Kaheawa Wind Power II
Habitat Conservation Plan
Annual Report: FY 2017

Kaheawa Wind Power II, LLC 3000 Honoapi'ilani Highway
Wailuku, Hawai'i 96768

August, 2017

ITL-15 and ITP TE27260A-0

I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate and complete.

Hawai`i HCP Manager
Terraform Power, LLC

Table of Contents

Figures

Tables

Appendices

Executive Summary

Kaheawa Wind Power II, LLC (KWPII) has been implementing a Habitat Conservation Plan (HCP) since approval December 2011. The HCP supports the Federal Incidental Take Permit TE-27260A- 0 and State of Hawai'i Incidental Take License ITL-15, both issued in January 2012. KWPII was commissioned to begin operating on July 2, 2012. Species covered under the HCP include the Hawaiian petrel (HAPE), Newell's shearwater (NESH), Hawaiian goose (nēnē), and the Hawaiian hoary bat (bat). This report is for State of Hawai'i fiscal year (FY) 2017, July 1, 2016 through June 30, 2017.

In FY 2017 the downed wildlife search area consisted of graded roads and wind turbine generator (WTG) graded pads found within a 70-meter radius circle centered on each turbine. Teresa Gajate has been contracted since October 2015 to conduct canine assisted searching. Staff HCP biologists visually searched when Ms. Gajate was not available. Visual searches were 14.1% of the all KWPII WTG searches in FY 2017. The search interval mean and standard deviation (SD) in days for KWPII was 7.0 (SD = 0.44). The FY 2017 search area density weighted proportion (DWP) of the predicted total fall distribution for the nēnē, seabirds and bat is approximately 35.0%, 23.6% and 53.4%, respectively.

No HCP covered species were found in FY 2017. Since the operations began in July 2012 four nēnē and three bats have been observed within the search areas and included in the total take estimated since the permit period began in 2012. Neither HAPE nor NESH have been found at KWPII since operations began. The total estimated direct take at the 80% credibility level for KWPII HCP covered species is 10 and 12 adults for nēnē and bats, respectively. Indirect take (IDT) converted to adult take is one and one for nēnē and bats, respectively. Lost future productivity as fledglings accrued for nēnē is 2.3. Total estimated take as adults therefore is 11 and 13 for nēnē and bat, respectively.

Independent contractor Kristin Mack has conducted searcher efficiency trials (SEEF) trials at KWPII since October 2015. The SEEF results for large, medium, and small size carcasses were 100% (N = 11), 100% (N = 11), 93.0% (N = 43), respectively. Five 28-day carcass retention (CARE) trials used five large, five medium, and 25 small size carcasses. The CARE mean and standard deviation (SD) in days for large, medium, and small carcasses were 28.0 (SD = 0), 28.0 (SD = 0) and 14.4 (SD = 11.4), respectively.

Wildlife Acoustics SM2BAT+™ bat detectors with one SMX-U1™ microphone each recorded nightly bat detections at all eight WTG associated ground locations at KWPII during 8.3% of total detector nights. Wildlife Acoustics SM2BAT+™ and SM3BAT™ bat detectors with SMX-U1™ and SMU-U1™ microphones, respectively, recorded detections 72 meters above ground at all seven WTG nacelle locations at KWPII during 7.8% total detector nights. Bats were detected in every month of the year with peaks in August, September and October near the ground and in March, May and August at nacelle height.

A total of 17 site personnel received Wildlife Education and Observation Program trainings in FY 2017.

Vegetation management of the search plots at KWPII for FY 2017 treated 21.7 acres of total search plot area using hand-held weed whackers and herbicide.

Seabird mitigation for Tier 1 estimated take for KWPII continues at the Makamaka'ole seabird enclosures and includes trapping and monitoring for potential predators, maintenance of enclosure fences, erosion control and monitoring seabird activity within the Makamaka'ole Stream drainage area and near artificial burrows within the enclosures. HCP required alternative seabird mitigation site surveys in East Maui were completed in FY 2016. Nēnē mitigation contracted to DOFAW for Tier 1 estimated take has been funded for two years and began March 2017 as nesting area predator control on Maui. Mitigation for Tier 1 and Tier 2 estimated bat take has been completely funded and continues as habitat management at Kahikinui State Forest Reserve. Mitigation for higher estimated take has been contracted as bat ecological research intended to better inform future bat habitat restoration and conservation and will begin in FY 2018 quarter 1.

An HCP amendment and state and federal take permit amendments are in preparation and include proposed mitigation and an increase in take requested for nēnē and bats. An Environmental Impact Statement Preparation Notice for KWPII was published in the Office of Environmental Quality Control *Environmental*

Notice on February 23, 2017.

KWPII provided abbreviated quarterly summary reports for FY 2017 quarters 1-3 and met periodically with USFWS and DOFAW. The Endangered Species Recovery Committee reviewed the FY 2016 annual HCP report on November 1-2, 2016.

Introduction

In July 2012 Kaheawa Wind Power Phase II, LLC (KWPII) began commercial operation to meet the growing need for renewable energy across the island of Maui. The State Board of Land and Natural Resources approved a Conservation District Use Permit (CDUP) for the facility, which is situated on state conservation lands, in August 2010.

In fulfillment of the Endangered Species Act and Chapter 195-D, Hawai`i Revised Statutes, KWPII developed a project-specific Habitat Conservation Plan (HCP) in cooperation with the U.S Fish and Wildlife Service (USFWS), the Department of Land and Natural Resources- Division of Forestry and Wildlife (DOFAW) ("the agencies") and the Hawai`i Endangered Species Recovery Committee (ESRC). Upon final approval of the HCP, the federal Incidental Take Permit (ITP# TE-27260A-0) and state Incidental Take License (ITL# 15) were issued in January 2012, each with a duration of twenty years. The ITP and ITL cover four federally-listed and endangered species: the Hawaiian petrel or 'ua'u or HAPE (*Pterodroma sandwichensis*), Newell's shearwater or 'a'o or NESH (*Puffinus newelli*), Hawaiian goose or nēnē (*Branta sandvicensis*), and the Hawaiian hoary bat or 'ope'ape'a or bat (*Lasiurus cinereus semotus*).

KWPII has previously submitted annual HCP progress reports for FY 2013 through FY 2016 to the agencies (Kaheawa Wind Power II 2013, 2014, 2015 and 2016). This report summarizes HCP related activities for KWPII during the State of Hawai'i fiscal year (FY) 2017 (July 1, 2016 through June 30, 2017).

Downed Wildlife Monitoring

KWPII HCP biologists have implemented a year-round intensive monitoring program to document downed (i.e., injured or dead) wildlife incidents involving HCP-listed and non-listed species on the project site since operations began in July 2012. At the March 31, 2015 ESRC meeting, after review of monitoring data for KWPII, members agreed to "encourage the applicant to work with the statistical experts and researchers to develop an alternative more efficient and focused monitoring strategy which still meets the committees expressed preference for continuation of annual monitoring".

Beginning in July 2015 with agreement from the agencies and after three years of weekly monitoring of 75 meter (m) circular plots centered on each wind turbine generator (WTG), the area searched weekly includes only graded roads and WTG graded pads found within a 70m radius circle centered on each WTG (Figure 1).

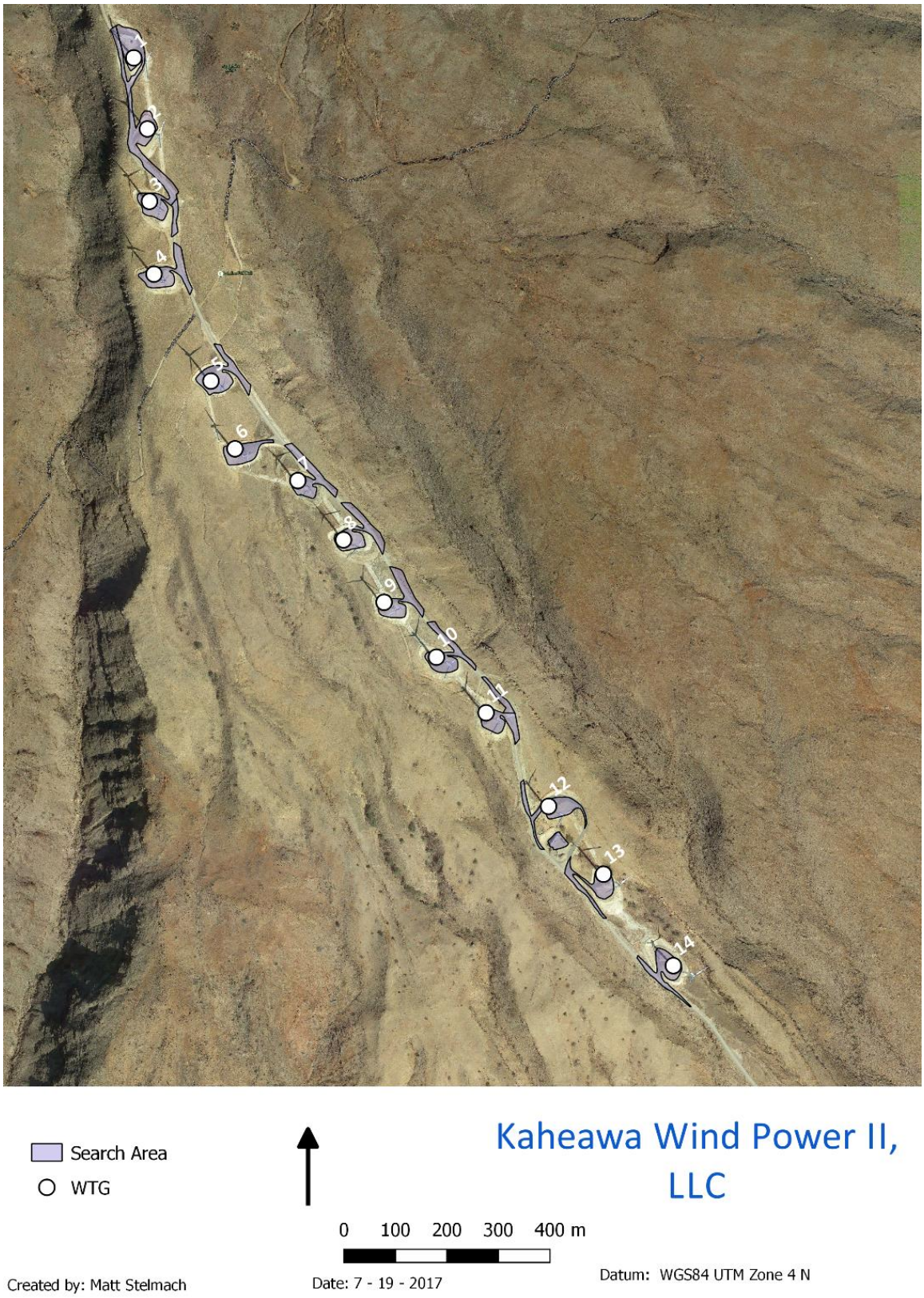

Figure 1. KWPII WTG locations and current search areas.

Search Area Density Weighted Proportion of the Predicted Fall Distribution

The density weighted proportion (DWP) of the predicted total fall distribution is one of the measured variables used to estimate the total take for each HCP listed species (see Estimated Adjusted Take). The DWP has also been called the density weighted area (DWA). The FY 2017 search area DWP of the predicted total fall distribution for the nēnē, seabirds and bat is approximately 35.0%, 23.6% and 53.4%, respectively (Appendix 1).

More birds or bats are expected to and do fall closer to the WTG and the distribution of fatalities is not uniform, becoming less dense per acre as distance increases from the WTG. To determine the DWP as distance increases the 70m circle is divided into six circular adjacent bands around the WTG and the 71-100m area into three 10m bands. The first, closest band encompasses the area from the WTG out to 20m radius and each band farther from the WTG has a 10m radius. The total area in acres is calculated for each band. The portion of the total area in each band that was searched (roads and pads) was determined using ARCGIS (Appendix 1). The product of the portion of area searched per band and the predicted fatality distribution per band are determined for each band for each carcass size class (large, medium and small) and the results summed for all bands to derive the DWP of the entire fall distribution of each carcass size class searched (Appendix 1). The fall distribution is assumed to be uniform around the turbine.

Nēnē

The DWP of the predicted total fall distribution was calculated for all observed nēnē fatalities from turbine strikes at KWP I and KWP II that fell within the search area between each WTG and out to a 70m radius. The DWP between 0 and 70m radius was based on 27 observed nēnē. To account for hypothetical takes that would have been expected, based on the ballistics modelling of Hull and Muir (2012) for large birds around “small” turbines, but not observed, six individuals (22% of the observed nēnē) were added to create the fall distribution between 70m and 100m. The KWP I and KWP II nacelle heights are 68m and 72m, respectively, and the maximum height of the rotor swept zones are 90m and 100m, respectively. These are considered small turbines per Hull and Muir (2012). Since the heights at KWPI and KWPII are similar, all the observed nēnē take from both sites has been used in creating the observed fall distribution.

A 70m circle centered on each WTG therefore is modeled to include approximately 81.8% of all nēnē carcasses expected to fall from turbine strikes (Figure 2). The reduced search area of graded roads and pads within 70m is estimated to encompass 35.0% of all nēnē fatalities that could occur during FY 2017 (Appendix 1).

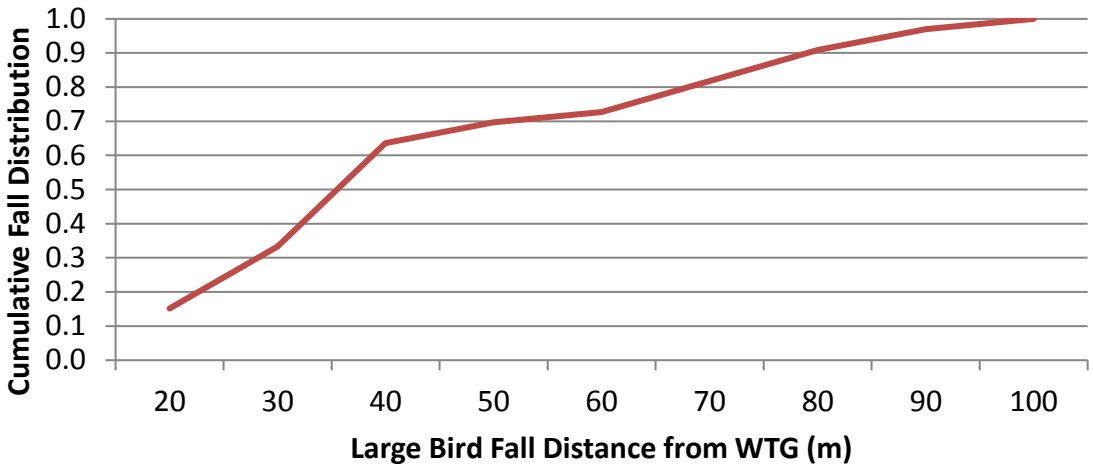

Figure 2. The cumulative fall distribution of nēnē struck by distance from WTG.

Hawaiian Petrel and Newell's Shearwater

The DWP of the predicted total fall distribution was calculated for all observed seabird fatalities from turbine strikes at KWP I and KWP II that fell within the search area between each WTG and out to a 70m radius. The DWP between 0 and 70m radius was based on 27 observed seabirds (HAPE, white-tailed tropicbirds and WTSH). To account for hypothetical takes that would have been expected, based on the ballistics modelling of Hull and Muir (2012) for medium birds around "small" turbines, but not observed, six individuals (22% of the observed seabirds) were added to create the fall distribution between 70m and 100m.

A 70m circle centered on each WTG therefore is therefore modeled to include approximately 81.8% of all seabird carcasses expected to fall from turbine strikes (Figure 3). The reduced search area of graded roads and pads within 70m is estimated to encompass 23.6% of all seabird fatalities that could occur during FY 2017, respectively (Appendix 1).

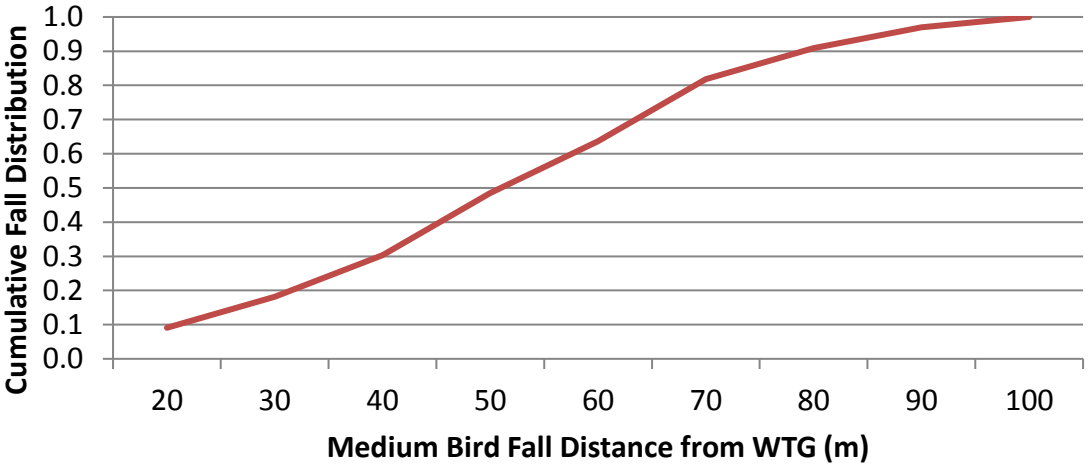

Figure 3. The cumulative fall distribution of HAPE struck by distance from WTG.

Hawaiian Hoary Bat

The DWP of the predicted total fall distribution was calculated using all bat fatalities (13 observed) from turbine strikes at KWP I and KWP II that fell within the search area out to a 70m radius circle. Hull and Muir (2012) modelled that no (or very few) bats fell beyond 50m.

A 70m radius circle centered on each WTG therefore is modeled to include 100% of all bat carcasses expected to fall from turbine strikes (Figure 4). The reduced search area of graded roads and WTG pads within 70m is estimated to encompass 54.2% of all bat fatalities that could occur during FY 2017, respectively (Appendix 1).

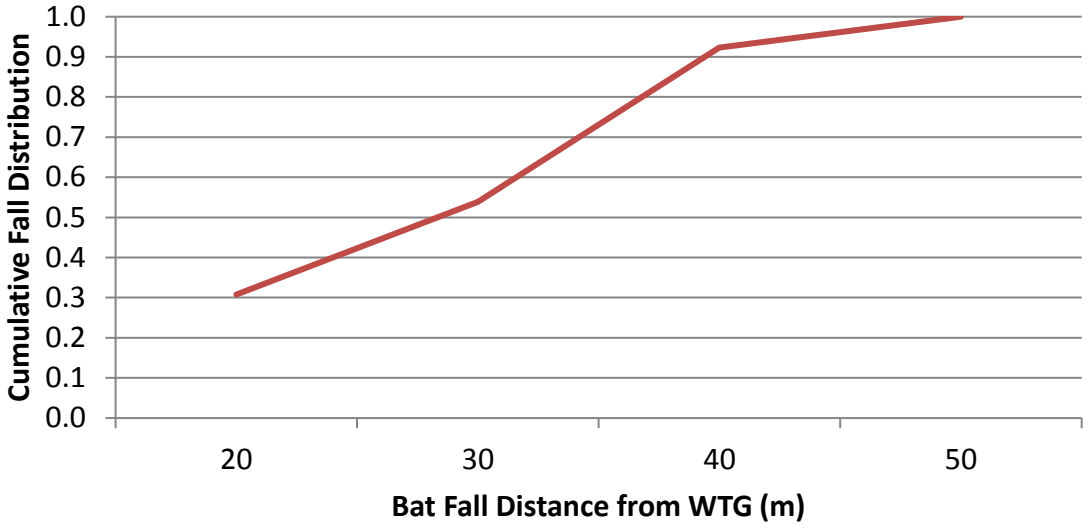

Figure 4. The cumulative fall distribution of bats struck by distance from WTG.

Search Interval

The search interval mean and standard deviation (SD) in days for KWPII downed wildlife monitoring was 7.0 (SD = 0.44) (Table 1 and Appendix 2). For the safety of the HCP staff, monitoring is halted during periods when wind speeds are reported higher than 15 meters per second (m/s). During FY 2017 no monitoring schedule interruptions occurred.

Teresa Gajate and her canine Makalani provided canine-assisted searching in FY 2017. Canine-assisted searching was the primary search method, with visual searching by HCP staff when canine-assisted searching was not available. In FY 2017 86.9% (N = 625) of searches were canine-assisted and 14.1% (N = 103) were visual (Appendix 3).

Table 1. Search interval mean and standard deviation (SD) in days per WTG plot at KWPII during FY 2017.

WTG	1	2	3	4	5	6	7
Mean	7.00	7.00	7.00	7.00	7.00	7.00	7.00
SD	0.44	0.49	0.44	0.44	0.44	0.44	0.44
WTG	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mean	7.00	7.00	7.00	7.00	7.00	7.00	7.00
SD	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Mean TOTAL		**7.00**		**SD TOTAL**		**0.44**	

Canine Interactions with Wildlife

Special precautions have been taken to eliminate any potential canine interaction with wildlife. The handler has been directed to immediately retrieve Makalani if nēnē were observed and to temporarily skip WTGs if nēnē were present within the WTG search area or vicinity. Skipped WTGs were preferentially searched later the same day or the next day with either canine assistance or visual search.

Canine searches were postponed or skipped in favor of visual searches if nēnē were present at the turbine or if WTG repairs were necessary. Nēnē presence halted two (0.3%) WTG searches. No canine wildlife interactions were observed.

Downed Wildlife Incidents

No HCP covered species were found in FY 2017. Migratory Species Treaty Act (MBTA) listed species found include one Hawaiian short-eared owl and two white-tailed tropicbirds. Table 2 summarizes all downed wildlife incidents documented at KWPII during FY 2017 including non-listed incidents. Figure 5 displays locations of fatalities in relation to nearest WTGs and site facilities. All incidents were reported to the agencies within 24 hours and downed wildlife incident reports submitted within three days of each discovery. The total take observed in search areas through FY 2017 for each HCP covered species is four nēnē and three bats. No HCP covered or MBTA listed fatalities were observed outside the search area through FY 2017.

Table 2. Downed wildlife incidents at KWPII during FY 2017.

Common Name	Discovery Date	WTG	Distance to Nearest Structure (m)
MBTA Species			
Hawaiian short-eared owl	8/17/2016	7	22
White-tailed Tropicbird	6/9/2016	13	54
White-tailed Tropicbird	3/8/2017	8	26
Non-listed Species			
Black Francolin	1/4/2017	2	1
Black Francolin	2/1/2017	1	10
Common Myna	6/1/2016	1	36
Common Myna	1/7/2017	14	22
Common Myna	3/15/2017	1	5
Common Myna	3/17/2017	1	8
Common Myna	3/22/2017	2	20
Common Myna	4/20/2017	2	1
Common Myna	5/3/2017	2	19
Gray Francolin	7/6/2016	5	27
Gray Francolin*	7/6/2016	5	90
Gray Francolin	4/26/2017	11	1
Gray Francolin	5/3/2017	7	45
Gray Francolin	5/3/2017	7	70
Gray Francolin	6/14/2017	14	31

*Downed wildlife found outside of the search area

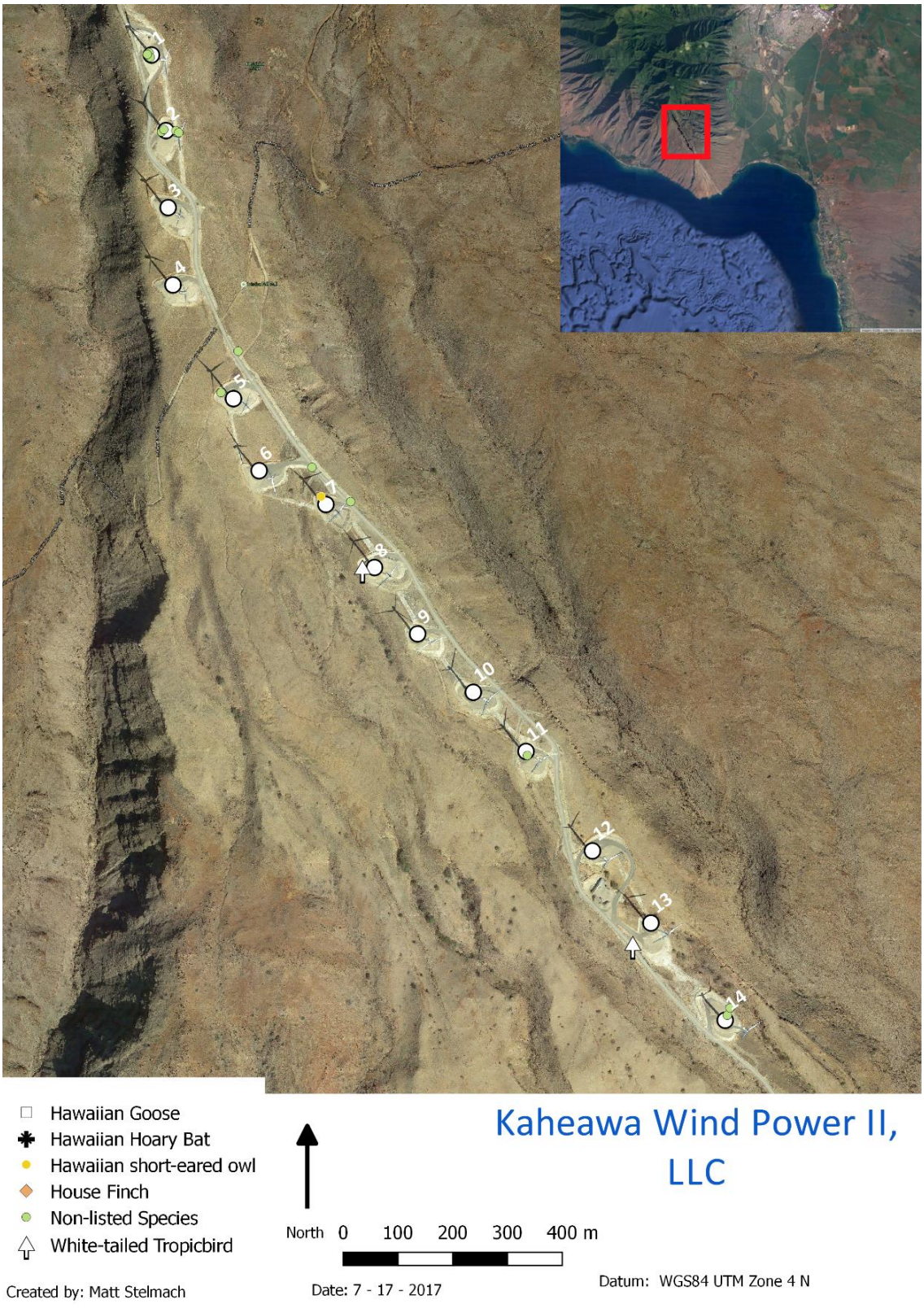

Figure 5. All downed wildlife observed during FY 2017 at KWPII in relation to WTGs.

Searcher Efficiency Trials

In FY 2017, independent contractor Kristin Mack (the SEEF proctor) conducted searcher efficiency (SEEF) trials. The SEEF proctor used randomly selected points within the reduced search area for SEEF locations. The schedule for placing carcasses was pre-determined for each week and unavailable to HCP staff and the canine handler. HCP staff would inform the SEEF proctor of the planned weekly search schedule to ensure SEEFs were put out for scheduled search days. At the end of each search day HCP staff would communicate to the SEEF proctor what was found. If any SEEF carcasses were missed a different HCP staff member (typically the HCP manager) would attempt to recover the carcass and report to the SEEF proctor if the carcass was still present. If the carcass was not found that carcass trial would be considered lost and not included in SEEF results.

For the KWPII SEEF trials a total of 65 carcasses were placed; 43 small size (rats), 11 medium size (wedge-tailed shearwaters (WTSH)), and 11 large size (chickens) (Appendix 4). Large, medium and small SEEF results were 100%, 100% and 93.0%, respectively (Table 3). Ten of 65 SEEF trials (15.4%) occurred during visual searches (Table 4).

Table 3. SEEF results for KWPII during FY 2017.

Carcass Size	Result	Trials
Large	100%	11
Medium	100%	11
Small	93.0%	43

Table 4. SEEF by search type and carcass size for KWPII during FY 2017.

Search Type	Carcass Size	Trials	Result
Canine-assisted	Large Bird	8	100%
	Med Bird	11	100%
	Rat	41	92.7%
Visual	Large Bird	3	100%
	Med Bird	0	N/A
	Rat	2	100%

Carcass Retention Trials

Carcass retention (CARE) trials are used to estimate how long a carcass remains detectable to searchers before complete removal or obscuring by scavengers or weather conditions (wind blowing a carcass out of a search area). Trials proctored were conducted using Rhode Island Red crossed chickens as surrogates for nēnē, WTSHs for HAPE and NESH, and commercially produced rats for bats. The chickens were from Maui farmers. WTSH carcasses were fledglings and adults found dead by the public and delivered to Sea Life Park on Oahu or collected by DOFAW on Maui. Rat carcasses were purchased from Layne Laboratories, Inc. in California, a pet food company. These rats are brown and/or black and are the Layne Laboratory "Small Colored" size category (approximately 11.4 cm in body length not including the tail) and have been chosen to mimic the body size of Hawaiian hoary bats. The HCP listed species are not available to use in CARE trials. Our state and federal

wildlife collection permits for WTSH use for KWPII are numbers WL 15-05 and MB24151B-0, respectively, through 2016, and WL18-09 and MB22098C-0, respectively, during 2017. Any take of MBTA species is also reported annually through these permits.

During FY 2017, CARE trials used five large size (chickens), five medium size (WTSHs), and 25 small size (rats) carcasses (Appendix 5). All trials were for 28 days. The CARE mean and SD in days for large, medium, and small carcasses were 28.0 (SD = 0), 28.0 (SD = 0) and 14.4 (SD = 11.4), respectively (Table 5).

Table 5. Carcass retention trial results at KWPII during FY 2017.

Carcass Size	Count	Mean Retention (days)	SD (days)
Large	5	28.0	0
Medium	5	28.0	0
Small	5	14.4	11.4

Scavenger Trapping

We initiated scavenger trapping near the WTGs in August 2015. Trapping in FY 2017 included six DOC250™ body grip kill traps, and six cage live traps (Figure 6). During FY 2017, 33 mongooses, eight rats and 21 cats were caught using the approved trapping protocol and monitoring frequency (Table 6).

Trapping is intended to decrease scavenging of any downed wildlife and may improve nēnē fledgling survival and nesting success. All traps were designed to minimize inadvertent interaction with nēnē. In FY 2017, two common mynas were inadvertently killed in DOC250™ traps.

Table 6. KWPII trapping and monitoring protocol.

Trap Type	Species Targeted	Monitoring Frequency	Frequency of Baiting/Re-setting	Frequency of Cleaning and Re-locating
DOC 250	Mongoose, Rat	Weekly	Weekly	Minimum 1x per 3 months
Cage Trap	Cat, Mongoose	24 Hours	2-7 Days	Minimum 1x per 3 months

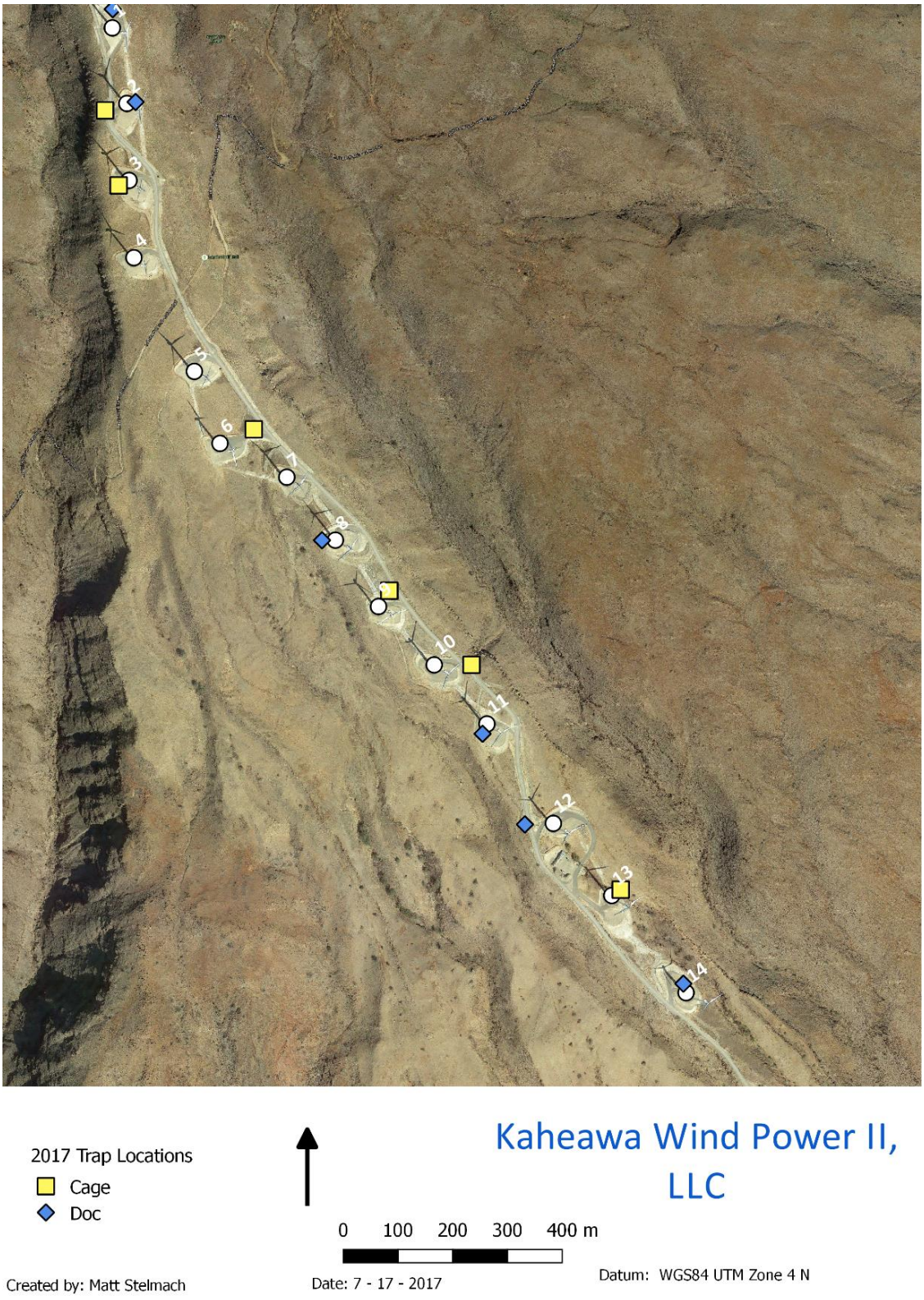

Figure 6. Location of KWPII predator traps during FY 2017.

Estimating Adjusted Take

The estimators used in this report were developed by the USGS (Huso *et al.* 2015 and Dalthorp *et al.* 2017) and have been recommended by the agencies. The USGS Evidence of Absence estimator's output is a value that represents the number of fatalities that has not likely been exceeded during the survey period. Values can be generated for varying levels of "credibility" (confidence) and expressed as a percentage (e.g., 50%, 80%, etc.). The higher the desired level of credibility the more conservative (higher) the estimated value. At the request of the agencies, the more conservative 80% credibility level is reported.

A stipulation of the estimator model is that only fatalities observed within the designated search area are included in the take estimation. Fatalities observed outside of the designated search area or incidental to searches are considered in the estimation calculation to have already been represented in the un-searched portion of the total expected fatality distribution.

No HCP covered specie's fatalities were found in FY 2017. The total estimated direct take at the 80% credibility level for the KWPII HCP covered species is 10 and 12 adults for nēnē and bat, respectively (Appendix 6). Observed direct take (ODT) is the only take that has been documented and confirmed at the site. However, for the purposes of estimating potential take for permitting and mitigation, the Evidence of Absence estimator calculates additional take that may have occurred but that was not observed. This unobserved direct take (UDT) attempts to account for fatalities that may have fallen outside of search plots, were missed by searchers within search plots, or were removed by scavengers or environmental factors such as high winds.

In addition to ODT and UDT, indirect take (IDT) is estimated separately for ODT and UDT and is the possible or known take of offspring that have been negatively affected by the direct take of their parents. Both parents of nēnē and the seabird species exhibit equal responsibility for care of young until fledging while only the female bat cares for their offspring. All four HCP covered species have seasonal breeding periods as described in the KWPII HCP and the point during the breeding season when an adult is taken determines to what extent the offspring is affected (i.e. the chance of survival of an offspring without one or both parents may vary).

IDT for nēnē is detailed in Appendix 7 and the calculation depends on what time of year the adult take was observed. Total IDT (for ODT and UDT) for nēnē is 0.7 fledglings. IDT converted to adult take for nēnē is one (rounded up, 0.7 X 0.512 = 0.36) and assumes three years from fledging to adulthood at an annual survival rate of 0.8 (0.512 after three years).

The total estimated nēnē take (direct plus indirect take) at the 80% credibility level is not more than 11 adults. Tier 1 take level is 18 adults and 3 fledglings (or 20 adults assuming three fledglings surviving to adult is 1.54 rounded up to 2). Eleven adult nēnē is 55% of the Tier 1 level as adults.

Accrued lost productivity for nēnē is 2.3 fledglings (Appendix 8). Accrued lost productivity for a given year for nēnē is determined by adding adult estimated take accumulated from all previous years (not yet mitigated for) and multiplying that adult total by 0.1 as proscribed in the KWP II HCP. Each year's lost productivity is accumulated until estimated adult take is mitigated for.

IDT estimated from bat ODT is calculated for adult female bats or bats of unknown sex (conservatively assumed to be female), found between April 1 and September 15, the bat breeding season designated by the agencies. Any ODT of adult female or sex unknown bats found during the breeding season are assumed to have dependent young, and a loss of 1.8 juveniles is calculated per female or unknown sex ODT (2 pups per female X 0.9 survival rate to weaning per pup = 1.8 juveniles). For KWP II no female bats and no bats whose sex has not yet been determined were observed during the breeding period through FY 2017. The sex of all bats found during the breeding period, if any, will be determined in FY 2018 and IDT recalculated.

IDT estimated from bat UDT assumes 50% of the UDT would be female and that for each female there is an average probability that she would be pregnant or lactating for three months in a year. Bats fly through the project area throughout the year and the probability of an individual female bat having dependent young during a 12-month period is assumed to be 25% (three out of 12 months). The average period of dependence

is determined considering that Hawaiian hoary bats have one brood a year, and that hoary bats in North America have an average 56-day gestation period followed by parental care to weaning averaging 34 days or approximately three months for gestation and parental care (Hayssen *et al* 1993, Hayes and Wiles 2013, and NatureServe 2015 for *Lasiuris cinereus*). There is not enough information for hoary bats from Hawai`i to determine the gestation and pre-weaning dependent period. Consequently, IDT is assessed to bats lost from female UDT at the rate of 0.225 juveniles/adult female bat (0.5 x 0.25 x 1.8 = 0.225). The IDT for the UDT considering the 80% credibility level is 2.25 juveniles (12 estimated – 3 observed = 9 unobserved x 0.225 = 2.03) (Appendix 9).

The estimated rate of survival of young to reproductive age (the next year after birth) assumed from available data is 0.30 (extrapolated from little and big brown bats (*Myotis lucifugus* and *Eptesicus fuscus*; Humphrey 1982, Humphrey and Cope 1976). Bat total IDT of 2.03 converts to 0.61 or one adult rounded up (2.03 x 0.3 = 0.61) (Appendix 9). The total estimated bat take at the 80% credibility level therefore is not more than 13 adult bats. The Tier 2 amended take limit of 11 adult bats is exceeded and a take amendment is in process.

Hawaiian Hoary Bat Monitoring

To better understand variations in bat activity specifically near the ground close to the WTGs, we have operated eight Wildlife Acoustics SM2BAT+™ ultrasonic bat detectors with one SMX-U1™ microphone (mic) each since October 2013 throughout KWPII. Prior to October 2013 Titley Anabat™ detectors had been deployed around the site near WTGs beginning in 2012 (KWP II 2012). The detector mics are mounted at 6.5 meters' height. Six are placed near the WTGs while two are placed near a gulch edge; each mic is positioned horizontally, pointing SW (away from the prevailing NE trade winds).

In addition to the ground units, five Wildlife Acoustics SM3BAT™ and two SM2BAT+™ ultrasonic bat detectors were also deployed in January 2015 in nacelles equipped with one SMM-U1™ or SMX-U1™ mic pointing backwards from the blades and parallel to the top of the nacelle. The SMX-U1 and the SMM-U1 mics are the same except that each is configured to fit the two different bat detectors. These seven detectors were deployed as an adaptive management measure to better understand bat activity patterns.

In FY 2017 bats were detected in every month of the year with peaks in August, September and October near the ground and in March, May and August at nacelle height (Figure 7). Detectors recorded bat activity at all eight ground WTG locations during 8.3% of detector nights (186 of 2232) (Table 7 and Figure 8). All seven detectors at nacelle height also recorded activity during 7.8% of detector nights (185 of 2383).

Table 7. Hawaiian hoary bat nights with detections and total detection nights at KWPII in FY 2017.

Detector Location (WTG)	Total Detector Nights	Total Detector Nights with Activity	% Total Detector Nights with Activity
Ground Detectors			
1	265	23	**8.6%**
2	237	26	**11.0%**
3 (Gulch)	188	3	**1.6%**
5	351	34	**9.7%**
9	312	19	**6.1%**
11	291	14	**4.8%**
13	294	36	**12.3%**
14 (Gulch)	294	31	**10.5%**
Totals	**2232**	**186**	**8.3%**
Nacelle Detectors			
1	320	41	**12.8%**
3	348	46	**13.2%**
5	341	14	**4.1%**
7	335	9	**2.7%**
9	350	28	**8.0%**
11	342	19	**5.6%**
14	347	28	**8.1%**
Totals	**2383**	**185**	**7.8%**

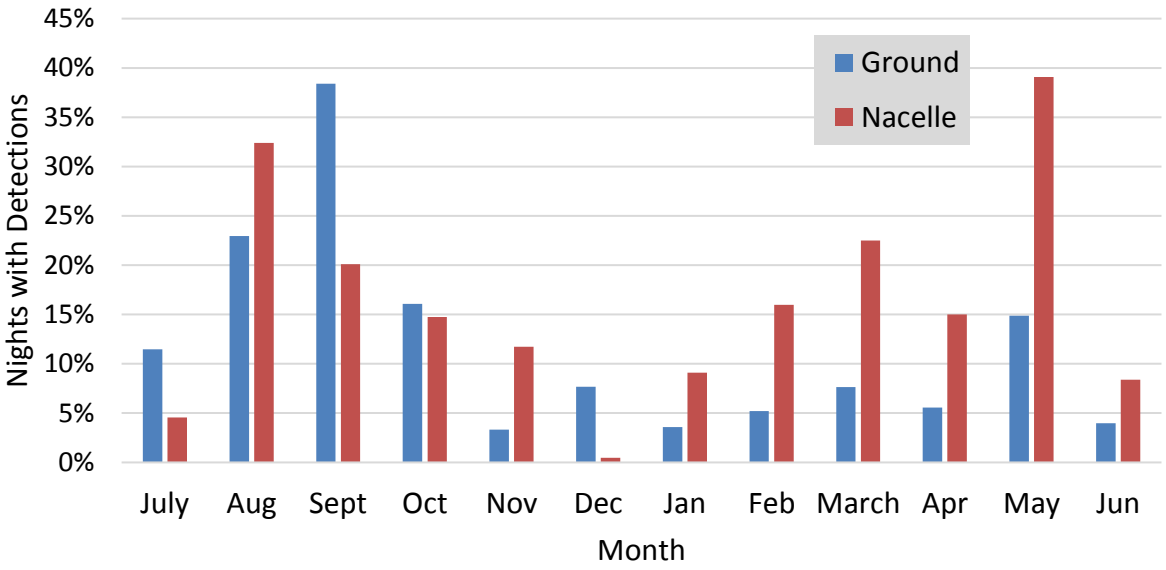

Figure 7. Bat nightly presence at KWPII by month during FY 2017.

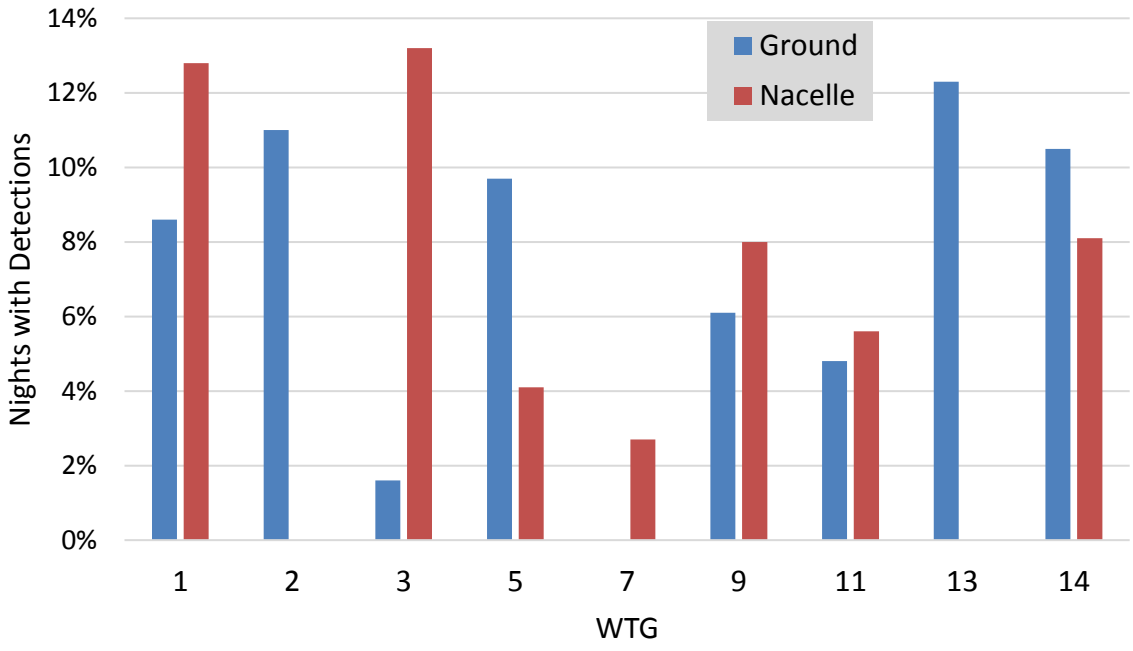

Figure 8. Bat nightly presence at KWPII by WTG during FY 2017 (these locations range from the highest elevation on the left (WTG-1) and lowest on the right (WTG-14G)). No ground detector at WTG 7 and no nacelle detector at WTG 2 and 13.

Wildlife Education and Observation Program

The wildlife education and observation program (WEOP) helps to ensure the safety and well-being of native wildlife in work areas and along site access roadways. The training provides useful information to assist staff, contractors, and visitors to be able to conduct their business in a manner consistent with the requirements of the HCP, CDUP, land use agreements and applicable laws. Records of wildlife observations by WEOP-trained staff are also used by the HCP program to identify the patterns of wildlife use of the site.

WEOP trainings were given to 17 personnel who were on-site regularly for two days or more (Appendix 10). The personnel were trained to identify covered and non-covered species of wildlife that may be found on-site and what protocol to follow, as determined in the HCP, when a downed wildlife is found. The trainees were also made aware of driving conditions and received instruction on how to drive and act around wildlife.

A total of 88 wildlife observations have been reported during FY 2017 at KWPII, including 207 Hawaiian geese, four Hawaiian short-eared owls, one white-tailed tropicbird, and 38 cattle egrets (Figures 9 and 10). There was an influx of cattle egrets to the site in March 2017. Data collected was used to better protect and understand HCP species and their habitat use.

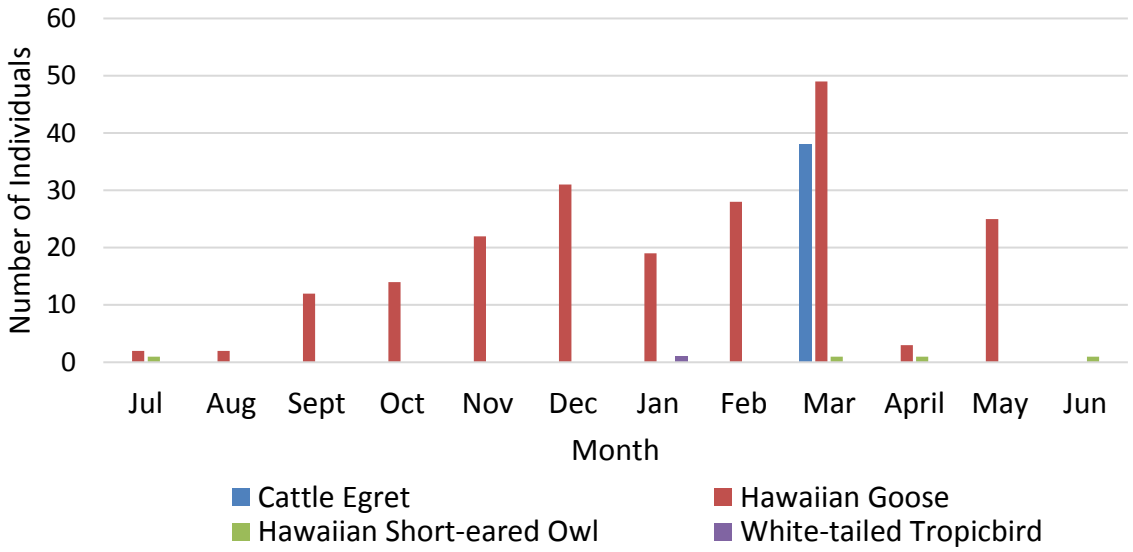

Figure 9. Wildlife observed by species and month as part of WEOP at KWPII during FY 2017.

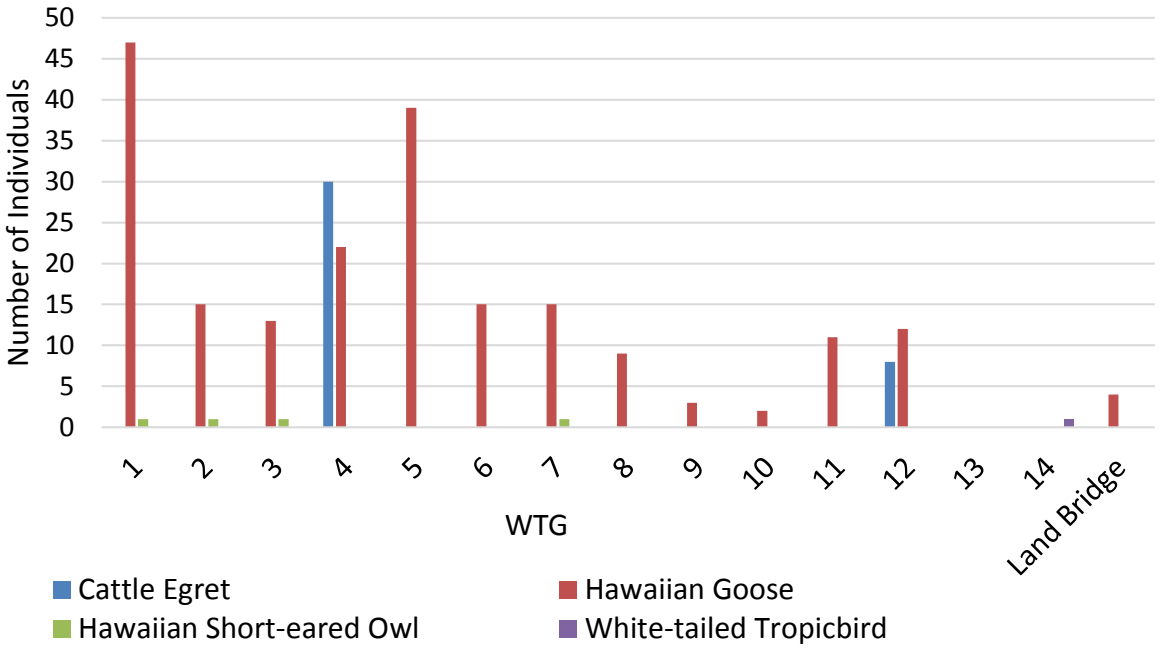

Figure 10. Wildlife observed by species and WTG location as part of WEOP at KWPII during FY 2017.

Vegetation Management

The HCP team manages ground cover at a low stature that will improve monitoring efficiency and minimize impacts to native plants without compromising soil stability. An overall site vegetation management plan was approved via letter from DOFAW dated November 15, 2010. Prior to 2010 no vegetation management was authorized. Nēnē nesting season restricts vegetation management activities within the search plots to only occur from April 1 through October 31. In November 2016, Stephanie Franklin of DOFAW-Maui verbally approved using hand management tools (spray packs and weed whackers) during nesting season if activity was within the current search area and did not disturb wildlife. Treatment for search plot areas was conducted in May 2017. In total, 56 person-hours was devoted to managing 21.7 acres.

Mitigation

Hawaiian Hoary Bat-Research

Mitigation for Tier 1 and Tier 2 estimated bat take has been completely funded and is ongoing as habitat management at Kahikinui State Forest Reserve. Mitigation for Tier 3 estimated take (34 bats) has been contracted as bat ecological research intended to better inform future bat habitat restoration and conservation and will begin in FY 2018 quarter 1. The contract funding will be $1,700,000 by the end of 2021.

East Maui Seabird Survey

In the unlikely event the initial five-year mitigation targets at Makamaka'ole for the NESH will not be

met, surveys of East Maui for potential additional mitigation sites was funded and completed in September 2015 (KWPII 2016). These surveys evaluated potential colony locations, estimated the numbers of birds present, assessed predator activity, and provided for management feasibility assessment.

Hawaiian Petrel and Newell's Shearwater- Makamaka'ole

Figure 11. Two completed enclosures on the Makamaka'ole seabird mitigation site in northern West Maui (Enclosure B is left and Enclosure A is right).

Weekly site visits to Makamaka'ole continue and focus on predator trapping and tracking, ongoing maintenance of both enclosures, artificial burrow checks, and game camera operation (Figure 11). Monitoring checklists have been created to ensure consistent oversight. These checklists include sound system battery checks, game camera operation and download, burrow checks for erosion damage, signs of bird activity (visual, scent, and game camera) and ongoing perimeter checks of fences and culverts. The Victor™ rat snap kill traps, DOC 200™ body grip kill traps (all encased in bird-safe boxes), and cage live traps are routinely maintained. Experimentation with bait and trap types have been ongoing.

The enclosures have shown to be an effective but not impermeable barrier to rats (Table 8). This year we saw an average of 6.5 rats per enclosure (N = 13). This translates to an average ingress rate of one rat every 56 days. Ingress tend to be clustered, and appear to have been related to breaches in the enclosure associated with heavy rain events and temporary fence or culvert degradation.

Table 8. Makamaka'ole trapping data by species and location during FY 2017.

Trap Location	Trap Type	Quantity Deployed	Number Caught
Outside A	Cage	1	0
	Victor Rat Snap	13	56 rats, 7 mice, 1 mongooses
	DOC 200 Body Grip	13	29 mongooses
Inside A	Victor Rat Snap	10	10 rats, 5 mice
	Cage	1	0
	DOC 200 Body Grip	4	1 rat
Outside B	Cage	1	0
	Victor Rat Snap	10	40 rats, 1 mongooses
	DOC 200 Body Grip	5	28 mongooses, 2 rats
Inside B	Victor Rat Snap	10	2 rats, 2 mice
	Cage	1	0
	DOC 200 Body Grip	5	0

Ten tracking tunnels inside each enclosure have been inked and baited every other month to assess small mammal activity (Table 9). Since January 24, 2014 no mongoose have been detected or trapped inside either enclosure. On January 7, 2015, we received our approved protocol to continue using Diphacinone bait blocks (KWP 2015). Twenty-five and 22 bait stations using Diphacinone bait blocks are currently deployed inside Enclosure A and Enclosure B, respectively. Bait stations within both enclosures continue to be checked biweekly, and re-baited as needed. Barn owl control contracted to DOFAW began at night in March 2017. No owls have been removed in FY 2017.

Table 9. Makamaka'ole rodent presence/absence summary, as the number of tracking tunnels with paw prints out of 10 total tunnels deployed.

	July 2016 Totals		September 2016 Totals		November 2016 Totals	
	% Enclosure A	% Enclosure B	% Enclosure A	% Enclosure B	% Enclosure A	% Enclosure B
Mouse	20	0	40	100	90	60
Rat	0	0	20	0	0	0
Mongoose	0	0	0	0	0	0
	January 2017 Totals		**March 2017 Totals**		**May 2017 Totals**	
	% Enclosure A	% Enclosure B	% Enclosure A	% Enclosure B	% Enclosure A	% Enclosure B
Mouse	30	40	0	20	10	0
Rat	0	0	0	0	0	0
Mongoose	0	0	0	0	0	0

Erosion inside and outside of enclosures continues to be monitored closely. Specially fabricated hydrologic flumes are still attached to the outflow sections of two culverts at Enclosure A. These flumes direct

water away from the enclosure, preventing erosion directly outside of the culvert tube and limiting the amount of displaced sediment entering neighboring streams. ʻUki (*Machaerina augustifolia*), ʻōhiʻa lehua (*Metrosideros polymorpha*), naupaka kuahiwi (*Scaveola gaudichaudii*), manono (*Kadua affinis*), propagated by Maui Native Nursery continue to be out-planted in and around both enclosures to stabilize soil in disturbed areas and to add to native flora within the mitigation area. We planted 110 ʻUki, 140 ʻōhiʻa, 40 naupaka, and 100 manono during FY 2017 with more variety of out-plantings scheduled for FY 2018. As specified by the NARs permit, regular herbiciding and weeding without motorized tools occurred each quarter. Target species for removal were *Clidemia hirta*, *Tibouchina spp*., *Melinus minutiflora* and *Psidium spp.*

Acoustic attraction systems broadcast social calls year-round. Sound files for the acoustic attraction system were updated in July, 2016 with a mixture of both HAPE and NESH calls provided by Maui Nui Seabird Recovery Project in enclosure A and only HAPE calls in enclosure B. Additional HAPE calls were recorded from Waikamoi, Maui in 2015 and NESH calls were recorded on Kaua'i from Pohakea in Hono O Nā Pali as well as from Upper Limahuli. KWP Biologists have been conducting monthly night surveys, beginning on March 9th, to ensure the sound systems work correctly and to monitor bird activity in the area (Appendix 11).

Seabird activity inside enclosure B has been increasing since our first sighting during the 2015 calendar year breeding season on June 22nd, 2015. Since then there have been three species of seabird, HAPE, NESH, and Bulwer's petrel (*Bulweria bulwerii*), frequenting multiple burrows within both enclosures between the months of April and October. The first bird activity for the 2017 calendar year breeding season recorded on May 11th was a NESH entering burrow A43 inside enclosure A. Last year the first bird sighting of had been a NESH on August 27, 2016 inside of enclosure A. Since the first sighting of 2017, there are now two burrows inside of enclosure A (A26, and A43) that are being frequented nightly by NESH (Figure 12 and 13). Burrow A26 had two NESH visiting on June 23rd. The first activity inside enclosure B this season on May 21st was a Bulwer's petrel entering burrow 22B (Figure 14). Since May 21st there have been frequent visits from both Bulwer's petrel and NESH at this burrow. On June 25th, two NESH at the same time in enclosure B was captured at 22B (Figure 15).

Figure 12. A Newell's shearwater near burrow A43 entrance (with NESH decoy in background) inside enclosure A on June 19, 2017.

Figure 13. Two Newell's shearwaters in front of burrow A26 (with NESH decoy to the right). The bird in front of the burrow entrance has nesting material in its mouth.

Figure 14. A Bulwer's petrel in front of burrow entrance 22B inside enclosure B on May 23, 2017 (with HAPE decoy).

Figure 15. Two Newell's shearwaters near the burrow entrance for 22B inside enclosure B on June 25, 2017 (HAPE decoy in the background).

Nēnē – Maui Predator Control

Two years of funding ($162,750) was provided by KWPII to DOFAW in FY 2017 to begin predator control at locations with high nēnē activity and/or nesting on Maui. Fledgling survival rates at chosen nesting locations were determined prior to initiating predator control. Increases in fledgling survival rates resulting from implementing predator control will determine the net benefit provided by the KWPII funded mitigation actions. DOFAW began mitigation activities in March 2017.

Adaptive Management

In accordance with the KWPII HCP, low wind speed curtailment (LWSC) up to wind speeds of 5 m/s was initially implemented at all WTGs when operations began and was scheduled for the months of April through November. LWSC is expected to reduce bat take as explained in the KWPII HCP. This curtailment period was extended to begin mid-February and continue through December 15, 2014 in response to bat fatalities documented at KWPII on March 13, 2013 and February 26, 2014, and at KWPI on December 14, 2013. On June 6, 2014 KWPII offered an adaptive management proposal to the USFWS and DOFAW to increase take minimization for bats and on July 29, 2014 the LWSC was raised to 5.5 m/s between February 15 and December 15 from sunset to sunrise. annually. KWP II currently operates eight ground bat detectors, and seven bat detectors at nacelle height to provide additional information about bat activity patterns that may contribute to reduced take.

Agency Visits and Reporting

During FY 2017, KWPII attended several meetings with agencies to discuss a variety of topics related to

HCP implementation. DOFAW conducted a site visit in December 2016 and observed HCP operations at both KWP sites and Makamaka'ole mitigation site. Abbreviated summary reports for FY 2017 quarters 1-3 were provided to USFWS and DOFAW. The Endangered Species Recovery Committee reviewed the FY 2016 annual HCP report on November 1-2, 2016.

Expenditures

The total KWPII HCP related expenditures in FY 2017 is $131,431 (Table 10).

Table 10. Expenses by category for KWPII during FY 2017.

Category	Cost ($)
Permit Compliance	11,350
Bat Mitigation	0
Seabird Mitigation	15,278
Vegetative Management	1,793
Fatality Monitoring	27,134
Equipment and Supplies	4,300
Terraform Power Labor	71,576
Total Cost	**131,431**

Citations

Dalthorp, D., M. M. P. Huso, and D. Dail. 2017. Evidence of absence (v 2.0) software user guide: U.S. Geological Survey Data Series 1055, 109p. https://doi.org/10.3133/ds1055 .

Hayes, G. and G. J. Wiles. 2013. Draft Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington. 158+ vi pp.

Hayssen, V., A. van Tienhoven, and A. van Tienhoven. 1993. Asdell's Patterns of Mammalian Reproduction: A Compendium of Species-Specific Data. Cornell University Press, Ithaca, New York, viii+1023 pp.

Hull, C. L. and S. Muir. 2010. Search areas for monitoring bird and bat carcasses at wind farms using a Monte-Carlo model. Australasian Journal of Environmental Management. 17:77-87.

Humphrey, S.R. 1982. Bats, Vespertilionidae and Molossidae. Pp 52 – 70 in Wild mammals of North America: biology, management, and economics (J.A. Chapman and G.A. Feldhamer, eds.). Johns Hopkins University Press, Baltimore, MD.

Humphrey, S.R. and J.B. Cope. 1976. Population ecology of the little brown bat, Myotis lucifugus, in Indiana and north-central Kentucky. American Society of Mammalogists. Stillwater, OK.

Huso, M. M. P., D. H. Dalthorp, D. A. Dail, and L. J. Madsen. 2015. Estimating wind-turbine caused bird and bat fatality when zero carcasses are observed. Ecological Applications. http://dx.doi.org/10.1890/14-0764.1

Kaheawa Wind Power II, LLC. 2012. Kaheawa Pastures Wind Energy Generation Facility: Phase 2 Habitat Conservation Plan FY-2012 Year 1 Annual Report. First Wind Environmental Affairs Division Portland, MA. 13 pp. + apps.

Kaheawa Wind Power II, LLC. 2013. Kaheawa Pastures Wind Energy Generation Facility Phase II Habitat Conservation Plan FY-2013 Annual Report: Year 1 HCP Implementation. First Wind Energy, LLC, Wailuku, HI 96793. 21 pp. + apps.

Kaheawa Wind Power II, LLC. 2014. Kaheawa II Habitat Conservation Plan FY 2014 Annual Report: Year 2. First Wind Energy, LLC, Wailuku, HI 96793. 33 pp. + apps.

Kaheawa Wind Power II, LLC. 2015. Kaheawa II Habitat Conservation Plan Annual Report: FY 2015. First Wind Energy, LLC, Wailuku, HI 96793. 27 pp. + apps.

Kaheawa Wind Power II, LLC. 2016. Kaheawa Wind Power II Habitat Conservation Plan Annual Report: FY 2016. SunEdison, LLC, Wailuku, HI 96793. 28 pp. + apps.

NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. NatureServe, Arlington, Virginia. Available at: http://www.explorer.natureserve.org/ . Accessed: July 23, 2016.

Appendices

Appendix 1. Density weighted proportion searched for Hawaiian goose, Hawaiian petrel and Hawaiian hoary bat at KWP II in FY 2017.

Radius Band (m)	Total Area (m^2)	Search Area (m^2)	Portion searched	Small Size Distribution	Small DWP	Medium Size Distribution	Medium DWP	Large Size Distribution	Large DWP
0-20	17584.0	15745.8	0.895	0.308	0.276	0.091	0.081	0.152	0.136
30	21980.0	12284.1	0.559	0.231	0.129	0.091	0.051	0.182	0.102
40	30772.0	9141.1	0.297	0.385	0.114	0.121	0.036	0.303	0.090
50	39564.0	7621.3	0.193	0.077	0.015	0.182	0.035	0.061	0.012
60	48356.0	5914.9	0.122	0.000	0.000	0.152	0.019	0.030	0.004
70	57148.0	4491.8	0.079	0.000	0.000	0.182	0.014	0.091	0.007
			Total	**1.00**	**0.534**	**0.818**	**0.236**	**0.818**	**0.350**

Appendix 2. Downed wildlife monitoring dates at KWPII during FY 2017.

WTG													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29
7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6	7/6
7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13	7/13
7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20	7/20
7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27
8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5	8/5
8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10
8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17
8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24	8/24
8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31	8/31
9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/7
9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14
9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21	9/21
9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28	9/28
10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5	10/5
10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12	10/12
10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19	10/19
10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26	10/26
11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2	11/2
11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9	11/9
11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16
11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22
11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30
12/7	12/8	12/7	12/7	12/7	12/7	12/7	12/7	12/7	12/7	12/7	12/7	12/7	12/7
12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14	12/14
12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21	12/21
12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28	12/28
1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11
1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18
1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25
2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1
2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8
2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15	2/15
2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22	2/22
3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1
3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15
3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22
3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29	3/29
4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12	4/12
4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19
4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26	4/26
5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3
5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10
5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17	5/17
5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24	5/24
5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31	5/31
6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7	6/7
6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14	6/14
6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21	6/21
6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28	6/28

Appendix 3. Canine-assisted to visual search ratio at KWPII during FY 2017.

	WTG						
Search Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Canine	44	42	45	45	45	45	45
Visual	8	10	7	7	7	7	7
Total	**52**	**52**	**52**	**52**	**52**	**52**	**52**
Canine Portion	*0.85*	*0.81*	*0.87*	*0.87*	*0.87*	*0.87*	*0.87*
Visual Portion	*0.15*	*0.19*	*0.13*	*0.13*	*0.13*	*0.13*	*0.13*

	WTG							
Search Type	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Total**
Canine	45	45	44	45	45	45	45	625
Visual	7	7	8	7	7	7	7	103
Total	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**728**
Canine Portion	*0.87*	*0.87*	*0.85*	*0.87*	*0.87*	*0.87*	*0.87*	*0.86*
Visual Portion	*0.13*	*0.13*	*0.15*	*0.13*	*0.13*	*0.13*	*0.13*	*0.14*

Appendix 4. SEEF trials at KWPII during FY 2017.

Trial date	Carcass type	WTG	Found	Recovered	Human/ Canine Searcher
7/6/2016	Small	14	Yes	Yes	Canine
7/6/2016	Small	12	Yes	Yes	Canine
7/6/2016	Large	9	Yes	Yes	Canine
9/7/2016	Large	11	Yes	Yes	Canine
9/7/2016	Medium	17	Yes	Yes	Canine
9/7/2016	Small	5	Yes	Yes	Canine
9/7/2016	Small	4	Yes	Yes	Canine
9/7/2016	Small	1	Yes	Yes	Canine
10/26/2016	Small	13	Yes	Yes	Canine
10/26/2016	Small	10	Yes	Yes	Canine
10/26/2016	Small	2	Yes	Yes	Canine
10/26/2016	Large	2	Yes	Yes	Canine
10/26/2016	Large	1	Yes	Yes	Canine
11/16/2016	Medium	4	Yes	Yes	Canine
11/16/2016	Small	3	Yes	Yes	Canine
11/16/2016	Medium	11	Yes	Yes	Canine
11/16/2016	Medium	10	Yes	Yes	Canine
11/16/2016	Small	7	Yes	Yes	Canine
11/16/2016	Small	8	No	Yes	Canine
12/21/2016	Small	12	No	Yes	Canine
12/21/2016	Small	11	No	Yes	Canine
12/21/2016	Small	4	Yes	Yes	Canine
12/21/2016	Small	4	Yes	Yes	Canine
12/21/2016	Large	3	Yes	Yes	Canine
1/25/2017	Small	9	Yes	Yes	Canine
1/25/2017	Medium	7	Yes	Yes	Canine
1/25/2017	Medium	4	Yes	Yes	Canine
1/25/2017	Small	2	Yes	Yes	Canine
1/25/2017	Small	2	Yes	Yes	Canine
1/25/2017	Large	1	Yes	Yes	Canine
2/22/2017	Small	1	Yes	Yes	Canine
2/22/2017	Small	3	Yes	Yes	Canine
2/22/2017	Small	3	Yes	Yes	Canine
2/22/2017	Small	6	Yes	Yes	Canine
2/22/2017	Small	11	Yes	Yes	Canine
3/22/2017	Small	12	Yes	Yes	Canine
3/22/2017	Small	5	Yes	Yes	Canine
3/22/2017	Large	2	Yes	Yes	Canine
8/17/2016	Small	14	Yes	Yes	Canine
8/17/2016	Small	12	Yes	Yes	Canine
8/17/2016	Small	8	Yes	Yes	Canine

Trial date	Carcass type	WTG	Found	Recovered	Human/ Canine Searcher
8/17/2016	Medium	7	Yes	Yes	Canine
8/17/2016	Small	5	Yes	Yes	Canine
8/17/2016	Small	2	Yes	Yes	Canine
4/12/2017	Large	5	Yes	Yes	Human
4/12/2017	Large	5	Yes	Yes	Human
4/12/2017	Small	11	Yes	Yes	Human
4/12/2017	Small	11	Yes	Yes	Human
4/12/2017	Large	14	Yes	Yes	Human
6/7/2017	Small	14	Yes	Yes	Canine
6/7/2017	Medium	11	Yes	Yes	Canine
6/7/2017	Small	10	Yes	Yes	Canine
6/7/2017	Large	8	Yes	Yes	Canine
6/7/2017	Medium	6	Yes	Yes	Canine
6/7/2017	Medium	5	Yes	Yes	Canine
6/7/2017	Small	2	Yes	Yes	Canine
6/7/2017	Small	1	Yes	Yes	Canine
6/7/2017	Small	1	Yes	Yes	Canine
5/3/2017	Small	11	Yes	Yes	Canine
5/3/2017	Small	11	Yes	Yes	Canine
5/3/2017	Small	7	Yes	Yes	Canine
5/3/2017	Small	6	Yes	Yes	Canine
5/3/2017	Small	5	Yes	Yes	Canine
5/3/2017	Small	4	Yes	Yes	Canine
5/3/2017	Medium	3	Yes	Yes	Canine

Appendix 5. CARE AD-AH trial results at KWPII during FY 2017.

CARE AD FY2017		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7
Carcass Type		Rat	WTSH	Chicken	Rat	Rat	Rat	Rat
WTG		13	11	10	7	2	1	1
Vegetation		Bare						
Distance (m)		50	48	52	6	13	43	59
Day	Date	P/A	P/A	P/A	P/A	P/A	P/A	P/A
0	7/26	P	P	P	P	P	P	**P**
1	7/27	P	P	P	P	P	P	A
2	7/28	P	**P**	P	P	P	P	
3	7/29	P	A	P	P	P	**P**	
4	7/30	P		P	P	**P**	A	
5	7/31	P		P	**P**	A		
6	8/1	P		P	A			
7	8/2	P		P				
8	8/3	P		P				
9	8/4	P		P				
10	8/5	P		P				
11	8/6	P		P				
12	8/7	P		P				
13	8/8	P		P				
14	8/9	P		P				
21	8/16	P		P				
28	8/23	**P**		**P**				
29	8/24		**P**					
Retention (days)		**28**	**28**	**28**	**5**	**4**	**3**	**0**

CARE AE FY2017		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7
Carcass Type		Chicken	Rat	Rat	Rat	Rat	Rat	WTSH
WTG		14	13	12	11	7	5	3
Vegetation		Bare						
Distance (m)		38	70	30	16	62	53	51
Day	Date	P/A	P/A	P/A	P/A	P/A	P/A	P/A
0	9/7	P	P	P	P	P	P	P
1	9/8	P	P	P	P	**P**	P	P
2	9/9	P	P	P	P	A	P	P
3	9/10	P	P	P	P		P	P
4	9/11	P	P	P	P		P	P
5	9/12	P	P	P	P		P	P
6	9/13	P	**P**	P	P		**P**	P
7	9/14	P	A	P	P		A	P
8	9/15	P		P	P			P
9	9/16	P		P	P			P
10	9/17	P		P	P			P
11	9/18	P		P	P			P
12	9/19	P		P	P			P
13	9/20	P		P	P			P
14	9/21	P		P	P			P
21	9/28	P		P	P			P
28	10/5	**P**		**P**	**P**			**P**
Retention (days)		**28**	**6**	**28**	**28**	**1**	**6**	**28**

CARE AF FY2017		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7
Carcass Type		Rat	Rat	WTSH	Rat	Rat	Rat	Chicken
WTG		13	12	9	8	7	4	2
Vegetation		Bare						
Distance (m)		54	43	22	50	39	20	50
Day	Date	P/A	P/A	P/A	P/A	P/A	P/A	P/A
0	10/19	P	P	P	P	**P**	P	P
1	10/20	P	P	P	P	A	P	P
2	10/21	P	P	P	P		P	P
3	10/22	P	P	P	P		P	P
4	10/23	P	P	P	P		P	P
5	10/24	P	P	P	P		P	P
6	10/25	P	P	P	P		P	P
7	10/26	P	P	P	P		P	P
8	10/27	P	P	P	P		P	P
9	10/28	P	P	P	P		P	P
10	10/29	P	P	P	P		P	P
11	10/30	P	P	P	P		P	P
12	10/31	P	P	P	P		P	P
13	11/1	P	P	P	P		P	P
14	11/2	**P**	P	P	P		P	P
21	11/9	A	P	P	P		**P**	P
28	11/16		**P**	**P**	**P**		A	**P**
Retention (days)		**14**	**28**	**28**	**28**	**0**	**21**	**28**

CARE AG FY2017		**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Trial 6**	**Trial 7**
Carcass Type		Rat	Rat	Chicken	Rat	Rat	Rat	WTSH
WTG		14	12	12	11	8	7	1
Vegetation		Bare						
Distance (m)		26	27	44	17	9	59	31
Day	Date	P/A	P/A	P/A	P/A	P/A	P/A	P/A
0	1/4	P	P	P	P	P	P	P
1	1/5	P	P	P	P	P	P	P
2	1/6	P	P	P	P	P	P	P
3	1/7	P	P	P	P	P	**P**	P
4	1/8	**P**	P	P	P	P	A	P
5	1/9	A	P	P	P	P		P
6	1/10		P	P	P	P		P
7	1/11		P	P	P	P		P
8	1/12		P	P	P	P		P
9	1/13		P	P	P	P		P
10	1/14		P	P	P	P		P
11	1/15		P	P	P	P		P
12	1/16		P	P	P	P		P
13	1/17		P	P	P	**P**		P
14	1/18		P	P	P	A		P
21	1/25		P	P	P			P
28	2/1		**P**	**P**	**P**			**P**
Retention (days)		**4**	**28**	**28**	**28**	**13**	**3**	**28**

CARE AH FY2017		**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Trial 6**	**Trial 7**
Carcass Type		Chicken	Rat	WTSH	Rat	Rat	Rat	Rat
WTG		12	12	7	5	4	10	12
Vegetation		Bare						
Distance (m)		71	44	37	69	75	43	43
Day	Date	P/A	P/A	P/A	P/A	P/A	P/A	P/A
0	4/17	P	P	P	P	P	P	P
1	4/18	P	P	P	P	P	P	P
2	4/19	P	P	P	P	P	P	P
3	4/20	P	P	P	P	P	P	P
4	4/21	P	P	P	P	P	P	P
5	4/22	P	**P**	P	P	P	P	P
6	4/23	P	A	P	P	P	P	P
7	4/24	P		P	P	P	P	P
8	4/25	P		P	P	P	P	P
9	4/26	P		P	P	P	P	P
10	4/27	P		P	P	P	P	P
11	4/28	P		P	**P**	P	**P**	P
12	4/29	P		P	A	P	A	P
13	4/30	P		P		P		P
14	5/1	P		P		P		P
21	5/8	P		P		P		P
28	5/15	**P**		**P**		**P**		**P**
Retention (days)		**28**	**5**	**28**	**11**	**28**	**11**	**28**

Appendix 6. Fatality estimation input parameters and results for Hawaiian goose at KWPII through FY 2017.

													Estimation Results			
Period #	**Year Portion**	**Portion Dates**	**Observed Mortality**	**Search Interval (Days)**	**SEEF Results**	**SEEF Trial Total Placed**	**CARE Mean[1]**	**CARE SD**	**CARE Trials Placed**	***k*[2]**	***dwp*[3]**	***rho*[4]**	***g*[5]**	***g lower***	***g upper***	**M* (Estimated Mortality, 80% Credibility**
1	1.00	7/1/12-6/30/13	1	7	0.67	9	27.45	1.68	22	1	0.7	1.00	0.676	0.615	0.735	2
2	2.00	7/1/13-6/30/15	2		0.86	29						2.00	0.698	0.694	0.702	6
3	1.00	7/1/15-6/30/16	1		1.00	13					0.350	1.00	0.349	0.341	0.356	9
4		7/1/16-6/30/17	0			11							0.348	0.34	0.356	10

[1]CARE Trials were for 28 days

[2] *k* represents the factor by which searcher efficiency decreases with each successive search (value of 1 indicates a carcass can be found on the second search as easily as for the first search)

[3] *dwp* is density weighted proportion: fraction of the total modeled or known carcasses that arrive in a searched area (value of 1 indicates the search area includes the area where all possible carcasses could fall)

[4] *rho* is the relative mortality rate

[5] *g* is overall detection probability, *g lower* and *upper* are the 95% confidence intervals around *g*

Appendix 7. Fatality estimation input parameters and results for Hawaiian hoary bat at KWPII through FY 2017.

													Estimation Results			
Period #	**Year Portion**	**Portion Dates**	**Observed Mortality**	**Search Interval (Days)**	**SEEF Results**	**SEEF Trial Total Placed**	**CARE Mean**	**CARE SD**	**CARE Trials Placed**	***k*[2]**	***dwp*[3]**	***rho*[4]**	***g*[5]**	***g lower***	***g upper***	**M* (Estimated Mortality, 80% Credibility**
1	1.00	7/1/12-6/30/13	1	7	0.42	19	10.25	8.52	12	0.7	1	1.00	0.443	0.241	0.656	5
2		7/1/13-6/30/14	2		0.52	50	5.89	7.33	19				0.359	0.235	0.493	12
3		7/1/14-6/30/15	0		0.38	56	7.75	9.66	8			0.85	0.336	0.187	0.504	12
4		7/1/15-6/30/16	0		0.81	42	14.86	13.82	22	1	0.534		0.346	0.257	0.441	12
5		7/1/16-6/30/17	0		0.93	43	14.36	11.4	25				0.409	0.345	0.476	12

[1] CARE Trials were for 28 days

[2] *k* represents the factor by which searcher efficiency decreases with each successive search (value of 1 indicates a carcass can be found on the second search as easily as for the first search)

[3] *dwp* is density weighted proportion: fraction of the total modeled or known carcasses that arrive in a searched area (value of 1 indicates the search area includes the area where all possible carcasses could fall)

[4] *rho* is the relative mortality rate (the product of Year Portion and Low Wind Speed Curtailment predicted mortality rate reduction (0.15 for periods 3-5))

[5] *g* is overall detection probability, *g lower* and *upper* are the 95% confidence intervals around *g*

Appendix 8. Nēnē lost productivity and indirect take at KWPII through FY 2017.

Component	*Fiscal Year*	*2013*	*2014*	*2015*	*2016*	*2017*	Total
A	**Observed Take**	***1***	***0***	***2***	***1***	***0***	***4***
B	Estimated Take Multiplier (**10/4= 2.5**)	2.50		2.50	2.50	2.50	
C	Estimated Direct Take (**A** x **B)**	2.50		5.00	2.50	0.00	***10.00***
D	Observed Indirect Take Multiplier (**Season defined**)	0.04		0.09	0.09	0.09	
E	Observed Indirect Take (**A** x **D**)	0.04		0.18	0.09	0.00	***0.31***
F	Unobserved Direct Take (**B** - **A**)	1.50		3.00	1.50	0.00	**6.00**
G	Unobserved Indirect Take (**F x 0.06**)	0.09		0.18	0.09	0.00	***0.36***
H	Accrued Adult Take (**Previous Years Accrued C**)		2.50	2.50	7.50	10.00	
I	Adult Lost Productivity (**H x 0.1**)		0.25	0.25	0.75	1.00	***2.25***
J	Indirect Take to Adult (**3 years previous G x 0.8^3** (0.8 = annual survival rate))				0.07		
K	Indirect Take to Adult Lost Productivity (**J x 0.1**)				0.007	0.007	***0.013***
	Total Lost Productivity (Total I + Total K**)**						***2.263***
	Total Indirect Take (Total C + Total G**)**						***0.67***

Appendix 9. Indirect take calculations for Hawaiian hoary bat at KWPII through FY 2017.

Component	Input	Value
A	Total Estimated Direct take	12
B	Observed direct take (ODT)	3
C	Unobserved direct take (UDT) (**A - B**)	9
D	ODT female or unknown during Apr 1- Sep 15 (0 female, 0 unknown) (**B x F**)	0
E	Proportion of UDT that could be female and probability a female is pregnant or lactating (0.5 x 3/12)	0.125
F	Survival of twin pups to weaning (0.9 x 2 pups)	1.8
G	ODT IDT (**D x F**)	0
H	UDT IDT (**C x E x F**)	2.03
I	IDT total (**G + H**)	2.03
J	Survival of juvenile to adult	0.3
K	**IDT as adults (I x J)**	0.61
Total IDT rounded up		**1**

Appendix 10. WEOP training log for FY 2017.

WEOP Training			
Name	**Date**	**Employer**	**Trainer**
Patrick Hannon	2/7/2017	Rope Partner	MS
Terry Miller	2/20/2017	Run Energy	MS
Willie Gonzales Jr	2/20/2017	Run Energy	MS
Eric Segura	2/20/2017	Run Energy	MS
Matthew Devers	2/20/2017	Run Energy	MS
Ryan O'Connell	2/20/2017	Run Energy	MS
Clyde Garcia	2/20/2017	Run Energy	MS
Darrel Grice	2/20/2017	Run Energy	MS
Ben Rhoan	2/21/2017	GE	SE
Jeremy Jones	3/3/2017	GE	MS
Nick Roussean	3/3/2017	Rope Partners	MS
Chris Banner	3/3/2017	Run Energy	SE
Jimmy Finen	3/3/2017	Rope Partner	SE
Micah Vokers	3/3/2017	GE	MS
John Calderera	4/5/2017	Rope Partner	MS
Jacob Macdonnell	5/30/2017	Run Energy	SE
Dave Bergstrom	5/30/2017	Run Energy	SE

Appendix 11. Makamaka'ole night survey summary data.

Survey Date	Location	Time	Type	Count	Distance (m)	Elevation	Behavior	Notes
7/20/16	B Makai	19:00	Unknown	4	0-50	Above	Transit	4 Unknown birds fly overhead
7/20/16	B Makai	19:38	NESH	1	51-200	Same	Transit	
7/20/16	B Makai	19:46	NESH	1	51-200	Same	Circling	
7/20/16	B Makai	19:50	NESH	1	0-50	Above	Circling	
7/20/16	B Makai	19:56	NESH	2	0-50	Above	Circling	
7/20/16	B Makai	20:06	NESH	2	0-50	Above	Circling	
7/20/16	B Makai	20:10	NESH	2	0-50	Above	Courtship	circling together
7/20/16	B Makai	20:20	NESH	1	0-50	Above	Courtship	
7/20/16	B Makai	20:26	NESH	1	0-50	Above	Ground Call	sounded like inside burrow entrance 22B
7/20/16	B Makai	20:33	NESH	1	0-50	Above	Other (notes)	landing in thick uluhe west of speaker and burrow 22B
8/10/16	B Mauka	19:20	NESH	1	0-50	Same	Circling	
8/10/16	B Mauka	19:20	HAPE	2	51-200	Below	Transit	
8/10/16	B Mauka	19:25	HAPE	2	51-200	Below	Circling	
8/10/16	B Mauka	19:33	HAPE	2	51-200	Below	Circling	
8/10/16	B Mauka	19:38	HAPE	2	51-200	Below	Circling	
8/10/16	B Mauka	19:42	NESH	2	0-50	Below	Transit	
8/10/16	B Mauka	19:47	NESH	2	51-200	Same	Transit	
8/10/16	B Mauka	19:50	NESH	2	0-50	Same	Circling	
8/10/16	B Mauka	19:55	HAPE		51-200	Same	Circling	
8/10/16	B Mauka	20:00	BAOW	2	0-50	Below	Transit	loud screech from below
8/10/16	B Mauka	20:07	NESH	1	0-50	Same	Circling	
8/10/16	B Mauka	20:14	NESH	1	0-50	Same	Ground Call	Landed
9/19/16	B Mauka	19:00	NESH	1	0-50	Above	Circling	
9/19/16	B Mauka	19:07	NESH	1	0-50	Above	Circling	Observed
3/30/17	Top of B	19:27	HAPE	1	201-500	Same	Transit	Call only (50% confidence)
5/4/17	Top of B	19:53	HAPE	2				
5/4/17	Top of B	19:45	HAPE	2				
5/4/17	Top of B	19:39	HAPE	2				
5/4/17	Top of B	19:29	HAPE	2				
5/4/17	Top of B	19:25	HAPE	1				
5/25/17	Top of B	20:09	HAPE	1	101-500	Above	Circling	Calls
5/25/17	Top of B	19:56	NESH	2	0-50	Above	Circling	Circling and calling over A
5/25/17	Top of B	19:43	NESH	2	0-50	Same	Transit	Continued calls
5/25/17	Top of B	19:35	HAPE	1	501-1000	Below	Transit	Heard in gulch
5/25/17	Top of B	19:34	NESH	2	0-50	Same	Circling	Flew past platform
5/25/17	Top of B	19:29	HAPE	2	101-500	Same	Circling	
5/25/17	Top of B	19:21	NESH	2	51-100	Above	Circling	
6/15/17	Road	18:31	NESH	1	201-500m	Above	Transit	Heard before sound systems turned on above B.