications from assessments conducted in 2014 and 2015 are provided in Appendix 3.

9.1.3 Studies (Tier 2/3)

As stated above, Kawailoa Wind, LCC finalized contracts with WEST and USGS in FY 2017 to conduct three studies as Tier 2/3 Hawaiian hoary bat mitigation. Kawailoa Wind, LLC has funded the studies as recommended by USFWS and DOFAW. Kawailoa Wind, LLC is investigating additional mitigation options for the remaining uncommitted funding obligation of approximately $353,700, and is reviewing potential projects identified by the regulatory agencies. A summary of the work completed for these studies during FY 2017 is provided below.

USGS' *Modeling Foraging Habitat Suitability of the Hawaiian Hoary Bat* study began in February 2017. During FY 2017, USGS ordered field equipment and supplies and obtained field site permission and access. As outlined in the study plan, acoustic and video data collection and data analysis and modeling will begin at the O'ahu field sites in early FY 2018.

For the *Hawaiian Hoary Bat Conservation Genetics* study, USGS collected bat tissue samples from carcasses and live captured bats from various agencies and facilities and catalogued the samples. In the upcoming fiscal year DNA will be extracted from the current sample collection, sex determination testing will begin for bat carcass samples, and mitochondrial gene PCR amplification and Sanger sequencing will be performed.

The study plan for WEST's *Hawaiian Hoary Bat Acoustic Surveys* study was finalized with the ESRC in FY 2017. The majority of the work conducted for this study in FY 2017 has been obtaining site access permissions and determining suitable detector locations. Bat detectors are currently being deployed, with 15 sites already collecting data.

9.2 Waterbirds

As stated above, USFWS and DOFAW provided written confirmation permitting adaptive management for the original bat and waterbird mitigation. Some activities completed for waterbird mitigation at 'Uko'a Wetland overlap with bat mitigation requirements and are summarized in Section 9.1.2 above.

In August 2016, prior to water hyacinth removal, a biologist conducted waterbird surveys to identify if nests or nests with chicks were present in the vicinity of the planned work area. These surveys are required as a Best Management Practice (BMP) when contractors are working at the site to avoid disturbance while working to minimize impacts to endangered Hawaiian waterbirds. In August 2016, a nest was observed in the vicinity of the hyacinth extraction point. At least one chick successfully fledged from the nest. Vegetation removal work did not begin until at least 2 weeks after the chicks fledged (December 2016).

More comprehensive weekly waterbird surveys were initiated throughout Uko'a Wetland in January 2017. A qualified biologist conducts bird surveys at seven point count stations set up in the vicinity of the open water and in areas with previous waterbird sightings. Moorhen playbacks are used to increase detection. In addition to the point count stations, independent waterbird observations are recorded while walking between stations. The detailed protocols for these surveys

are provided in Appendix 4. Waterbird surveys will occur weekly from December to September each year. Surveys will continue for 4 years or until mitigation requirements are met.

The Hawaiian moorhen was the listed waterbird species most frequently detected during weekly surveys. Adult moorhen have been recorded at all point count stations, as well as at two incidental location between stations (Figure 6). Moorhen (either adults, chicks, or fledglings) were observed or heard on all 26 survey dates. Moorhen have been observed breeding and successfully fledging chicks at several locations. Four nests were observed between January and the end of June 2017. One nest was observed at Point Count (PC) 1 in February 2017. Two nests were observed at PC4, (February and May). A predated nest (with approximately 5-7 eggs) was observed at PC6 in May 2017.

Hawaiian moorhen are cryptic and vegetation and water level conditions make ʻUkoʻa a challenging place to survey for this species. The removal of water hyacinth has altered habitat available to moorhen, as well as the ability to survey, throughout the survey period. The biologist began using a kayak at the end of June 2017 to survey previously inaccessible areas, including an additional point count station. Data from that point count station will be incorporated in the next annual report.

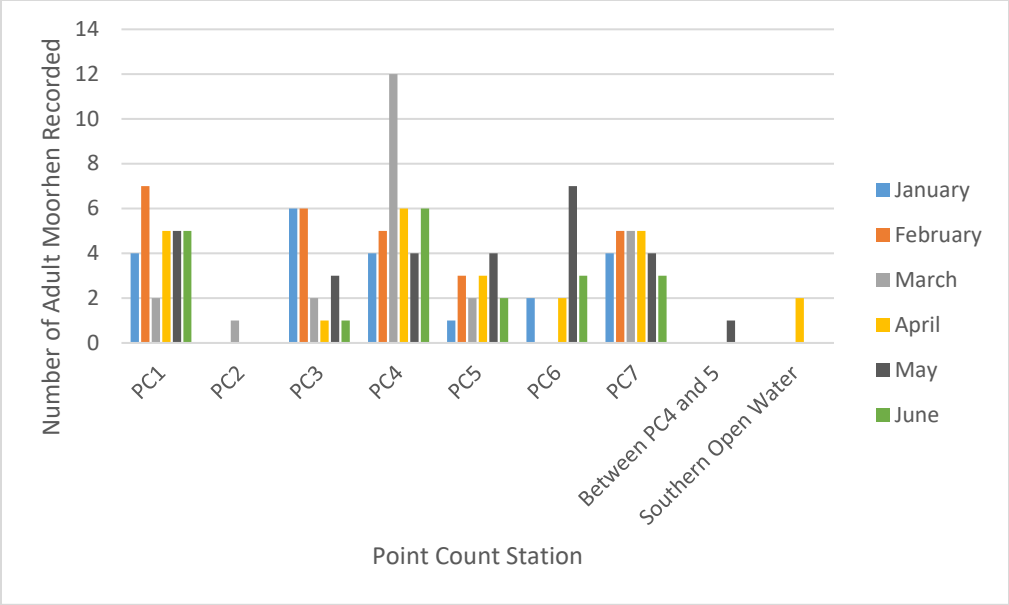


Figure 6: Number of Adult Hawaiian Moorhen Detected at the Various Point Count Stations between January and June 2017.

On March 15, 2017, a single adult Hawaiian coot was seen in the newly opened waters of ʻUkoʻa Wetland; this species was not recorded during baseline surveys in 2014 or 2015. Fifteen adult Hawaiian stilt were seen on four occasions during the surveys (January 25, February 2, February 24, and June 28, 2017).

9.3 Seabirds

Tier 1 seabird mitigation for the Project is complete. Seabird colony activity assessment funded by the Project and implemented by the Kauaʻi Endangered Seabird Recovery Project using Wildlife Acoustics Songmeters was completed for the 2014 breeding season in FY 2015 Q1 (see Kawailoa Wind, LLC 2015). This assessment was part of a predator control project co-funded by Kahuku Wind Power.

9.4 Hawaiian Short-eared Owls or Pueo

The Project contributed $12,500 to Hawaiʻi Wildlife Center in February 2012, prior to the initiation of commercial operations and representing the first installment of its funding commitment for Hawaiian short-eared owl mitigation under Tier 1. In FY 2017, the Hawaiʻi Wildlife Center treated 10 Hawaiian short-eared owls (Samantha Christie, Hawaiʻi Wildlife Center, pers. comm., July 11, 2017).

An additional $12,500 was provided to DOFAW to complete the mitigation obligation in the second quarter of FY 2017. This funding, in combination with funding from other wind projects, was utilized by DOFAW to hire a pueo researcher for the Pueo Project which will investigate the population size, distribution, and habitat use of pueo throughout Oʻahu. The goals of the study are to 1) improve population monitoring, and (2) define habitats important to pueo population stability (https://www.pueoproject.com/). The Pueo Project's biologist will begin Oʻahu-wide surveys in August 2017 (Afsheen Siddiqi, DOFAW, pers. comm., July 17, 2017).

10.0 Adaptive Management

Low wind speed curtailment (LWSC) at 5 meters/second had been required in the original HCP to occur March 1 - November 30 annually. Currently at the Project, LWSC spans from February 6 to December 15. This window has been expanded over time as an adaptive management response to a greater than expected rate of bat take. The ending date for the LWSC period was extended to December 15 in December 2012. The initiation of LWSC was moved up to February 10 in February 2013 and again to February 6 in February 2015.

11.0 Agency Meetings and Visits

Kawailoa Wind, LLC and Tetra Tech conducted six meetings with USFWS and DOFAW staff in FY 2017. The purpose of these meetings varied and included required semi-annual meetings, site visits, and discussions regarding the HCP amendment. Meetings took place on:

- August 9, 2016—USFWS—HCP Amendment discussion;
- September 29, 2016—USFWS (Pacific Islands and Regional Office)— Site visit to ʻUkoʻa Wetland and canine search demonstration;
- October 12, 2016—USFWS and DOFAW— HCP semi-annual meeting;

- January 18, 2016—DOFAW— Site visit to ʻUkoʻa Wetland;
- April 20, 2017—USFWS and DOFAW— HCP semi-annual meeting; and
- June 1, 2017—USFWS and DOFAW—Site visit to ʻUkoʻa Wetland and canine search demonstration.

In addition, DESRI and Tetra Tech met with the Endangered Species Recovery Committee (ESRC) on November 2, 2017 to review the FY 2016 HCP annual report. DESRI, Tetra Tech, The Trust for Public Lands, and Department of Land and Natural Resources also made a joint presentation to the ESRC on December 8, 2016 to describe the proposed acquisition of the Helemano Wilderness Area as Tier 4 bat mitigation.

12.0 Expenditures

Total HCP-related expenditures for the Project in FY 2017 were $642,342 (Table 3).

Table 2. HCP-related Expenditures at the Project in FY 2017.

Category	Amount
Permit Compliance	$45,363
Facility Vegetation Management	$150,000
Fatality Monitoring	$50,000
Equipment and Supplies	$4,615
Hawaiian Short-eared Owl/Pueo Mitigation	$12,500
ʻUkoʻa Wetland Mitigation Compliance	$207,525
Additional Bat Mitigation	$204,659
Total Cost for FY 2017	**$642,342**

13.0 Other

Federal and state collection permits for the Project were renewed in Quarter 3 of FY 2017. A Protected Wildlife Permit was issued by the State on February 23, 2017, and will remain valid until February 23, 2019. A Migratory Bird Special Purpose Utility Permit was issued by USFWS on February 2, 2017. This permit authorizes utilities to collect, transport, and temporarily possess migratory birds found dead on utility property, structures, and rights-of-way for avian mortality monitoring or disposal purposes. The Special Purpose Utility Permit became effective February 14, 2017 and expires March 31, 2019.

As requested by USFWS, bat carcasses previously held in the Kawailoa freezer were transferred to USGS on April 17, 2017 (Quarter 4 of FY 2017). Two scent training carcasses remain on-site, as approved by USFWS.

14.0 Literature Cited

Dalthorp, D., M. Huso, and D. Dail. 2017. Evidence of absence (v2.0) software user guide: U.S. Geological Survey Data Series 1055, 109 p., https://doi.org/10.3133/ds1055.

DOFAW (Department of Land and Natural Resources, Division of Forestry and Wildlife). 2015. Endangered Species Recovery Committee Hawaiian hoary bat guidance document. Approved December 17, 2015.

Grey Boar Wildlife Services LLC. 2017a. ʻUkoʻa Predator Control Program. 1st Quarter Report 2017. Prepared for Kawailoa Wind LLC.

Grey Boar Wildlife Services LLC. 2017b. ʻUkoʻa Predator Control Program. 2nd Quarter Report 2017. Prepared for Kawailoa Wind LLC.

H. T. Harvey (H. T. Harvey and Associates) and SWCA (SWCA Environmental Consultants). 2014. ʻUkoʻa Wetland Hawaiian Hoary Bat Mitigation Management Plan. Prepared for First Wind. Approved by USFWS and DOFAW 2014.

Kawailoa Wind, LLC. 2015. Kawailoa Habitat Conservation Plan FY 2015 Annual Report.

Kawailoa Wind, LLC. 2014. Kawailoa Habitat Conservation Plan FY 2014 Annual Report.

SWCA. 2012. ʻUkoʻa Wetland Management Plan for Waterbirds 2012 – 2032. Prepared for First Wind. Approved by USFWS and DOFAW 2012.

Tetra Tech. 2016. Kawailoa Wind Power Habitat Conservation Plan, FY 2016 Annual Report.

APPENDIX 1

DOCUMENTED FATALITIES AT THE PROJECT DURING FY 2017

Appendix 1. Documented Fatalities at the Project during FY 2017.[1]

Species	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)
Columba livia (Rock Dove)	7/14/2016	21	28	290
Acridotheres tristis (Common Myna)	7/15/2016	30	3	90
Lonchura punctulata (Scaly-breasted Munia)	7/28/2016	04	11	270
Spilopelia chinensis (Spotted Dove)	7/28/2016	02	1	90
Estrilda astrild (Common Waxbill)	8/18/2016	04	34	136
Geopelia striata (Zebra Dove)	10/10/2016	05	14	90
Phaethon lepturus (White-tailed Tropicbird)	11/8/2016	27	9	274
Lasiurus cinereus semotus (Hawaiian hoary bat)	11/14/2016	06	10	170
Phaethon lepturus (White-tailed Tropicbird)	12/27/2016	19	2	90
Pluvialis fulva (Pacific Golden-plover)	12/27/2016	22	32	208
Lasiurus cinereus semotus (Hawaiian hoary bat)	12/30/16	17	30	255
Estrilda astrild (Common Waxbill)	1/2/2017	01	1	300
Estrilda astrild (Common Waxbill)	1/5/2017	02	4	153
Estrilda astrild (Common Waxbill)	1/5/2017	05	1	143
Geopelia striata (Zebra Dove)	1/10/2017	25	1	277
Acridotheres tristis (Common Myna)	1/12/2017	13	3	90
Estrilda astrild (Common Waxbill)	1/20/2017	26	4	101
Estrilda astrild (Common Waxbill)	1/20/2017	29	6	211
Spilopelia chinensis (Spotted Dove)	1/20/2017	27	1	2
Pluvialis fulva (Pacific Golden-plover)	1/26/2017	03	15	120
Estrilda astrild (Common Waxbill)	1/26/2017	09	1	30
Estrilda astrild (Common Waxbill)	1/31/2017	30	1	0
Geopelia striata (Zebra Dove)	2/7/2017	30	1	319
Estrilda astrild (Common Waxbill)	2/7/2017	27	1	120
Estrilda astrild (Common Waxbill)	2/7/2017	28	1	30
Estrilda astrild (Common Waxbill)	2/9/2017	15	20	270
Estrilda astrild (Common Waxbill)	2/10/2017	30	1	0
Estrilda astrild (Common Waxbill)	2/14/2017	28	1	90
Estrilda astrild (Common Waxbill)	2/14/2017	27	30	90
Pluvialis fulva (Pacific Golden-plover)	2/16/2017	11	25	132
Pluvialis fulva (Pacific Golden-plover)	2/16/2017	01	25	340
Spilopelia chinensis (Spotted Dove)	2/23/2017	10	1	330
Estrilda astrild (Common Waxbill)	2/28/2017	21	20	282
Spilopelia chinensis (Spotted Dove)	2/28/2017	25	1	15
Pluvialis fulva (Pacific Golden-plover)	3/2/2017	02	20	11
Geopelia striata (Zebra Dove)	3/7/2017	30	1	211
Pluvialis fulva (Pacific Golden-plover)	3/9/2017	11	32	110
Spilopelia chinensis (Spotted Dove)	3/9/2017	04	0	330
Estrilda astrild (Common Waxbill)	3/13/2017	11	0	20
Estrilda astrild (Common Waxbill)	3/14/2017	28	2	55
Spilopelia chinensis (Spotted Dove)	3/21/2017	19	2	355
Estrilda astrild (Common Waxbill)	4/5/2017	28	30	66
Estrilda astrild (Common Waxbill)	4/6/2017	09	1	180
Lonchura punctulata (Scaly-breasted Munia)	4/6/2017	15	20	138
Acridotheres tristis (Common Myna)	4/6/2017	01	3	90
Spilopelia chinensis (Spotted Dove)	4/7/2017	18	20	200
Zosterops japonicus (Japanese White-eye)	4/10/2017	04	5	195
Spilopelia chinensis (Spotted Dove)	4/11/2017	19	1	340
Phasianus colchicus (Ring-necked Pheasant)	4/24/2017	21	1	356
Estrilda astrild (Common Waxbill)	5/2/2017	28	20	33
Estrilda astrild (Common Waxbill)	5/2/2017	20	35	70
Acridotheres tristis (Common Myna)	5/5/2017	28	9	90
Acridotheres tristis (Common Myna)	5/9/2017	29	1	90
Lonchura punctulata (Scaly-breasted Munia)	5/9/2017	21	10	90

Appendix 1. Documented Fatalities at the Project during FY 2017 (continued).[1]

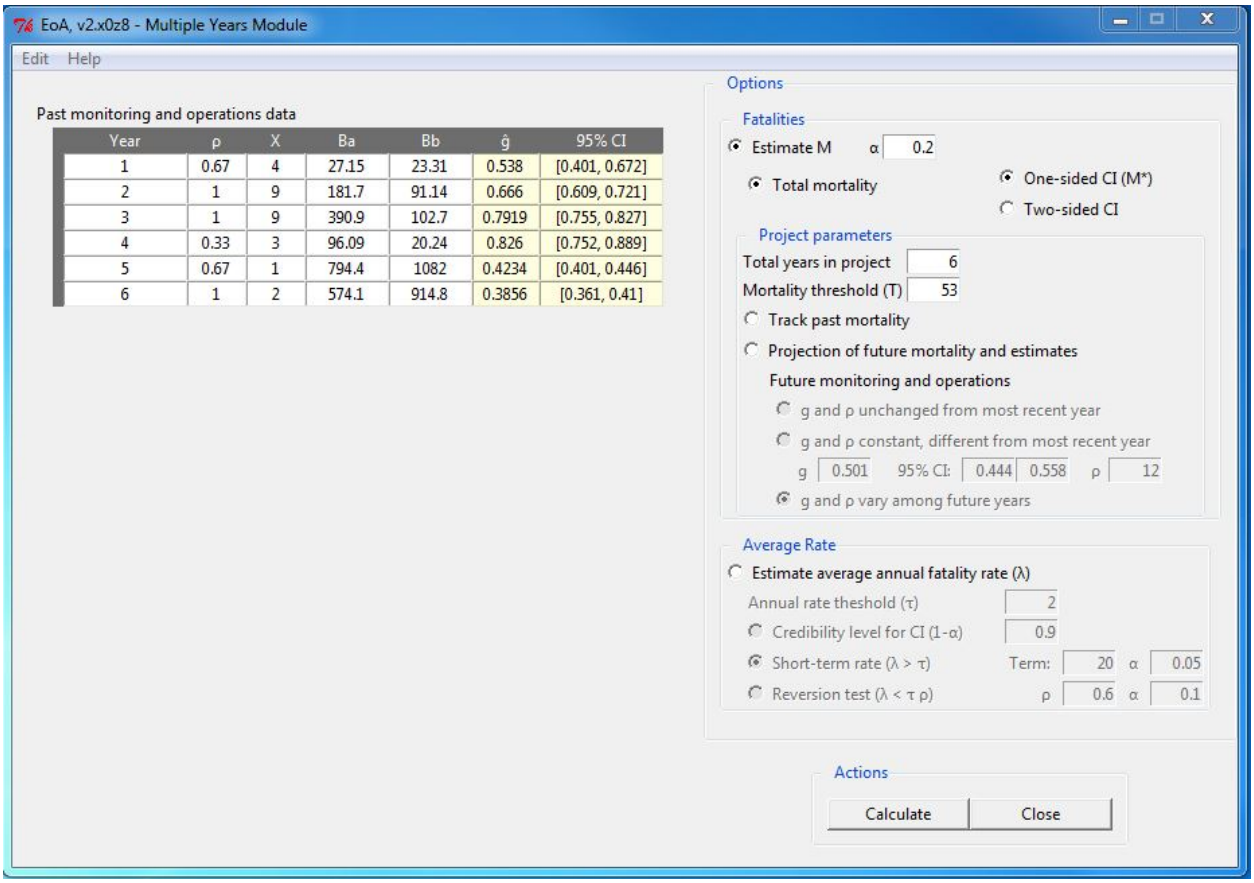
Species	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)
Acridotheres tristis (Common Myna)	5/12/2017	18	8	62
Spilopelia chinensis (Spotted Dove)	5/15/2017	13	4	65
Geopelia striata (Zebra Dove)	5/16/2017	20	1	0
Acridotheres tristis (Common Myna)	5/19/2017	29	4	82
Acridotheres tristis (Common Myna)	5/23/2017	29	2	90
Acridotheres tristis (Common Myna)	5/23/2017	29	2	60
Acridotheres tristis (Common Myna)	5/30/2017	28	2	60
Spilopelia chinensis (Spotted Dove)	6/1/2017	15	1	105
Acridotheres tristis (Common Myna)	6/1/2017	07	4	89
Acridotheres tristis (Common Myna)	6/1/2017	10	4	90
Acridotheres tristis (Common Myna)	6/1/2017	06	4	83
Acridotheres tristis (Common Myna)	6/8/2017	01	3	75
Acridotheres tristis (Common Myna)	6/9/2017	29	4	90
Acridotheres tristis (Common Myna)	6/19/2017	12	4	90
Bubulcus ibis (Cattle Egret)	6/20/2017	26	7	80
Acridotheres tristis (Common Myna)	6/26/2017	01	4	90
Acridotheres tristis (Common Myna)	6/26/2017	03	4	90

[1]Covered Species are highlighted in yellow. Species Protected by the MTBA are highlighted in gray.

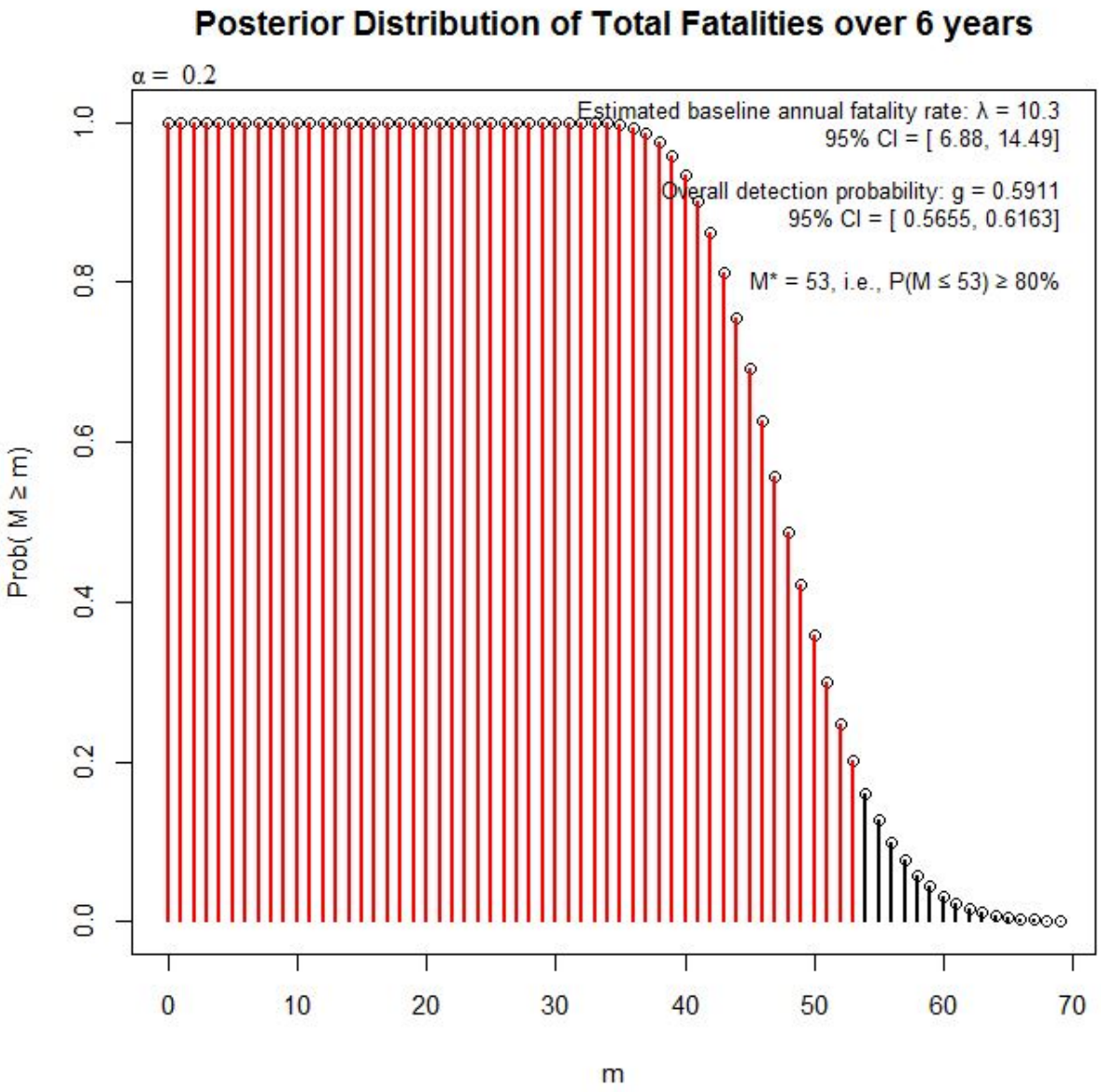
APPENDIX 2

DALTHORP ET AL. (2017) FATALITY ESTIMATION FOR HAWAIIAN HOARY BATS AT PROJECT THROUGH FY 2017

Appendix 2. Dalthorp et al. (2017) Fatality Estimation for Hawaiian hoary bats at Project through FY 2017.[3]



[3] Rho represents the portion of a year represented for each line of data. Year 1 represents November 2012 – June 2013, Year 2 represents July 2013 – June 2014, Year 3 represents July 2014 – June 2015, Year 4 represents July 2015 – October 2015, Year 5 represents November 2015 – June 2016, Year 6 represents July 2016 – June 2017. "Year 4" and "Year 5" were parsed due to the change in search strategy, reducing the search area for bats from 50 percent of the maximum blade tip height of the turbine to a 35-meter radius search plot.


Posterior Distribution of Total Fatalities over 6 years
α = 0.2
Estimated baseline annual fatality rate: λ = 10.3
95% CI = [6.88, 14.49]
Overall detection probability: g = 0.5911
95% CI = [0.5655, 0.6163]
M* = 53, i.e., P(M ≤ 53) ≥ 80%
Prob(M ≥ m)
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60
70
m

APPENDIX 3

RESULTS OF INSECT IDENTIFICATIONS FROM ASSESSMENTS CONDUCTED IN 2014 AND 2015

Appendix 3. Results of Insect Identifications from Assessments Conducted in 2014 and 2015.

Name	Size Range (mm)	Sum of Individuals Counted in All Traps
Blattaria (Cockroaches)		
Blaberidae: *Pycnoscelus indicus*	14.1-19.5	324
Blatellidae: *Balta notulata*	9.8-11.8	12
Blatellidae: *Blatella* sp.	6.8-8.9	71
Blattidae: *Platyzosteria soror*	18.2-18.2	46
Blattidae: *Periplaneta* sp.	29.2-29.2	49
Coleoptera (Beetles)		
Bostrichidae (small)	5.9-7.4	4
Bostrichidae (male)	8.1-10.8	141
Bostrichidae (female)	11.1-13	148
Bruchidae	4.6-4.6	6
Carabidae	4.4-6.2	4
Cerambycidae (orange)	5.8-7.1	7
Cerambycidae (dark brown, mottled)	7.4-10.2	87
Cerambycidae (light brown)	11.4-12.6	13
Cerambycidae (striped)	16.6-23.7	31
Cerambycidae (spotted)	17-17	2
Chrysomelidae	3.7-4.4	1
Coccinellidae	4.4-5.9	23
Curculionidae	4.6-7.3	585
Curculionidae (large, red & black)	8.1-11.8	4
Cupedidae	4.1-4.1	1
Elateridae	8.1-15.4	2,735
Hydrophilidae	9.3-9.3	181
Helodidae	3.7-4	1,972
Nitidulidae	4.4-6.8	28
Nitidulidae: *Phenolia limbata*	5.6-6.5	783
Oedemeridae	8.1-8.9	87
Scarabaeidae (small)	4.1-5.2	622
Scarabaeidae	10.1-16.3	187
Staphylinidae	5-7.4	161
Tenebrionidae (small)	4.7-6.4	3,107
Tenebrionidae (large)	9.5-11	79
Tenebrionidae (very large)	10.4-11.4	3
Dermaptera (Earwigs)	14.8-18.6	231
Diptera (Flies)		
Calliphoridae	7.4-8.6	100
Chironomidae	3.4-4.9	870
Culicidae	3.7-4.3	17
Dolichopodidae	4-5.2	44
Drosophilidae	3.6-3.6	1
Lauxaniidae	3.6-4	13
Limoniidae: *Erioptera* sp.	3.7-4.4	21
Limoniidae: *Dicranomyia* sp.	4-4.9	151
Limoniidae: *Styringomyia* sp.	4.6-5.6	367
Limoniidae (large)	5.9-7.1	2
Muscidae (alien)	4-4.6	61
Muscidae (large)	5.5-6.7	66
Muscidae: *Lispocephala* sp.(native)	6.1-6.1	1
Ottitidae	4.3-4.3	3
Sarcophagidae	8.1-9.2	4
Scenopinidae	4-4.7	4
Sciaridae	4-4.4	219
Stratiomyidae	9.9-9.9	2

Appendix 3. Results of Insect Identifications from Assessments Conducted in 2014 and 2015 (continued).

Name	Size Range (mm)	Sum of Individuals Counted in All Traps
Stratiomyidae: *Hermetia illucens*	14.8-14.8	1
Syrphidae: *Allograpta* sp.	4.4-5.6	13
Syrphidae: *Syritta orientalis*	5.9-8	1
Syrphidae: *Volucella* sp.	6.8-11.4	5
Tachinidae	13.2-13.2	1
Embiidina (Webspinners)		
Oligotomidae	5.2-6.7	199
Hemiptera (True bugs, hoppers, scales)		
Cicadellidae	5.9-11	220
Cydnidae (small)	3.7-3.9	961
Cydnidae (large)	6.2-7.1	1,216
Flatidae	4-4.9	1,370
Lygaeidae: *Nysius* sp.	3.8-4	8
Lygaeidae: *Remaudiereana* sp.	5-5.6	166
Lygaeidae (large)	5.9-6.8	6
Membracidae	3.7-4.1	34
Nabidae	6.7-7.1	19
Notonectidae	4.6-4.7	7
Pentatomidae: *Plautia stali*	9.6-9.6	2
Reduviidae	9.6-9.6	29
Trophiduchidae	3.6-4.4	27
Hymenoptera (Bees & wasps)		
Ampulicidae	15.7-15.7	1
Apidae: *Apis* sp.	12.3-12.3	4
Apidae: *Ceratina* sp.	7.1-7.4	3
Braconidae	4.4-4.4	6
Chalcidoidea	3.7-4.7	9
Crabronidae: Trypoxylon sp.	11.1-12.3	2
Formicidae (other alate)	3.7-6.2	747
Formicidae (myrmecine alate)	6.7-7.1	1,864
Formicidae: *Camponotus alate* (female)	10.2-11.2	236
Halictidae: *Lasioglossum* sp.	4.7-5.5	16
Ichneumonidae	4.4-8.6	93
Pompilidae	8.3-8.3	1
Scoliidae	8.7-9	2
Vespidae: *Polistes* sp.	17-19.2	1
Vespidae: *Delta* sp.	28.9-28.9	1
Isoptera (Termites)		
Kalotermitidae: *Incisitermes immigrans*	7-7	1,149
Lepidoptera (Moths and butterflies)		
Crambidae (large)	11.4-11.4	1
Crambidae	5.6-9.5	316
Gelechioidea	3-4.4	4,709
Geometridae: *Macaria abydata*	9.5-11.8	13,476
Geometridae: other	11-12.7	376
Tortricidae (small)	4.6-5.8	2,603
Tortricidae (large)	6.4-8.6	1,265
Tortricidae (fat)	8.3-9.8	54
Opogona (small)	5.6-6.2	660
Opogona (large)	7.4-8.9	476
(long palpi)	4.9-5	15
Noctuidae	16-21	138
Nymphalidae: *Agraulis vanillae*	21.3-21.5	3

Appendix 3. Results of Insect Identifications from Assessments Conducted in 2014 and 2015 (continued).

Name	Size Range (mm)	Sum of Individuals Counted in All Traps
Pterophoridae	6.4-6.7	4
Neuroptera (Lacewings)		
Chrysopidae	7.3-7.3	1
Hemerobiidae	4.9-4.9	2
Odonata (Dragonflies and damselflies)		
Aeschnidae: *Anax* sp.	32	3
Coenagrionidae: *Enallagma civile*	26.6-26.6	15
Orthoptera (Grasshoppers and crickets)		
Acrididae	21.3-36.6	2
Gryllidae	11.5-14.9	127
Tettigoniidae	12.9-15.5	25
Trichoptera (Caddisflies)		
Hydroptilidae	3.9-5.3	438

APPENDIX 4

PROTOCOL FOR ʻUKOʻA WETLAND WATERBIRD MONITORING SURVEYS

Protocol for Ukoa Wetland Waterbird Monitoring Surveys (2017)

BACKGROUND

Kawailoa Wind Power, LLC is working to fulfill mitigation obligations under its approved Habitat Conservation Plan (HCP) by conducting predator control, fencing, and vegetation maintenance for four listed waterbird species (SWCA 2011). Monitoring of waterbird presence and reproductive success is being conducted to identify any emerging threats and inform adaptive management. Waterbird surveys were previously conducted in 2014 and 2015 by a SunEdison biologist when vegetation management was first initiated. This memorandum outlines the protocols for waterbird monitoring surveys at the Ukoa Wetland now that the Conservation License with the landowner (Kamehameha Schools) has been executed, and vegetation management has resumed. These surveys are in addition to the bird surveys required as a Best Management Practice when contractors are working at the site to minimize disturbance and impacts to endangered Hawaiian waterbirds.

SURVEY TIMING

Waterbird surveys throughout Ukoa wetland began in January 2017. Waterbird surveys will occur weekly from December to September each year. Surveys will continue for 4 years or until mitigation requirements are met.

METHODS

A qualified biologist will conduct bird surveys at seven point count stations (Figure 1) set up in the vicinity of the open water and in areas with previous waterbird sightings. Moorhen playbacks will be used during surveys at the point count stations, as playbacks have been shown to increase detection of gallinules by 30 percent on Oahu (DesRochers et al. 2008). At each station, 5 minutes of passive observations will occur to allow birds to adjust to the presence of the observer and to record visual detections. Playbacks will begin after 5 minutes, consisting of a 15-second recording. The biologist will monitor for 5 minutes after finishing the playback to document moorhen vocalizations, movement, or sightings at each station. If there is no response after 5 minutes, the biologist will broadcast the playback again for 15 seconds and monitor for an additional 5 minutes. Approximately 15 minutes will be spent at each station.

In addition to the point count stations, independent waterbird observations will also be recorded while walking between stations. If unique waterbird individuals are observed between stations, the locations will be recorded using a Global Positioning System (GPS) unit.

Tetra Tech, Inc.
737 Bishop Street, Suite 2340, Mauka Tower, Honolulu, HI 96813
Tel 808.441.6655 Fax 808.836.1689 www.tetratech.com

Data will be collected using a standard field data sheet (see Appendix A). Information collected at each station will include the following:

- Survey date and time
- Weather conditions (i.e., cloud cover, wind speed, precipitation)
- Number and species of listed waterbird individuals observed
- Age of individuals observed (i.e., adults, fledglings, chicks)
- Approximate distance to bird(s) or nest(s)
- Behavior (e.g., foraging, loafing)
- Habitat type (i.e., percent vegetation cover and presence of standing water)
- Number of nests observed and number of eggs per nest (as visible)
- Evidence of predation (including identification of specific predators if possible)
- Evidence of avian botulism
- Non-listed waterbird species observed

Photographs of each point count station (dated January 2017) are provided in Appendix B.

REPORTING

The results of the Ukoa Wetland waterbird surveys will be summarized in the HCP annual report, which will be submitted to USFWS and DOFAW by August 1st each year.

REFERENCES

DesRochers, D.W., H.K.W. Gee, and J.M. Reed. 2008. Response of Hawaiian Moorhens to broadcast of conspecific calls and a comparison with other survey methods. Journal of Field Ornithology 79: 448–457.

SWCA. 2011. Kawailoa Wind Power Final Habitat Conservation Plan. Prepared for Kawailoa Wind Power LLC, October 2011.

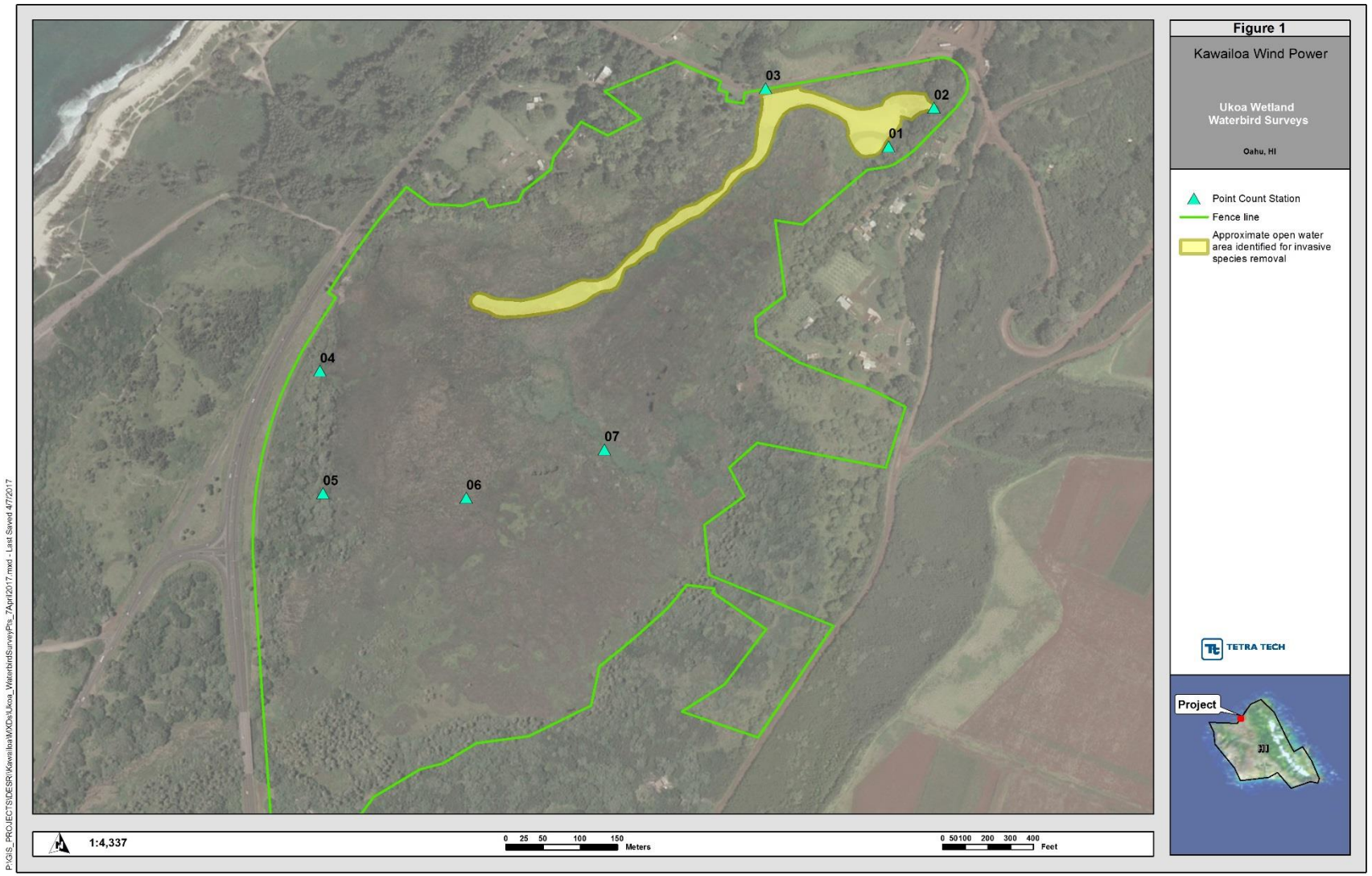


Figure 1
Kawailoa Wind Power
Ukoa Wetland
Waterbird Surveys
Oahu, HI
Point Count Station
Fence line
Approximate open water area identified for invasive species removal
01
02
03
04
05
06
07
TETRA TECH
Project
1:4,337
0 25 50 100 150
Meters
0 50100 200 300 400
Feet
P:\GIS_PROJECTS\DESR\Kawailoa\MXDs\Ukoa_WaterbirdSurveyPts_7April2017.mxd - Last Saved 4/7/2017

Appendix A
Ukoa Pond Waterbird Survey Data Sheet

Ukoa Wetland Waterbird Survey Datasheet (version: January 2017)
Prepared for: Kawailoa Wind LLC, Prepared by: Tetra Tech, Inc.

TETRA TECH

	Date	Station	Start Time (24hr)	End Time (24hr)	Temp (°F)	Cloud Cover (%)	Wind Speed (mph)/ Direction	Precipitation (Y/N)	Listed Species	Other Waterbird Species	Time Detected	Distance (m)	Bearing (deg)	Behavior	Vegetation Cover (%)	Standing Water (Y/N)	Nest Observed (# of eggs)	# of Adults detected	# of Fledglings detected	# of Chicks detected	# of Unknown Age detected	Botulism Evidence	Predation Evidence	Notes
Ex:	2/1/2017	PC2	8:15	8:30	68	40	0	No	-	-	-	-	-	-	80	Yes	No	0	0	0	0	No	No	No response to playback
Ex:	2/15/2017	PC5	9:15	9:30	76	100	0-3 SW	Mist	HAMO	CAEG	9:21	60	10	Foraging	60	Yes	No	1	0	0	0	No	No	

Appendix B

Representative Photographs at the Point Count Stations

Point Count Station 1

Point Count Station 2

Point Count Station 3

Point Count Station 4

Point Count Station 5

Point Count Station 6

Point Count Station 7