Kawailoa Habitat Conservation Plan- FY-2014 Annual Report Year 2

Kawailoa Wind Power, LLC

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Haleiwa, Hawaii 96712

August, 2014

ITL 14/ TE59861-A

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.

Hawaii HCP Manager
First Wind Energy, LLC

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Executive Summary

Kawailoa Wind Power, LLC (KAW) has been implementing a Habitat Conservation Plan (HCP) since approval October 27, 2011. The HCP supports a Federal Incidental Take Permit (TE-59861A-0) issued December 8, 2011 and a State of Hawaii Incidental Take License (ITL-14) issued January 6, 2012. The project was constructed in late 2011 and throughout 2012, and was commissioned to begin operating (COD) on November 2, 2012. Species covered under the HCP include six threatened and endangered birds and one endangered bat.

KAW submitted annual HCP progress reports for State of Hawaii Fiscal Years (FY) 2012 and 2013 to USFWS and DOFAW on August 28, 2012 (Kawailoa Wind Power FY 2012 Progress Report) and on August 1, 2013 (Kawailoa Wind Power FY 2013 Progress Report).

Fatality monitoring search plots have been marked in straight parallel transects out to 75 and 113m from the wind turbine generators (WTGs) (50% and 75% of the maximum turbine height, respectively) and 50m from the permanent meteorological tower (50% of the tower height). We continually manage vegetation within all the fatality monitoring plots. KAW initiated the use of a trained dog in July 2013 to assist with fatality searches.

The FY 2014 50% plot mean and standard deviation (SD) in days for search intervals during Q1, Q2, Q3 and Q4 were 3.49 (SD = 0.78), 3.65 (SD = 0.98), 3.51 (SD = 0.83), and 3.50 (SD = 0.74), respectively. The FY 2014 75% plot mean and SD in days for search intervals during Q1, Q2, Q3, and Q4 were 14.00 (SD = 0.41), 15.49 (SD = 4.42), 14.00 (SD = 0.41), and 13.94 (SD = 0.34), respectively.

The overall FY 2014 50% and 75% plot mean and standard deviation in days for search intervals were 3.54 (SD = 0.84) and 14.41 days (SD = 2.49), respectively, and in FY 2013 were 3.54 (SD = 0.83) and 14.01 (SD = 0.72), respectively.

Nine Hawaiian hoary bat fatalities were documented in FY 2014 surveys. No bird species listed in the Incidental Take License (ITL) and Incidental Take Permit (ITP) were found. The project total observed bat take is 14 through the end of FY 2014. The appropriate application of confidence intervals to fatality estimates has not yet been determined for Kawailoa. However, to illustrate a range of possibilities, take is reported here as a mean, with the 20% and 80% CI's.

Using 20% and 80% confidence intervals (CI), the estimated bat fatality for 14 observed bats (n = 11 after 3 were subtracted based on an assumption of the estimator) is between 18-24 with a mean of 21 adults using the Huso (2012) estimator and the indirect take considering the confidence interval range is 0.7 to 1.3 juveniles. Considering the one female and one unknown take observed during the breeding seasons of FY 2013-2014, 0.23 juveniles are added to the 0.7 to 1.3 range. The total indirect take ranges from 1 to 2 when rounded up and is divided by 2.1 as amended to convert to adult take. The total amended take is 19 to 25 bats (20% and 80% CI) with a mean of approximately 22 adults.

Also found in FY 2014 were 49 bird carcasses, including ten individuals of species protected under the Migratory Bird Treaty Act: two White-Tailed Tropicbirds, two Cattle Egrets, three Great Frigatebirds and three Pacific Golden Plovers. Other fatalities comprised non-native introduced species, including 18 Common Mynas, two Common Waxbills, six Spotted Doves, four Zebra Doves, one Red Crested Cardinal, one Ring Necked Pheasant, two House Finches, one Gray Francolin and four Nutmeg Mannikins.

Eight 28 day carcass retention (CARE) trials were conducted in FY 2014 using 21 small (rat) and 7 medium (Wedge-tailed Shearwater (WTSH)) size carcasses in short vegetation and 13 small (rat) and 4 medium (WTSH) size carcasses in medium vegetation. 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 site CARE mean and SD in days for all small carcasses is

6.68 (SD = 5.14) and for medium carcasses is 10.36 (SD = 5.52). In FY 2013 the site CARE mean and SD in days for all small carcasses was 7.04 (SD = 5.99) and for medium carcasses was 12.33 (SD = 3.97).

The overall searcher efficiency (SEEF) in FY 2014 for small (N = 216) and medium size carcass trials (N = 21) combining both vegetation classes was 72.2% and 95.2%. The overall canine only SEEF in FY 2014 for small (N = 118) and medium size carcass trials (N = 10) combining both vegetation classes was 81.4% and 100%. The overall human only SEEF in FY 2014 for small (N = 98) and medium size carcasses (N = 11) combining both vegetation classes was 61.2% and 90.9%. Through FY 2013 and 2014 the overall SEEF for small (N = 315) and medium size carcasses (N = 47) combining both vegetation classes was 69.2% and 95.7%, respectively.

Forty-eight Wildlife Acoustics™ SM2BAT+ ultrasonic detectors (SM2) with two microphones (mics) each located 75m from 30 WTGs detected Hawaiian hoary bats on 1285 of 15023 detector nights (9.0% of detector nights) in FY 2014. Detections occurred near all 30 WTG locations. Twelve SM2s with two mics each positioned at various heights in or at the edge of gulches that are near to WTGs detected bats on 214 of 3356 detector nights (6.3% of detector nights). Thirty SM2s in WTG nacelles with two mics each at 100m detected bats on 122 of 8558 detector nights (1.4% of detector nights), although not all detectors have been downloaded yet for this quarter.

Ukoa Wetland restoration and predator trapping and fish and frog control as part of Tier 1 mitigation for waterbirds and bats began in FY 2014-Q4. Seabird colony activity assessment on Kauai began in FY 2014-Q1 and continues through FY 2015-Q2. This assessment is part of a predator control project co-funded by Kahuku Wind Power. A Tier 2 bat mitigation site has been selected and implementation of the fencing, predator control and bat assessment there may begin as soon as FY 2015-Q1. Environmental and physical characteristics of the KAW site are being related to bat detections to determine if a model can predict future collision risk.

First Wind biologists issued 54 Wildlife Education and Observation Program (WEOP) trainings in FY 2014.

On August 13 representatives from the USFWS and DOFAW visited the KAW project site. KAW hosted a dog Search and Rescue training workshop on September 8. On November 12 representatives from the USFWS, DOFAW and First Wind met in Honolulu to discuss the status and plans for bat mitigation at KAW. DOFAW representatives visited KAW on February 6 to show their new HCP Planning Associate the wind facilities. KAW began monthly calls with DOFAW and USFWS in December 2013 to review bat mitigation and adaptive management progress.

In addition to the FY 2012 and 2013 annual reports, we also provided quarterly reports for FY2013 and FY 2014-Q1, Q2 and Q3.

Introduction

This report summarizes work performed by Kawailoa Wind Power (KAW) under the terms of the approved Habitat Conservation Plan (HCP) dated October 27, 2011 and pursuant to the obligations contained in the project's Incidental Take License (ITL-14) and Federal Incidental Take Permit (ITP) (TE-59861A-0) at the conclusion of the 2014 State of Hawaii fiscal year (July 2013- June 2014, Year 2).

The ITP and ITL were issued for the project in December 2011 and January 2012, respectively. The ITP and ITL cover 6 federally-listed threatened and endangered species and 1 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 moorhen or 'alae 'ula (*Gallinula chloropus sandvicensis*), Newell's shearwater or 'a'o (*Puffinus auricularis newelli*), Hawaiian hoary bat or 'ope'ape'a (*Lasiurus cinereus semotus*) and the Hawaiian short-eared owl or Pueo (*Asio flammeus sandwichensis*), respectively.

KAW was commissioned for operations November 2, 2012. The KAW site layout and WTG, search plot and bat detector locations, are depicted in Figure 1.

Fatality Monitoring

Searches are conducted by a team of trained HCP Compliance Technicians employed by First Wind Energy, LLC and based at the project site. Specially trained Search and Rescue dogs assist personnel with searches. As of the end of FY 2014 four HCP Compliance Technicians, one KAW HCP Compliance Supervisor, one Canine Compliance Supervisor and a vegetation management contractor were assigned to the site under the direction of the Hawaii HCP Compliance Manager.

Searches are conducted within circular plots centered on the WTGs and MET towers. At each WTG two concentric plots are marked: a "50% plot" with a radius equivalent to 50% of the maximum turbine height with the blade extended vertically (75m), and a "75% plot" with a radius equivalent to 75% of the maximum turbine height (113m). Each MET tower has a single circular plot with a radius of 50m (50% of the tower height). The 50% plots are searched twice per week and the 75% plots are searched every two weeks in accordance with the monitoring protocol prescribed in the HCP. To accomplish this, two rounds of searches are conducted each week. In the first round, the 50% plots are searched at all 30 WTG's and the two MET towers. For the second round the full 75% plots are searched at 15 WTGs, and the 50% plots are searched again at the remaining 15 WTG's and the two MET towers. The 15 WTGs searched out to 75% alternate each week, such that the full search protocol takes two weeks to complete.

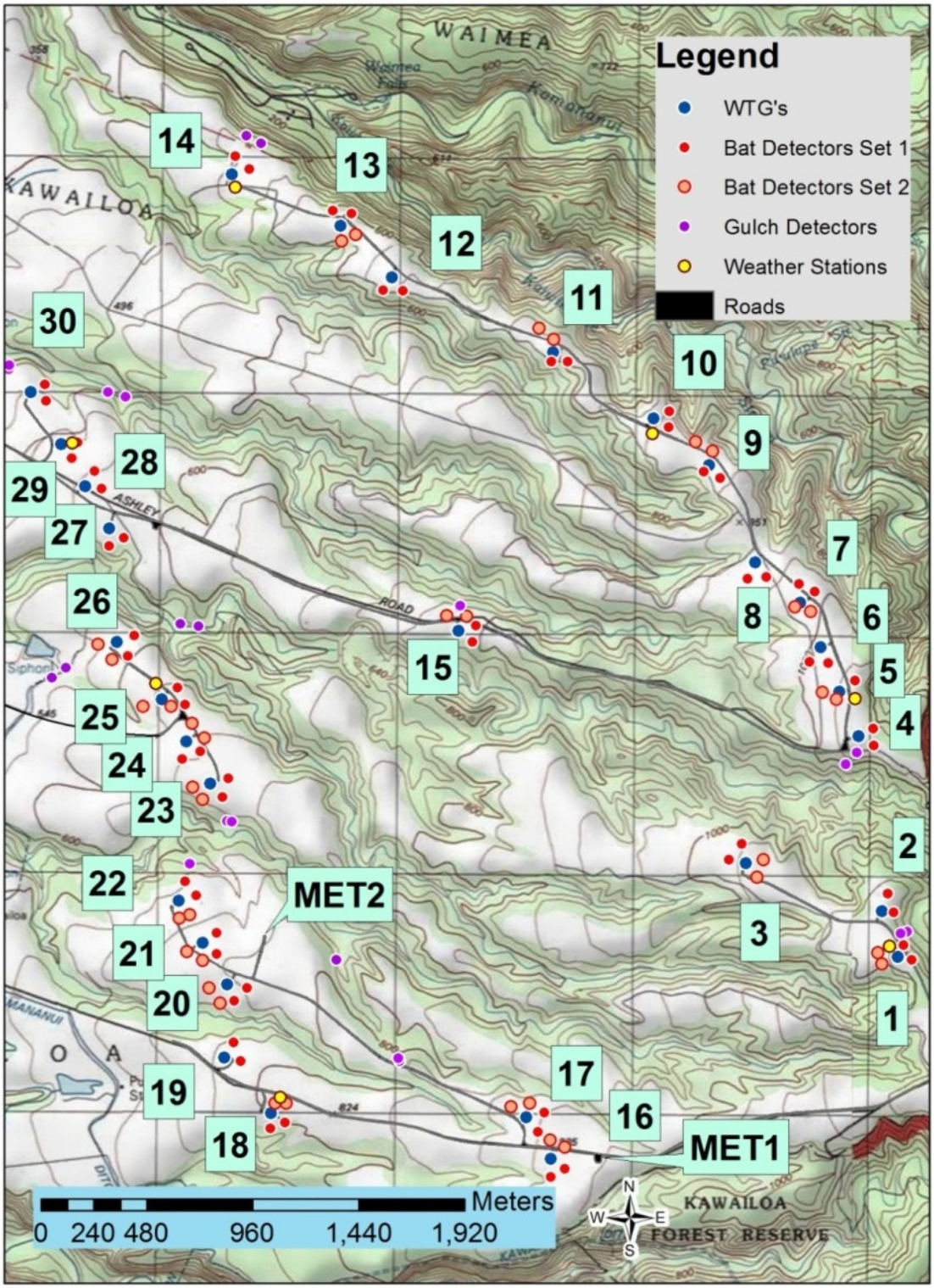


Figure 1. KAW roads, WTGs, MET towers, and bat detector locations.

Parallel transects across the search plots are staked every 14m (Figure 2). Searchers follow these marked transects, as well as unmarked transects half way between, so that the maximum distance between searched transects is 7m. Searching is usually conducted by one person either on foot or on an all-terrain vehicle (ATV). Slopes that are too steep to drive with ATVs are walked horizontally along the contours following transects that are no greater than 7m apart.

Figure 2. Transect marking stakes at WTG 29 (the yellow arrow shows 3 stakes in line for a marked transect). The 3 white arrows show 3 posts 14m apart in a line that is perpendicular to the transects and mark the different transects.

On June 20, 2013 three specially-trained search dogs arrived at KAW. Emma, Solo and Murphy are yellow Labrador retrievers that had been in training in California at Mountain View Dog Training since October 2012. On July 1, 2013 Sheila McKee, the primary trainer at Mountain View Dog Training, began 2 weeks of on-site handler training. On July 15, 2013 we began using the three dogs to assist with searches within the 50% plots. The three dogs now cover 8-11 WTG plots on each search day and generally search perpendicular to the wind and zig-zag across the plots (Figure 3).

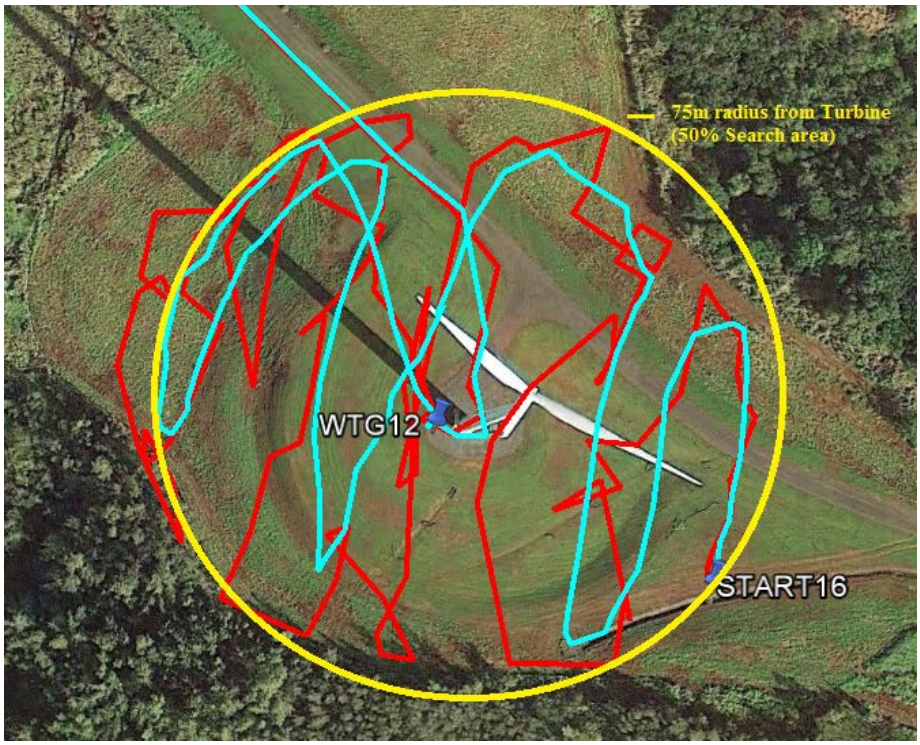


Figure 3: Dog and human handler GPS tracks for a 50% plot search at WTG 12 (Google Earth photo). The blue track is the human searcher and the red track is the dog and the yellow circle indicates the extent of the 50% search area.

All collected data such as searcher information (WTG searched, weather, search time per plot, human or canine searched, etc.), CARE trial status and location, SEEF trial placement, bat detector status and date of download, and trap results is recorded on a field form or a field notebook, digitized as an Microsoft™ EXCEL spreadsheet, QA/QC'd by the originator of the data, the supervisor and finally the report author. CARE trial photos are downloaded, labeled and backed up on a central computer.

Bat detector data is collected on SD cards, downloaded to a central computer, backed up on external hard drives, and analyzed with Wildlife Acoustics™ Kaleidoscope software. The HCP supervisor confirms bat detections and detection file data is recorded and summarized on an EXCEL spreadsheet. Final detection numbers and detector nights are determined from the detection files and from the "sensor" file (that shows detector operation times) and QA/QC'd by the HCP supervisor and report author.

Search plots are classified into two searchable vegetation types, short and medium, and unsearchable (typically steep gulch). Short vegetation consists of bare ground or gravel and grass with height shorter than 9 cm and is typical of the 50% plots; medium vegetation is 10-50 cm height and typifies the area between the 50% and 75% limits. The grass areas within the 50% are mowed once every two weeks, while the areas within the 75% ring are mowed one to two times every four weeks. Within the 75% plots of all 30 WTGs combined 44.16% of the total area is short, 37.45% is medium and 18.39% is unsearchable. Within just the 50% plots 73.55% is short, 19.70% is medium and 6.75% is unsearchable.

Appendix 1 provides search dates of the 50% and 75% search plots for each WTG and the MET towers during each quarter of FY 2014.

The FY 2014 Q1, Q2, Q3 and Q4 50% plot mean and SD for all WTGs combined for search intervals in days were 3.49 (SD =0.78), 3.65 (SD = 0.98), 3.51 (SD = 0.83), and 3.50 (SD = 0.74), respectively. The FY 2014 Q1, Q2, Q3, and Q4 75% plot mean and SD for all WTGs combined for search intervals in days were 14.00 (SD = 0.41), 15.49 (SD = 4.42), 14.00 (SD = 0.41), and 13.94 (SD = 0.34) respectively.

The FY 2014 overall 50% and 75% plot mean and standard deviation for all WTGs combined for search intervals in days were 3.54 (SD = 0.84) and 14.41 days (SD = 2.49), respectively, and in FY 2013 were 3.54 (SD = 0.83) and 14.01 (SD = 0.72), respectively.

Fatalities

Of the seven species listed in the ITL we documented take of only the Hawaiian hoary bat during FY 2014 (Table 1). A total of 14 Hawaiian hoary bat fatalities (five in FY 2013) have been found at the site since operations began through June 30, 2014 (Appendix 2).

Age	Sex	Date Found	WTG	Distance from WTG (m)	Direction from WTG (°)
A	M	7/15/2013	10	36	283
A	F	8/12/2013[1]	5	18	328
U	M	8/12/2013	14	34	180
U	U	9/4/2013[2]	19	45	222
A	M	9/17/2013	30	35	220
U	U	9/24/2013[2]	29	55	224
U	U	10/4/2013[2]	25	53	195
A	U	6/2/2014[1]	1	54	310
A	M	6/17/2014	30	21	143
[1]female or unknown found during the breeding season [2] not included in the fatality estimation					

Table 1. Hawaiian hoary bat fatalities at KAW in FY 2014.

Between July 1, 2013 and June 30, 2014 First Wind biologists found 49 bird carcasses. None were of species listed as state or federally endangered or threatened. These included ten individuals of species protected under the Migratory Bird Treaty Act: two White-Tailed Tropicbirds, two Cattle Egrets, three Great Frigatebirds and three Pacific Golden Plovers. Other fatalities comprised non-native introduced species, including 18 Common Mynas, two Common Waxbills, six Spotted Doves, four Zebra Doves, one Red Crested Cardinal, one Ring Necked Pheasant, two House Finches, one Gray Francolin and four Nutmeg Mannikins.

Hawaiian Hoary Bat Take Estimation

Observed take 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, various statistical methods have been developed for estimating additional take that may have occurred but that was not observed. This "unobserved take" attempts to account for fatalities that may have fallen outside of search plots, were missed by searchers, or were removed by scavengers or environmental factors such as high winds Estimating unobserved take is an evolving science and no one method is universally accepted or valid in all situations. Further, use of different estimators can sometimes yield widely differing results. The estimators used in this report were developed by USGS and have been recommended by DOFAW and USFWS.

Huso has informally suggested (pers comm during the July 2014 workshop) that the Huso 2012 estimator be used when the number of fatalities observed is greater than five or six. According to an assumption of this estimator 3 of 14 bat fatalities observed were not included in the calculation; those found September 4 and 24, and October 4, 2013 (Table 1). This assumption requires observed fatalities to have died within the previous search interval. Based on the condition of the 3 excluded fatalities when they were found, the time since death was judged to be longer than the 3-4 day search interval.

The appropriate application of confidence intervals to fatality estimates has not yet been determined for Kawailoa. However, to illustrate a range of possibilities, take is reported here as a mean, with 20% and 80% confidence interval (CI). Using the 20% and 80% CI the estimated take for the 14 Hawaiian hoary bat fatalities found between October 1, 2012 and June 30, 2014 using Huso (2012) estimator software (n = 11 instead of 14 for the actual calculation after 3 observed bats were subtracted based on an assumption of the model) is between 18-24 bats with a mean of 21 (Appendix 4).

The unobserved direct take (UDT) ranges from 7 (18 estimated minus 11 observed) to 13 (24 minus 11) bats given 20% and 80% CI. The formula provided in the HCP for calculating indirect take (IDT) uses the UDT and multiplies the rate of 0.1 juvenile per UDT. The calculated range of IDT considering the chosen CI's is 0.7 to 1.3 juvenile bats.

During the breeding season, April through August as designated in the HCP, for FY 13-14; five observed bat fatalities were male, one was female and one was of unknown sex. The one female, found August 12, 2013, was also the adult female captured and banded on June 28, 2013. Considering this female had pups on June 28 and 44 days had passed when the fatality was discovered, it is reasonable to assume the young were no longer dependent at the time of death (D. Johnston, H.T. Harvey, pers. comm.).

The sex ratio of adult bats found during April through August is 5 males to 1 female. If we assume this ratio applies to the one unknown bat found during the breeding season then the likelihood is 0.17 that the bat was female. If any adult of unknown sex is assumed to be female and is found during the breeding season we apply a 0.75 chance of being pregnant or lactating. The rate of 0.75 is chosen to indicate the average breeding rate of adult females is greater than 50% and less than 100%. The actual rate is not known.

If an adult is female and pregnant or lactating she loses 1.8 juveniles (2 pups X 0.9 survival rate) if killed. Therefore the IDT from the one observed adult whose sex was unknown and reproductive state unable to be determined could be 0.17 X 0.75 X 1.8 = 0.23 juveniles. The IDT total through FY 2014 therefore would range from 0.93 to 1.53 juveniles.

After First Wind requested a clarification of the ITL and ITP, the USFWS and DOFAW offered that the take for the five-year Tier 1, 2 and 3 could be amended from 16 adults and 8 juveniles, 24 adults and 12

juveniles, and 32 adults and 16 juveniles to 20, 30 and 40 adult bats, respectively (letter from the USFWS to First Wind, May 20, 2014. First Wind accepted July 31, 2014). The twenty-year Tier 1, 2 and 3 take levels is amended from 16 adults and 8 juveniles, 32 adults and 16 juveniles, and 48 adults and 24 juveniles also to 20, 40 and 60 adult bats, respectively. The amendment assumes that the indirect juvenile take be converted to adult take at a rate of 2.1 juveniles equals 1 adult. Under this amendment the range of juvenile take (considering 20% and 80% CI's) converted to adults is 0.93/2.1 to 1.53/2.1 or 0.44 to 0.73, rounded up is one additional adult in both cases. The project's estimated take as amended therefore ranges from 19 to 25 bats with a mean of approximately 22 adults, which is at the lower end of the Tier 2 five-year range of 20-30 and the 20 year range of 20-40.

Carcass Retention Trials

For Carcass Retention Trials (CARE) and Searcher Efficiency Trials (SEEF) we assign carcasses to two size classes, small and medium. Rats are used as surrogates for bats and represent the small size class. Wedge-tailed shearwaters (WTSH) are medium size surrogates for Hawaiian Coot, Moorhen, Stilt, Petrel, Owl and Duck and Newell's Shearwater. WTSH carcasses are generally deceased fledglings that have been found by the public and delivered to Sea Life Park on Oahu. KAW possesses state and federal wildlife collection permits, numbers WL 13-11 and MB40087A-0, respectively. Rat carcasses came 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 11.3 cm in body length) and were chosen to mimic body size of Hawaiian hoary bats (Figure 4).

Figure 4. Hawaiian hoary bat and rat surrogate for CARE and SEEF trials.

Eight 28 day CARE trials occurred in FY 2014 using 21 small (rat) and 7 medium (WTSH) size carcasses in short vegetation and 13 small (rat) and 4 medium (Wedge-tailed Shearwater) size carcasses in medium vegetation (Appendix 5). CARE trials in the past and at other sites have only lasted for 14 days. Trial lengths recently have been standardized to one month. Since all CARE trials have lasted at least 14 days for comparison we present the mean here assuming trials lasted only 14 days. When estimating fatalities however we use the data as it has been collected (up to 30 day trials). Considering only the first 14 days as the trial length, the site FY 2014 CARE mean and SD in days for all small carcasses is 6.68 (SD = 5.14) and for medium carcasses is 10.36 (SD = 5.52). In FY 2013 the site CARE mean and SD in days for all small carcasses was 7.04 (SD = 5.99) and for medium carcasses was 12.33 (SD = 3.97). Table 2 shows the Mean and SD for each year, carcass size and vegetation type combination. The SD in some cases is particularly high compared to the mean because the persistence time varies widely from very short (1-2 days) to the full extent of the trial period (14 days).

We considered an avian carcass as "present" until fewer than 10 of its body feathers and/or fewer than two of its wing feathers remained (Young et al, 2012).

Carcass Size	Small (Rat)					
Vegetation Type	Short			Medium		
	N	Mean	SD	N	Mean	SD
FY2013	19	7.63	6.29	7	5.43	5.16
FY2014	21	6.76	5.12	13	6.54	5.39
Carcass Size	Medium (WTSH)					
Vegetation Type	Short			Medium		
	N	Mean	SD	N	Mean	SD
FY2013	11	12.82	3.92	7	11.57	4.23
FY2014	7	11.71	4.54	4	8.00	6.98

Table 2. Mean and SD in days of CARE in FY 2013 and 2014 by carcass size class and vegetation type.

Scavenger Trapping

The success rate of the Goodnature Ltd. A24™ Stoat/Rat traps was quite low even after many trials using different baits. The A24 traps were removed from use by November 2013 for replacement with an upgraded model. Twenty-seven DOC250 traps were deployed in late April 2014. These were concentrated at four WTGs for 2-3 weeks then moved to another set of four WTGs. Twenty-seven mongoose were caught using 27 traps over 58 days in April, May and June 2014. Up to eight Hav-a-hart™ cat traps were deployed intermittently for a total of 167 trap days in FY 2014; three cats and eight mongoose were caught.

Pigs have been photographed on game cameras scavenging CARE trial carcasses. In FY 2015 we intend to begin corral trapping pigs around the site. We will continue to use DOC250 and Hav-a-hart™ traps and will redeploy the new A24 traps to trap mongoose and cats.

Searcher Efficiency Trials

SEEF trials at KAW are proctored by staff that do not search fatality monitoring plots. SWCA Environmental Consultants generated random GPS point locations within each vegetation class across all WTG search plots to direct carcass placement. Vegetation classes are short and medium. Short vegetation generally covers the flat, graded areas (pads) immediately around the WTGs that are consistently mowed every 2-3 weeks to maintain grass as short as 5 cm. The gravel and dirt roads are included in the short vegetation class. Medium vegetation covers all other areas outside the graded pads including graded slopes leading away from the pads and all other ungraded areas within the full plots. Medium vegetation ranges from 10 to 50 cm.

Proctors place carcasses (see CARE carcass type above) in random locations on-site in the early morning before KAW HCP Compliance Technicians arrive. On a trial day a searcher may have multiple carcasses on the plots they search or none at all. When a carcass is found the searcher sends a text message to the proctor indicating the WTG number and approximate location. After searches are complete for the day proctors verify that any undiscovered carcasses are still in place. If a carcass is missing that trial is not counted.

The overall searcher efficiency (SEEF) in FY 2014 for small (N = 216) and medium size carcass trials (N = 21) combining both vegetation classes was 72.2% and 95.2%. The overall canine only SEEF in FY 2014 for small (N = 118) and medium size carcass trials (N = 10) combining both vegetation classes was 81.4% and 100%. The overall human only SEEF in FY 2014 for small (N = 98) and medium size carcasses (N = 11) combining both vegetation classes was 61.2% and 90.9%. Through FY 2013 and 2014 the overall SEEF for small (N = 315) and medium size carcasses (N = 47) combining both vegetation classes was 69.2% and 95.7%, respectively.

Size Class	Total		Total Short Veg	Found	% Short	Total Med Veg	Found	% Med	% Overall
Small (rats)	Canine	118	77	62	80.5	41	34	82.9	81.4
	Human	197	156	108	69.2	41	14	34.1	61.9
	Overall	315	233	170	73.0	82	48	58.5	**69.2**
Medium (WTSH)	Canine	11	4	4	100	7	7	100	100
	Human	36	25	25	100	11	10	90.1	97.2
	Overall	47	29	29	100	18	16	88.9	**95.7**

Table 3. SEEF trial results for human visual searching and canine scent searching at KAW through FY 2014.

Hawaiian Hoary Bat Monitoring

Beginning July 2013 we significantly increased deployment of bat detectors at the site in order to better understand patterns of bat activity in light of a greater than expected number of fatalities during the first several months of operation. We deployed 39 additional SM2s on the ground approximately 75m from each WTG, and in 12 nearby gulch locations, for a total of 60 ground-based detectors, each having two independently recording microphones (mics) (Figure 1). Mics adjacent to WTGs are oriented facing SW (away from prevailing trade winds) on poles 6.5 meters above the ground, placed 50 to 100 meters apart (Figure 5). If a WTG has two sets of

mics they are typically in the NE hemisphere. Mics for gulch detectors were similarly mounted at various heights in or at the edges of gulches and are labelled relative to the closest WTG.

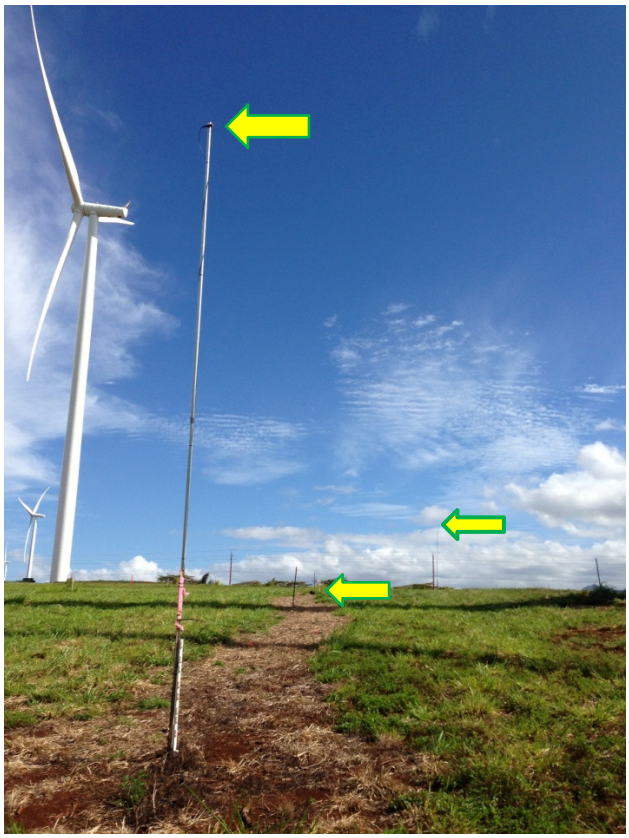


Figure 5. Two Wildlife Acoustics™ Songmeter SM2 mics on 6.5m poles with the detector unit between the mics.

In addition to the 5 existing nacelle detectors we deployed 25 more SM2s in nacelles (resulting in 30 total, one in each nacelle), all with two mics each, beginning in August 2013 (Figure 1). As of August 2013 there were a total of 90 detectors deployed on the ground and at nacelle height throughout the site. Each of the 30 WTG nacelle detectors has one mic pointing vertically toward the ground under the back of the nacelle (Figure 6), and the other approximately one meter behind the nacelle pointing backwards and parallel to the top of the nacelle (Figure 7). In May and July 2013 we deployed seven portable weather stations (Rainwise MK-III™ RT1 with an integrated rain gauge, locations in Figure 1) around the site near WTGs to assess the relationship between bat activity and an array of weather parameters (Figure 8).

Figure 6. Downward facing mic in WTG nacelle.

Figure 7. Rearward facing mic on WTG nacelle.

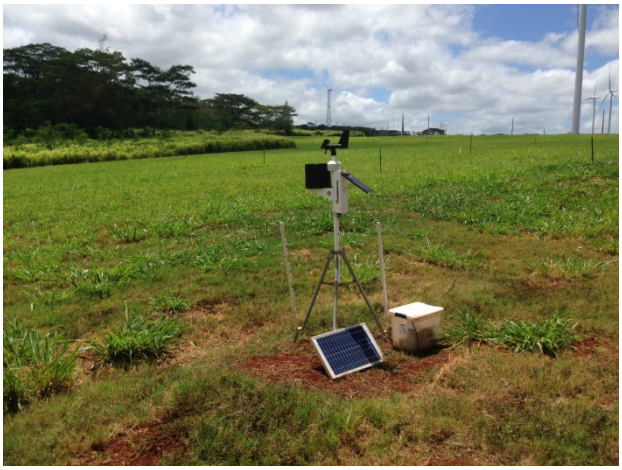


Figure 8. Ground based weather station.

The 48 ground-based WTG detectors recorded Hawaiian hoary bats on 1285 of 15023 detector nights (9.0% of detector nights) in FY 2014 (Figure 9). Detections occurred near all 30 WTG locations. Twelve gulch detectors recorded bats on 214 of 3356 detector nights (6.3% of detector nights). Thirty nacelle detectors recorded bats on 122 of 8558 detector nights (1.4% of detector nights), although not all detectors have been downloaded yet for FY 2014. Appendix 7 provides the deployment date, nights with detections and total nights for each location in FY 2013 and 2014.

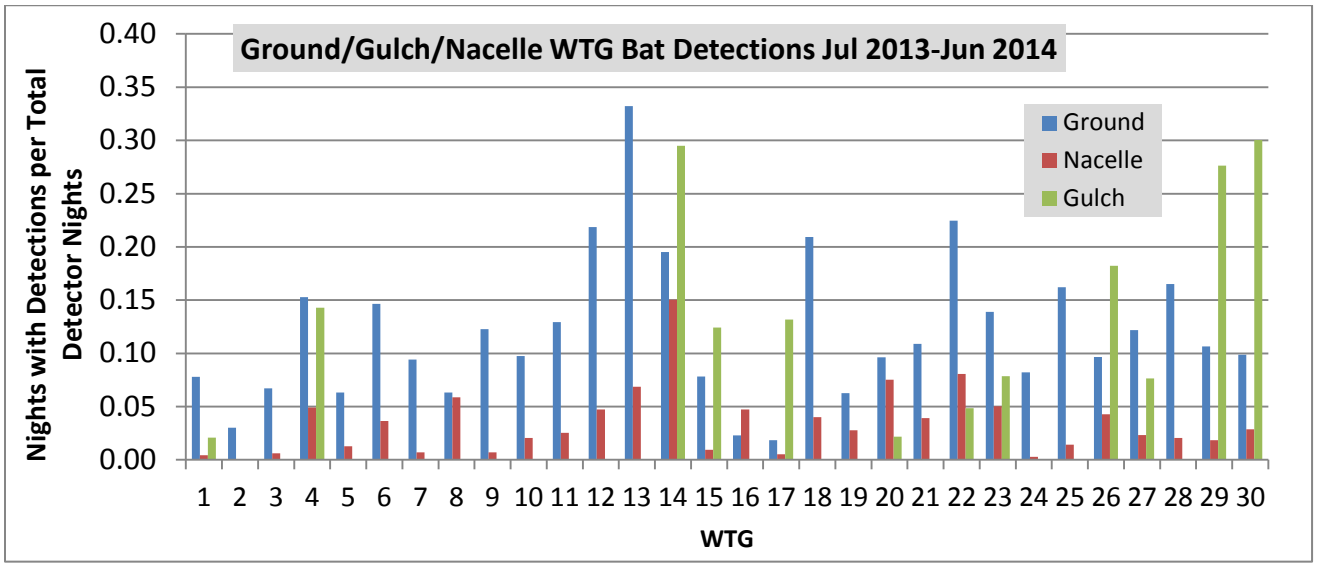


Figure 9. Nights with bat detections per total detector nights at KAW by WTG for three location types. The nine "original" ground level detectors deployed near WTGs in mid-December 2012 represent the detectors with the longest running record of bat detections on-site (Figure 10 and 11).

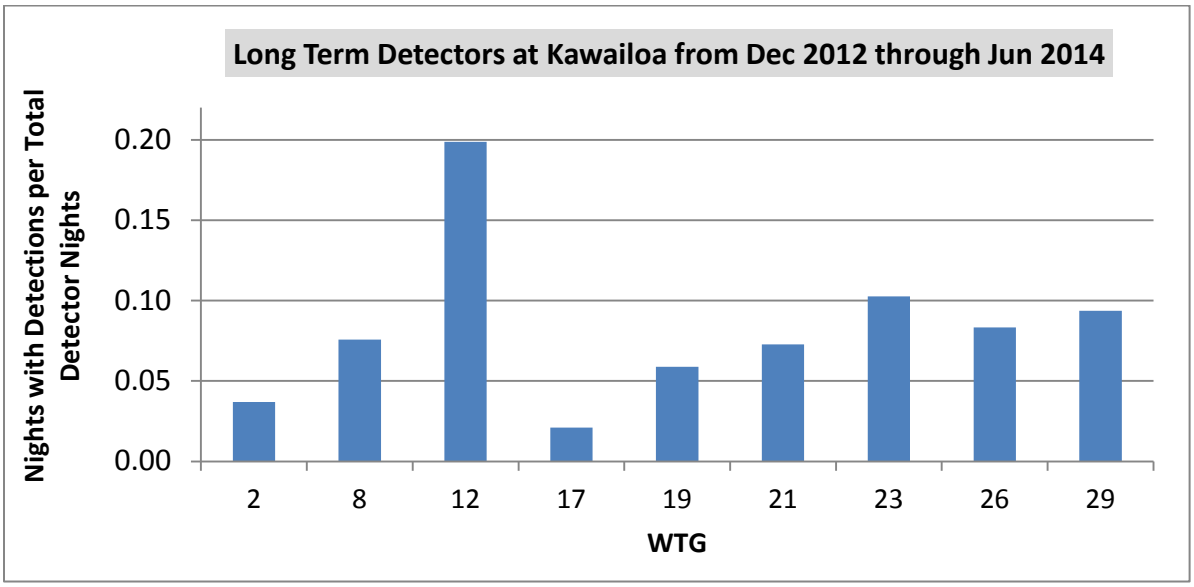


Figure 10. Nights with bat detections per total detector nights at KAW for 9 ground WTG detectors.

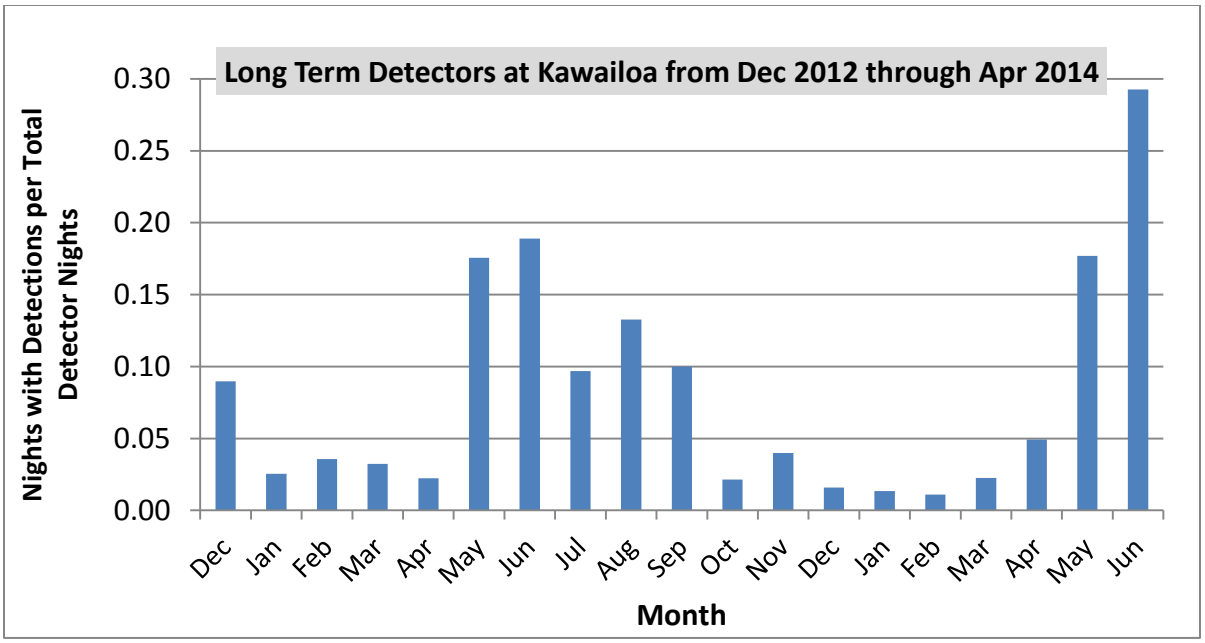


Figure 11. Nights with bat detections per total detector nights by month at KAW for 9 ground WTG detectors.

Nightly bat presence at all 90 detectors (ground, gulch and nacelle) from August 2013 through June 2014 generally show highest levels of bat activity at gulch and ground stations and a distinct seasonal pattern (Figure 12).

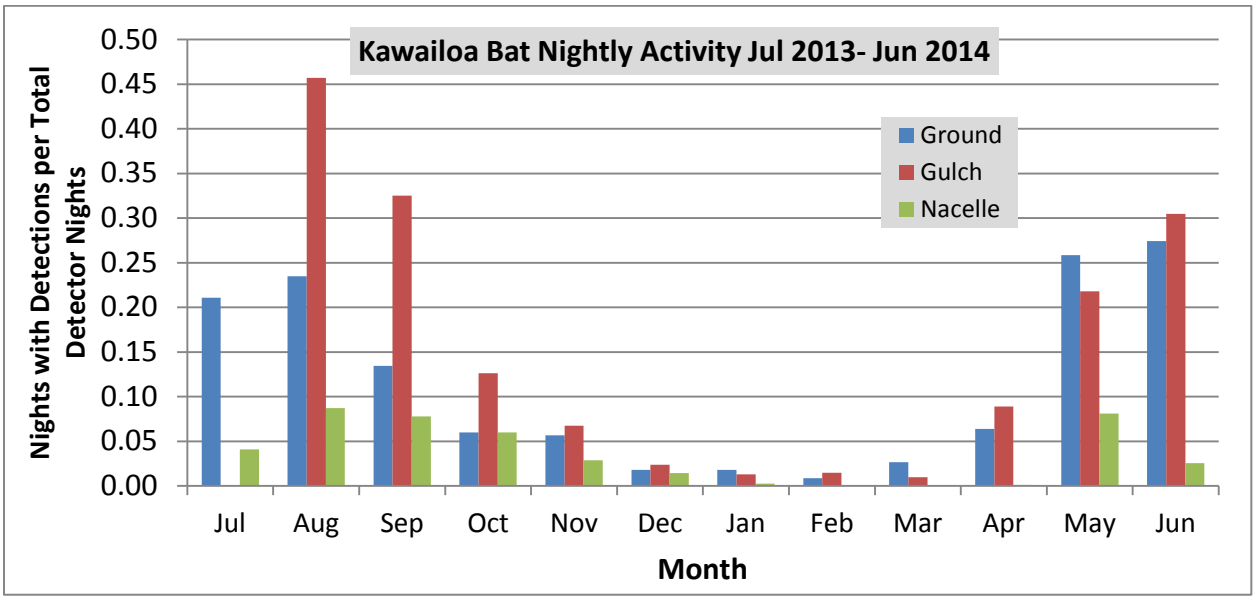


Figure 12. Nights with detections by month (Aug 2013-Jun 2014) at KAW for 90 detectors in 3 location types.

Wildlife Education and Observation Program

WEOP trainings were given to 54 new, temporary staff on-site regularly for one day or more. Staff was trained to identify listed and non-listed native species of birds that may be found on-site and appropriate protocols to follow, as prescribed in the HCP, when downed wildlife is found. New staff was also made aware of driving conditions onsite at the time and how to drive and act around trained dog searchers.

We began to include Nene identification in our WEOP after observing a pair of Nene near Turbine 27 on January 2, 2014. These Nene were later determined to have been initially from Kauai and then trans-located by the Hawaii State DOFAW to Hawaii Island. These two Nene flew towards the south from WTG 27 past WTG 26. A pair of Nene (assumed to be the same pair) was also sighted later around sunset flying from the mountain toward the ocean along the entire WTG 4-14 turbine string then turning north after passing around WTG 14. Nene have not been observed since the initial sighting. None of the birds listed in our take permit have been seen on - or flying over - the site by KAW personnel.

Figure 13. Two Nene sighted near WTG 27 at KAW.

Vegetation Management

The HCP for KAW stipulates that the fatality monitoring plots around the WTGs and MET tower be mowed every month. Areas around the WTGs that are well-graded and flat (pads) are mowed every 2-3 weeks to 5 to 8 cm (Short vegetation class) using a 60 inch Scag™ Turf Tiger zero turn mower (Figure 14). Rock lined swales that cannot be mowed are weed-whacked to 8 cm and sprayed with herbicides to reduce frequency of weed-whacking to 3 times per year. Other areas outside the pads and graded slopes are mowed to 12 cm (Medium vegetation class) every 2 to 3 weeks with either a Scag™ Turf Tiger or a Case™ Farmall 95U tractor pulling either a Woods™ Batwing 10 or 15 ft. mower.

A machine operator was contracted beginning on February 3, 2014 to contribute full-time to vegetation management. Tractor mowing typically occurs Monday, Tuesday, Thursday, and Friday right after an area has been searched for the day.

Figure 14. Part of the WTG 29 fatality monitoring plot (WTG 29 is to the right, not visible) with gulch in the background. Medium vegetation class on the left (green) and Short vegetation class on the right (brown).

There are gulches that overlap portions of nearly every search area at KAW (see cover photo). Gulches can be very deep with steep sides. Buffers have been established to prevent erosion and for safety while mowing and searching. Gulches and their associated buffer zones are considered unsearchable if they are within the search plots. Adjustments to take of covered species are made to account for fatalities that may occur but are not recovered from these unsearchable areas.

Mitigation and Adaptive Management

Hawaiian Hoary Bats

Bat activity assessment using Wildlife Acoustics™ Songmeter SM2BAT+ began in April 2012 and will continue at least three more years at Ukoa Wetland. The first of two 3-week long periods for mist-netting bats began on June 12, 2013. On June 29, 2013 HT Harvey Ecological Consultants (HTH) bat specialists captured a lactating adult female, attached numbered and colored bands and a radio transmitter (Holohil Systems, Inc., model BD-2N), and gathered a wing punch for genetic analysis (Figure 15).

Figure 15. Reproductively active Hawaiian hoary bat caught at Ukoa Wetland, Oahu.

HTH and KAW biologists tracked this bat to her roost in an Ironwood tree just north of Waimea Gulch and also sighted two bat pups she had been attending. She was also tracked in the area near WTG 30. Tracking of this bat ended July 5, 2013 (Appendix 8). This female is the first record ever on Oahu of a bat with pups. We found this banded female, dead, at WTG 5 on August 12, 2013, 45 days after she was caught during lactation. A second mist-netting effort at Ukoa Wetland occurred between September 9 and 23, 2013, without success.

HTH also deployed mist-nets around the KAW site beginning September 15, 2013 as part of an effort to better understand patterns of bat activity around turbines in light of unexpectedly higher fatality rates observed in 2013. On September 27, 2013 a sexually active male was caught in the gulch near WTG 29 at KAW. This bat was also fitted with a radio transmitter, an LED light (Dr. Dave Johnston constructed) and numbered and colored identification bands; released within 2 hrs. and tracked nightly as long as a signal was detected (Appendix 9). The male Hawaiian hoary bat was radio tracked with successful triangulations for three out of five consecutive nights before its signal was lost (Figure 16). A total of 55 position points were recorded. HT Harvey and Associates determined the forage range (FR, 0.95 Kernel) for this individual was 2866.0 hectares (ha) and the the commonly used area (CUA) used by the animal (0.50 Kernel) was 511.8 ha.

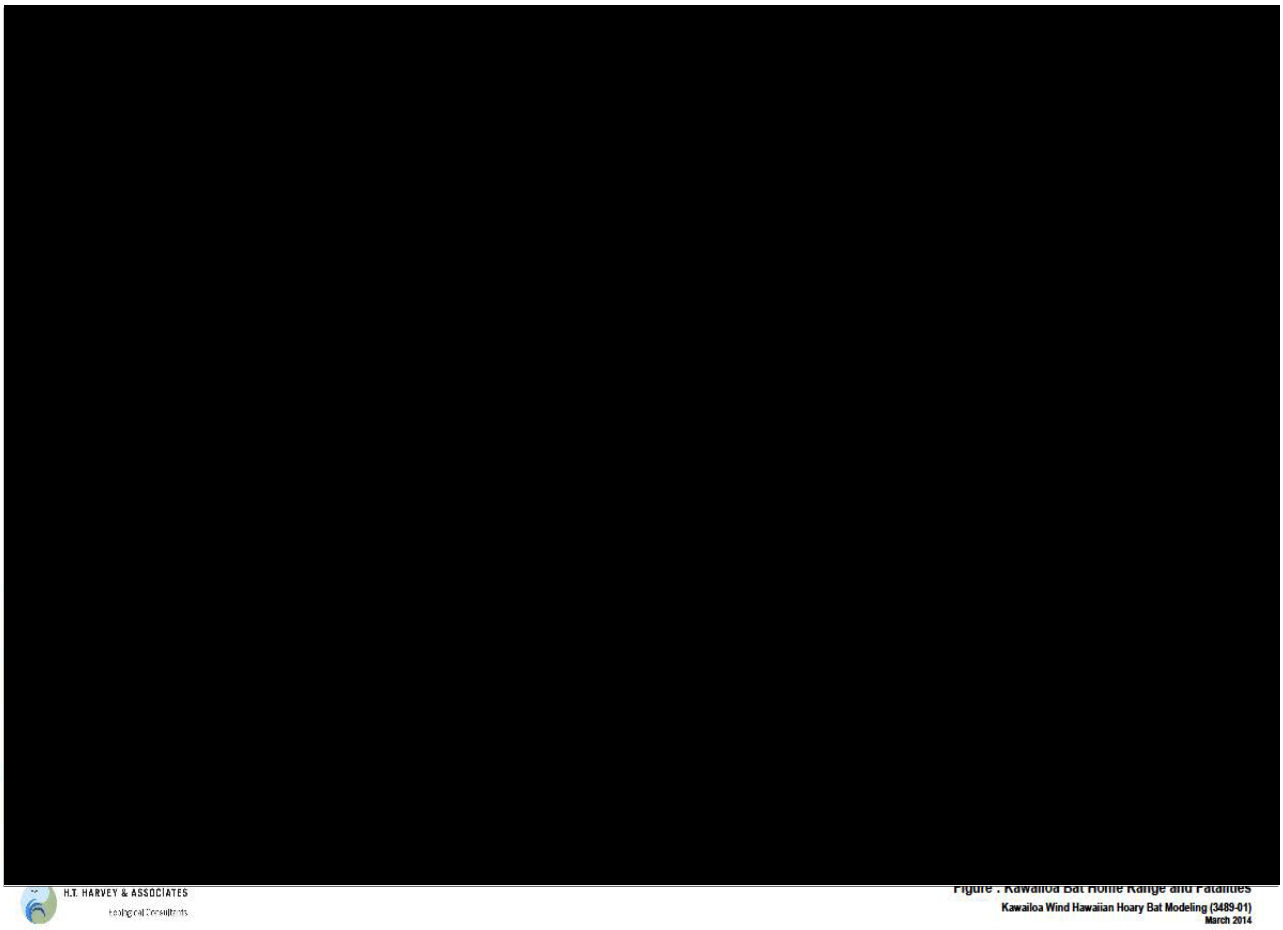


Figure 16. FR and CUA of Male Hawaiian Hoary Bat Radio Tracked at the Kawailoa Wind Project Site on Oahu, 30 September–2 October (HT Harvey and Associates). Yellow dots represent that bat's location. Probability distribution is represented by the gradient color. FR, 95%, is represented by the maroon outlined polygon, and CUA, 50%, is represented by the red outlined polygon.

The Hawaiian hoary bat mitigation plan for Ukoa Wetland is being considered for approval.

In fulfillment of the research requirement under Tier 1 bat mitigation KAW supported a cooperative study of Hawaiian hoary bats with the U. S. Geological Survey (USGS) and Bat Conservation International (BCI). On May 15, 2013 the USGS began an intensive bat activity assessment at four WTGs (23-26) using thermal and near-infrared video cameras to research and develop proposed new and improved techniques for quantifying bat activity and fatality at wind energy facilities (Figure 17). Concurrently BCI began daily searches of fatality monitoring plots around these WTGs (Figure 18). On-site field data collection continued until November 15, 2013.

Figure 17. Hawaiian hoary bat (circled) recorded on thermal video (USGS photo).

Figure 18. Fatality monitoring plots at WTG 23-26 with white transect marking posts (BCI photo).

The USGS continued to collect bat detector recordings through May 15, 2014 from detectors they had deployed along the north Koolau Mountains, and First Wind provided data from on-site detectors deployed at Kahuku and KAW sites. The USGS have also been provided with weather records from the WTG nacelle mounted sensors and the portable ground stations at the KAW site. The first draft report is expected in FY 2015-Q1.

KAW proactively funded research and engineering development of an ultrasonic bat deterrent through Bat Conservation International and Deaton Engineering as an adaptive management effort to promote options

for reducing bat fatalities. BCI conducted a nine day trial between October 16 and 24, 2013 on Hawaii Island to test the effectiveness of their latest design (Figure 19).

Figure 19. BCI setting up ultrasonic bat deterrent devices in a Macadamia nut grove.

BCI concluded the deterrent device significantly reduced bat activity compared to controls with no deterrent. Further improvements to the design are being considered, and BCI hopes to obtain additional support for design and testing through an upcoming U. S. Department of Energy (DOE) grant program.

Also as part of adaptive management efforts, KAW retained HT Harvey Ecological Consultants to investigate whether modeling environmental and physical characteristics of the KAW site relative to bat detections could be used to predict, and thus reduce, collision risk. HTH completed a preliminary analysis based on the first several months of data, which was favorably peer reviewed by Normandeau Environmental Consultants. The analysis will be refined and expanded in FY 2015-Q2 to include data from the 2014 summer high bat activity season.

SWCA Environmental Consultants has investigated possible mitigation sites to fulfill requirements for KAW Tier 2 level Hawaiian hoary bat take. A 300 acre parcel on the west side of the Koolau Mountains has been identified. A proposed mitigation plan for the parcel is in preparation. A research focus that will complete the Tier 2 mitigation has yet to be determined.

Newell's Shearwater

As part of KAW's seabird mitigation obligation KAW funded the Kaua'i Endangered Seabird Recovery Project (KESRP) to deploy and analyze data from 13 Wildlife Acoustics™ Songmeters at five locations in Kauai's remote mountains to survey Newell's Shearwater nesting colonies. These were deployed August 5, 2013 via helicopter and were retrieved in mid-November 2013 and the songs analyzed by Conservation Metrics. Beginning in FY 2014-Q3 KAW began funding KESRP to again deploy Songmeters on Kauai throughout the 2014 seabird nesting period. The deployment locations were chosen using the six most promising sites that had been surveyed in FY 2014-Q1 and Q2 (Figure 20).

Figure 20. Songmeter deployment via helicopter on Kauai (device is orange-below the helicopter step in this photograph.).

Waterbirds

Waterbird and bat plans for Ukoa Wetland will be finalized in FY 2015-Q1. Kamehameha Schools (KS) will make First Wind a conservation licensee in lieu of a Memorandum of Agreement between KS and First Wind. The license document will include the expected contribution each company will make toward conservation of the wetland. In the interim a short-term Right of Entry agreement has been signed to allow First Wind and its sub-contractors access.

A 4 ft. high ungulate fence with mesh skirting at the base that encloses 135 acres (including the wetland) was completed by Pono Pacific in FY 2014-Q1.

A contract with Ducks Unlimited (DU) to plan and implement restoration at Ukoa Wetland is in place. DU has prepared a bid package including plans and specifications for Ukoa restoration, conducted a site visit for contractors on June 19, and distributed the bid package to prospective contractors on July 18, 2014.

A permit to electroshock mosquitofish at Ukoa Wetland has been approved by the Hawaii State Department of Aquatic Resources. SWCA has conducted preliminary electroshock trials and is waiting for more surface area to be cleared of vegetation to continue trials.

A contract to conduct animal trapping to eradicate pigs, cats, mongoose and rats from inside the Ukoa exclusion fence was awarded to Grey Boar Wildlife Services in March 2014. Grey Boar deployed traps and conducted a month long intensive trap out in June 2014 with good success (Appendix 10).

Insect assessment for 2014 began in June and the results of the collections have been analyzed by Dr. Karl Magnacca (Appendix 11).

Adaptive Management

After the bat fatality on November 27, 2012 KAW elected to continue low wind speed curtailment (LWSC) at 5 m/s through the winter months. The HCP prescribes LWSC initially only from March through November. Additional days have been included to implement LWSC after bat fatalities were found outside the time period stipulated by the HCP. The LWSC at KAW now spans February 10 to December 15. Adaptive management to date has also consisted of increased site wide bat activity assessment (bat detectors, infrared video, and weather), modeling, and support for bat deterrent development (as described above under *Mitigation*).

Agency Meetings and Visits

On August 13, 2013 representatives from the USFWS and DOFAW visited the wind farm. KAW hosted a dog Search and Rescue training workshop on September 8, 2013. On November 12, 2013 representatives from the USFWS, DOFAW and First Wind met in Honolulu to discuss the status and plans for bat mitigation at KAW. DOFAW representatives visited KAW on February 6, 2014 to show their new HCP coordinator the wind facilities. KAW began monthly calls with DOFAW and USFWS in December 2013 to review bat mitigation and adaptive management progress.

Expenditures

Total expenditures in FY 2014 for the HCP program were $1,483,346 (Appendix 12).

Citations

Huso, M, Som, N, and Ladd, L. 2012. Fatality estimator user's guide: U.S. Geological Survey Data Series 729, 22 p.

Kawailoa Wind Power, LLC. 2012. Kawailoa Habitat Conservation Plan-ITL 14: FY 2012 Progress Report. First Wind Energy, LLC, Haleiwa, HI 96712.

Kawailoa Wind Power, LLC. 2013. Kawailoa Habitat Conservation Plan-ITL 14: FY 2013 Progress Report. First Wind Energy, LLC, Haleiwa, HI 96712.

SWCA. 2011. *Kawailoa Wind Power Final Habitat Conservation Plan*. Prepared for Kawailoa Wind Power LLC and U.S. Fish and Wildlife Service.

Young, D.P. Jr., S. Nomani, W. Tidhar, and K. Bay. 2012. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: Fall 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 27, 2012.

Appendix 1. Fatality Monitoring Plot Search Dates at KAW in FY 2014 Q1 (7/1 through 9/30/13). The black colored dates are searches within the 50% perimeter, red are within the 75% perimeter (full plots).

WTG															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/2
7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/5
7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/9
7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/11	7/12
7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/15	7/17
7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/19
7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/22	7/23
7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/25	7/26
7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/29	7/30
8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/1	8/2
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	8/5	8/6
8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/9
8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/12	8/13
8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/15	8/16
8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/19	8/20
8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/22	8/23
8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/26	8/27
8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/29	8/30
9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/4
9/5	9/5	9/5	9/4	9/4	9/5	9/5	9/5	9/5	9/5	9/5	9/5	9/5	9/5	9/5	9/6
9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/9	9/10
9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/13
9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/17
9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/19	9/20
9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/23	9/24
9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/26	9/27
9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	9/30	10/1
WTG															
17	18	19	20	21	22	23	24	25	26	27	28	29	30	Met 1	Met 2
7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2	7/2
7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5	7/5
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	7/9	7/9
7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12	7/12
7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17	7/17
7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/19
7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23	7/23
7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26	7/26
7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30	7/30
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	8/2	8/2
8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6	8/6
8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9
8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13	8/13
8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16	8/16
8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20	8/20
8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23	8/23
8/27	8/27	8/27	8/27	8/27	8/27	8/27	8/27	8/27	8/27	8/28	8/27	8/27	8/27	8/27	8/27
8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30	8/30
9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/4
9/6	9/6	9/6	9/5	9/5	9/5	9/6	9/6	9/6	9/6	9/6	9/6	9/6	9/6	9/6	9/5
9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10	9/10
9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13	9/13
9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17	9/17
9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20	9/20
9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24	9/24
9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27	9/27

Appendix 1 (cont). Fatality Monitoring Plot Search Dates at KAW in FY 2014 Q2 (10/1 through 12/31/13). The black colored dates are searches within the 50% perimeter, red are within the 75% perimeter (full plots).

WTG															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
															10/1
10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/4
10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/7	10/8
10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/11
10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/15	10/16
10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/17	10/18
10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/21	10/22
10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/24	10/25
10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/28	10/29
10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	10/31	11/1
11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/4	11/5
11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/7	11/8
11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11	11/12
11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/14	11/15
11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/18	11/19
11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/20	11/22
11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/25	11/26
12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/2	12/3
12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/5	12/6
12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/9	12/10
12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/13
12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/16	12/17
12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/19	12/20
12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/23	12/24
12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/26	12/27
12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/30	12/31

WTG															
17	18	19	20	21	22	23	24	25	26	27	28	29	30	Met 1	Met 2
10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1	10/1
10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4	10/4
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	10/8	10/8
10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11
10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16	10/16
10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18	10/18
10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22	10/22
10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25	10/25
10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29	10/29
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	11/1	11/1
11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5	11/5
11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8	11/8
11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12
11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15	11/15
11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19	11/19
11/22	11/22	11/22	11/22	11/22	11/21	11/21	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22
11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26	11/26
12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3
12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6	12/6
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	12/10	12/10
12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13	12/13
12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17	12/17
12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20	12/20
12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24	12/24
12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27	12/27
12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31	12/31

Appendix 1 (cont). Fatality Monitoring Plot Search Dates at KAW in FY 2014 Q3 (1/1 through 3/31/14). The black colored dates are searches within the 50% perimeter, red are within the 75% perimeter (full plots).

WTG															
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
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	1/2	1/3
1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/6	1/7
1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/10
1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/13	1/14
1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/17
1/21	1/21	1/21	1/20	1/20	1/20	1/21	1/21	1/21	1/21	1/21	1/21	1/21	1/21	1/20	1/22
1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/23	1/24
1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/27	1/28
1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/30	1/31
2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/4
2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/6
2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/10	2/11
2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/13	2/14
2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/18	2/19
2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/21
2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/24	2/25
2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/27	2/28
3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/4
3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/6	3/7
3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/10	3/11
3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/14
3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/17	3/18
3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/21
3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/25
3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	3/28
3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	

WTG and MET															
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**Met 1**	**Met 2**
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	1/3	1/3
1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/7
1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10
1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14	1/14
1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17	1/17
1/21	1/22	1/22	1/22	1/22	1/22	1/22	1/21	1/23	1/21	1/21	1/21	1/22	1/21	1/22	1/22
1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/24
1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28	1/28
1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31	1/31
2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
2/6	2/6	2/6	2/7	2/7	2/7	2/6	2/6	2/6	2/6	2/6	2/6	2/6	2/6	2/6	2/7
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	2/11	2/11
2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14	2/14
2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19	2/19
2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21
2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25	2/25
2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28
3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7	3/7
3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/11	3/12	3/11	3/11
3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14	3/14
3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18	3/18
3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/21
3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25	3/25
3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/28

Appendix 1 (cont). Fatality Monitoring Plot Search Dates at KAW in FY 2014 Q4 (4/1 through 6/30/14). The black colored dates are searches within the 50% perimeter, red are within the 75% perimeter (full plots).

WTG															
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	3/31	4/1
4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/3	4/4
4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/7	4/8
4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/11
4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/14	4/15
4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/17	4/18
4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/21	4/22
4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/24	4/25
4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/28	4/29
5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/1	5/2
5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/6
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	5/8	5/9
5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/12	5/13
5/14	5/14	5/14	5/15	*5/15*	*5/15*	5/15	5/15	5/15	5/15	5/15	5/15	5/15	5/15	5/15	5/16
5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/19	5/20
5/22	5/22	5/22	5/22	5/22	5/22	5/22	5/22	5/21	5/21	5/21	5/22	5/22	5/22	5/22	5/23
5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/27	5/28
5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/29	5/30
6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/3
6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/5	6/6
6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/9	6/10
6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/13
6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/17
6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/19	6/20
6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/23	6/24
6/26	6/26	6/26	6/25	6/25	6/25	6/25	6/25	6/25	6/25	6/25	6/25	6/25	6/25	6/25	6/27
6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	6/30	7/1
WTG and MET															
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**Met 1**	**Met 2**
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	4/1	4/1
4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8	4/8
4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11	4/11
4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/15
4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18	4/18
4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22	4/22
4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25	4/25
4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29	4/29
5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2	5/2
5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6
5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9	5/9
5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13	5/13
5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20	5/20
5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23	5/23
5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28	5/28
5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30
6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3
6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6
6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10	6/10
6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13	6/13
6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17	6/17
6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20	6/20
6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24	6/24
6/27	6/27	6/27	6/27	6/27	6/27	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26
7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1	7/1

Appendix 2. Hawaiian Hoary Bat Fatalities at KAW through FY 2014.

Age	Sex	Date Found	WTG	Distance from WTG (m)	Direction from WTG (^{o})	Opposite Direction through WTG (^{o})
A	F	11/27/2012	25	44	261	99
A	M	2/14/2013	13	51	240	120
A	F	2/26/2013	26	73	245	115
U	M	6/13/2013	15	27	332	28
A	M	6/29/2013	3	99	199	161
A	M	7/15/2013	10	36	283	77
A	F	8/12/2013	5	18	328	32
U	M	8/12/2013	14	34	180	180
U	U	9/4/2013	19	45	222	138
A	M	9/17/2013	30	35	220	140
U	U	9/24/2013	29	55	224	136
U	U	10/4/2013	25	53	195	165
A	U	6/2/2014	1	54	310	50
A	M	6/17/2014	30	21	143	217
		Mean		46	242	118
		SD		21	56	56

Appendix 3. MBTA listed bird fatalities documented at KAW in FY 2014.

Species	**Date**	**WTG**	**Distance from WTG (m)**	**Direction from WTG (degree)**
White Tailed Tropicbird	10/24/2013	7	42	220
Pacific Golden Plover	11/12/2013	19	70	170
Pacific Golden Plover	11/26/2013	22	90	170
Cattle Egret	2/14/2014	27	112	40
Great Frigatebird	5/22/2014	20	37	8
White Tailed Tropicbird	6/9/2014	11	30	232
Great Frigatebird	6/12/2014	6	30	330
Great Frigatebird	6/20/2014	21	15	264

Appendix 4. Huso (2012) Fatality Estimation for Hawaiian Hoary Bats at KAW through FY 2014.

The number found does not include 3 observed fatalities
considered to have died more than 3.5 days before observed.
This study included all 30 turbines located at the study site.
User-defined alpha level of 0.2; all reported confidence intervals are 80% confidence intervals.

Requested Summaries

Group	Level	**Number Found**	PerTurb Est	PerTurb Lwr	PerTurb Upr	**SiteTot Est**	SiteTot Lwr	SiteTot Upr
LACI		**11**	0.69	0.61	0.79	**21**	18	24

Searcher Efficiency Estimates; AICc for mean-only model: 397.03

	Found	Placed	**SE**	Lwr	Upr
Mean	223	321	**0.69**	0.66	0.73

Carcass Persistence Estimates; AICc for mean-only model and distribution = lognormal: 356.81
Estimates and Confidence Intervals for r based on an interval of 2 days.

	Placed	**CP**	Lwr	Upr	r	r Lwr	r Upr
Mean	68	**6.87**	5.43	8.72	0.91	0.87	0.94

Appendix 5. CARE F at KAW in FY 2014.

CARE F FY2014	1			2			3			4			5			6			7			8		
Carcass Type	Rat			RAT			RAT			Rat			Rat			Rat			Bird			Bird		
WTG	1			3			5			11			18			19			28			29		
Vegetation	Short			Medium			Medium			Short			Short			Medium			Medium			Medium		
Distance (m)	41			23			36			71			51			73			94			55		
SEEF ID pt #	34			55			30			35			47			93			27			29		
	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes
day 0	P	7/11		P	7/11		P	7/11		P	7/11	M	P	7/12		P	7/12		P	7/12		P	7/12	
day 1	P	7/12		P	7/12		P	7/12		P	7/12		P	7/13		**P**	7/13		**P**	7/13	L	P	7/13	L,I
day 2	**P**	7/13	L,I	P	7/13	L	P	7/13	L	P	7/13		P	7/14	L,I	A	7/14		A	7/14		P	7/14	M
day 3	A	7/14		P	7/14		P	7/14		P	7/14		P	7/15			7/15			7/15		P	7/15	
day 4		7/15		P	7/15		P	7/15	S	P	7/15	S	P	7/16	L		7/16			7/16		P	7/16	
day 5		7/16		P	7/16	L,S	P	7/16	L, S	**P**	7/16	S	**P**	7/17			7/17			7/17		P	7/17	
day 6		7/17		**P**	7/17		P	7/17		A	7/17		A	7/18			7/18			7/18		P	7/18	
day 7		7/18		A	7/18		P	7/18			7/18			7/19			7/19			7/19		P	7/19	S
day 8		7/19			7/19		P	7/19			7/19			7/20			7/20			7/20		P	7/20	
day 9		7/20			7/20		P	7/20			7/20			7/21			7/21			7/21		P	7/21	
day 10		7/21			7/21		P	7/21			7/21			7/22			7/22			7/22		P	7/22	
day 11		7/22			7/22		P	7/22			7/22			7/23			7/23			7/23		P	7/23	
day 12		7/23			7/23		P	7/23			7/23			7/24			7/24			7/24		P	7/24	
day 13		7/24			7/24		P	7/24			7/24			7/25			7/25			7/25		P	7/25	
day 14		7/25			7/25		P	7/25			7/25			7/26			7/26			7/26		P	7/26	
day 21		8/1			8/1		**P**	8/1			8/1			8/2			8/2			8/2		P	8/2	
day 28		8/8			8/8		A	8/8			8/8			8/9			8/9			8/9		**P**	8/9	
Retention (days)	***2***			***6***			***14***			***6***			***5***			***1***			***1***			***14***		

A	ants	H	hair loss
B	body feathers	I	Insects
C	dirt covered	L	fly larvae
D	desiccated	M	moved
F	feathers	S	skeleton
E	eaten	W	wing feathers
P/A	Present/Absent		

Appendix 5 (cont). CARE G at KAW in FY 2014.

CARE G FY2014	1			2			3			4			5		
Carcass Type	Rat			Rat			Rat			Rat			Rat		
WTG	1			3			8			8			10		
Vegetation	Short			Short			Short			Medium			Short		
Distance (m)	67			66			45			99			25		
SEEF ID pt #	235			228			221			219			213		
	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes	P/A	Date	Notes
day 0	P	8/18		P	8/18		P	8/18		P	8/18		P	8/18	
day 1	P	8/19		P	8/19		P	8/19		P	8/19		P	8/19	
day 2	P	8/20		P	8/20		P	8/20		P	8/20		P	8/20	
day 3	P	8/21	D,A	P	8/21	D,S	P	8/21	L	P	8/21	D	P	8/21	L
day 4	P	8/22		P	8/22		P	8/22		P	8/22		P	8/22	
day 5	P	8/23		**P**	8/23		P	8/23		P	8/23		P	8/23	
day 6	**P**	8/24	A	A	8/24		**P**	8/24	S	**P**	8/24		P	8/24	
day 7	A	8/25	S,V				A	8/25	S,V	A	8/25		**P**	8/25	
day 8		8/26						8/26					A	8/26	
day 9		8/27	_												
day 10		8/28													
day 11		8/29													
day 12		8/30													
day 13		8/31													
day 14		9/1	S	P	9/1	S									
day 22		9/9													
day 29		9/16	S												
Retention (days)	***6***			***5***			***6***			***6***			***7***		

Appendix 5 (cont). CARE H at KAW in FY 2014.

CARE H FY2014		1		2		3		4		5		6	
Carcass Type		Bird		Rat		Rat		Rat		Rat		Bird	
WTG		4		12		14		19		22		23	
Vegetation		Medium		Medium		Medium		Medium		Medium		Medium	
Distance (m)		94		68		65		75		75		83	
SEEF ID pt #		100		99		98		97		96		95	
	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
day 0	10/9	P		P		P		P	A	P		P	
day 1	10/10	P	A,L	**P**	A,L	P	A,L	P	L	P	A,L	P	A,L
day 2	10/11	P		A		P		P		P		P	
day 3	10/12	P				P		P		P		**P**	
day 4	10/13	P				**P**		P	D	P	D	A	
day 5	10/14	P				A		P	S	P	S		
day 6	10/15	P						P		P			
day 7	10/16	P	C,W,F					P		P			
day 8	10/17	P						P		P			
day 9	10/18	P	_					P		P			
day 10	10/19	P						P		P			
day 11	10/20	P						P		P	I		
day 12	10/21	P						P		P			
day 13	10/22	P						P		P			
day 14	10/23	**P**						P		P			
day 21	10/30	A	W					P		**P**			
day 28	11/6							**P**		A	W		
Retention (days)		***14***		***1***		***4***		***28***		***21***		***3***	

Appendix 5 (cont). CARE I at KAW in FY 2014.

CARE I FY2014		1		2		3		4		5		6	
Carcass Type		Rat		Bird		Bird		Rat		Rat		Rat	
WTG		15		6		14		14		17		26	
Vegetation		Short		Short		Short		Short		Short		Short	
Distance (m)		7		25		3		3		5		4	
SEEF ID pt #		267		248		263		257		227		220	
	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
day 0	11/13	P		P		P	H	**P**		**P**		P	
day 1	11/14	P		P		P	M,S,F	A	(cat)	A	(cat)	P	
day 2	11/15	P	A,H	P	L	P	M(cat)					P	
day 3	11/16	P		P		P						**P**	
day 4	11/17	**P**		P		P						A	(cat)
day 5	11/18	A	(pig)	P		P							
day 6	11/19			P	I	P							
day 7	11/20			P	M,F,B (pig)	P							
day 8	11/21			P	M,L	P							
day 9	11/22			P	M,B	P	F,B,W						
day 10	11/23			**P**	M	P							
day 11	11/24			A	(pig)	P							
day 12	11/25					P							
day 13	11/26					P							
day 14	11/27					**P**							
day 21	12/4					A							
day 28	12/11												
Retention (days)		***4***		***10***		***14***		***0***		***0***		***3***	

Appendix 5 (cont). CARE J at KAW in FY 2014.

CARE J FY2014		1		2		3		4		5		6	
Carcass Type		rat		rat		bird		rat		rat		bird	
WTG		10		14		17		19		25		30	
Vegetation		short		short		short		short		short		short	
Distance (m)		25		26		45		64		41		11	
SEEF ID pt #		213		218		212		214		233		217	
	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
day 0	1/7	P		P		P		P		P		P	
day 1	1/8	P		P		P	I	**P**	I	P	I	P	I
day 2	1/9	P		P		P		A		P		P	
day 3	1/10	P	I	P		P				P	H	P	
day 4	1/11	P	L	P	**L,D**	P	L			P	L	P	L, D
day 5	1/12	P	S	P		P				P		P	
day 6	1/13	P	H	P	H	P				P	S	P	
day 7	1/14	P	D	P		P				P		P	
day 8	1/15	P		P		P				P		P	
day 9	1/16	P	_	P	S	P				P		P	
day 10	1/17	P	C	**P**		P				P		P	
day 11	1/18	P		A		P				P		P	
day 12	1/19	P				P				P		P	
day 13	1/20	P				P				P		P	
day 14	1/21	**P**				P				**P**		P	
day 21	1/28	A				P				A		P	M
day 28						**P**						**P**	
Retention (days)		***14***		***10***		***28***		***1***		***14***		***28***	

Appendix 5 (cont). CARE K at KAW in FY 2014.

CARE K FY2014		1		2		3		4				5		6		7		8	
Carcass Type		rat		rat		rat		rat				rat		bird		bird		rat	
WTG		18		23		25		30				1		6		10		14	
Vegetation		medium		medium		short		medium				medium		short		short		short	
Distance (m)		74		75		69		74				71		28		61		27	
SEEF ID pt #		377		336		366		377				276		277		383		252	
	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes		Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
day 0	2/18	P		P		P		P		day 0	2/19	P		P		P		P	
day 1	2/19	P		P		P		P	L	day 1	2/20	P	L	P	L	P	L	P	L
day 2	2/20	P	L	P	L	P	L	P		day 2	2/21	**P**		P		**P**		P	
day 3	2/21	**P**		**P**		P	H	P	H	day 3	2/22	A		P	I	A		P	
day 4	2/22	A		A		P		P		day 4	2/23			P	E,M,W			P	
day 5	2/23					P		P		day 5	2/24			P				P	
day 6	2/24					P		P		day 6	2/25			P				P	
day 7	2/25					P		P		day 7	2/26			P				P	
day 8	2/26					P		P		day 8	2/27			P				P	S
day 9	2/27					P		P	S	day 9	2/28			P				P	
day 10	2/28					P		P		day 10	3/1			P				P	H
day 11	3/1					P		P		day 11	3/2			P	<w			P	
day 12	3/2					P		P		day 12	3/3			P				P	
day 13	3/3					P		P		day 13	3/4			P				P	
day 14	3/4					P		P		day 14	3/5			P				P	
day 21	3/11					**P**		**P**		day 21	3/12			**P**				P	
day 28	3/18					A		A		day 28	3/19			A				**P**	
Retention (days)		***3***		***3***		***21***		***21***				***2***		***21***		***2***		***28***	

Appendix 5 (cont). CARE L at KAW in FY 2014.

CARE L FY2014		1		2		3		4		5		6	
Carcass Type		rat		rat		rat		rat		rat		bird	
WTG		4		5		6		20		25		25	
Vegetation		Short		Short		Short		Short		Medium		Short	
Distance (m)		72		49		36		74		63		53	
SEEF ID pt #		245		283		295		342		280		247	
Trial Day	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
day 0	3/31/14												
day 1	4/1/14	P		P		P		**P**		P		P	
day 2	4/2/14	P		P	M	P		A		P		P	
day 3	4/3/14	P	L	P		P				**P**	L	P	
day 4	4/4/14	**P**		P	L	**P**	L			A	Cat	P	L
day 5	4/5/14	A	Cat	P		A	Cat					P	
day 6	4/6/14			P								P	
day 7	4/7/14			**P/A**	Eaten by Emma							P	
day 8	4/8/14											P	
day 9	4/9/14											P	
day 10	4/10/14											P	
day 11	4/11/14											P	
day 12	4/12/14											P	
day 13	4/13/14											P	
day 14	4/14/14											P	D
day 21	4/21/14											P	I
day 28	4/28/14											**P**	
Retention (days)		***4***		***7***		***4***		***1***		***3***		***28***	

Appendix 5 (cont). CARE M at KAW in FY 2014.

CARE M FY2014		1		2		3		4		5		6		7		8	
Carcass Type		rat		rat		rat		rat		rat		rat		rat		rat	
WTG		2		5		12		14		17		19		26		28	
Vegetation		Short		Short		Short		Medium		Medium		Medium		Short		Short	
Distance (m)		57		49		27		66		24		28		37		26	
SEEF ID pt #		401		283		403		399		418		419		435		434	
Trial Day	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
day 0	5/6/14	P		P		P		P		P		P		P		P	
day 1	5/7/14	P		P		P	A,H	P	A	P		P		P		P	M,A*,H
day 2	5/8/14	P	L	P	L	P	M	P		P		P		P	A,L	P	M,L
day 3	5/9/14	**P**		P		P		P		P	M,L	P	A,L	P	H	P	
day 4	5/10/14	A		P		P		P		P		P		**P**		P	
day 5	5/11/14			P		P	M	P	A	P	M	P	M,D	A		**P**	S
day 6	5/12/14			P	H	P		**P**		P	D	P				A	C *
day 7	5/13/14			P		P		A		P		**P**					
day 8	5/14/14			P		**P**				**P**	S	A					
day 9	5/15/14			P		A				A							
day 10	5/16/14			P	M												
day 11	5/17/14			P													
day 12	5/18/14			P													
day 13	5/19/14			P	D												
day 14	5/20/14			P													
day 21	5/27/14			P	M												
day 28	6/3/14			**P**													
Retention (days)		***3***		***28***		***8***		***6***		***8***		***7***		***4***		***5***	

Appendix 6. SEEF Trials at KAW in FY 2014.

Trial date	WTG	Veg type	Carcass type	Found (short Veg)	Found (medium veg)	Point ID	K9/ Human
7/11/2013	3	short	Rat	0		55	Human
7/11/2013	5	short	Rat	0		30	Human
7/11/2013	1	medium	Rat		0	34	Human
7/12/2013	18	short	Rat	0		47	Human
7/12/2013	19	medium	Rat		0	93	Human
7/12/2013	28	medium	Bird		1	27	K9
7/12/2013	29	medium	Bird		1	29	K9
7/15/2013	11	medium	Rat		1	35	K9
8/1/2013	7	short	Rat	1		205	Human
8/1/2013	8	short	Rat	0		226	Human
8/1/2013	4	short	Rat	0		242	K9
8/1/2013	5	short	Rat	1		250	K9
8/1/2013	6	medium	Rat		1	203	K9
8/2/2013	30	short	Rat	0		217	Human
8/2/2013	17	medium	Rat		1	212	K9
8/2/2013	16	short	Rat	0		230	K9
8/6/2013	22	medium	Rat		1	225	K9
8/16/2013	18	medium	Rat		1	207	K9
8/19/2013	3	medium	Rat		0	228	Human
8/19/2013	1	short	Rat	0		235	Human
8/19/2013	10	short	Rat	1		213	K9
8/19/2013	8	short	Rat	1		221	K9
8/22/2013	13	medium	Rat		1	206	Human
8/22/2013	11	short	Rat	1		208	Human
8/22/2013	14	short	Rat	1		218	Human
8/22/2013	13	short	Rat	1		224	Human
8/22/2013	15	short	Rat	0		202	K9
8/22/2013	9	medium	Rat		1	234	K9
8/29/2013	15	short	Rat	1		202	K9
8/29/2013	6	short	Rat	1		211	K9
8/29/2013	13	medium	Rat		1	206	K9
8/29/2013	11	short	Rat	1		208	K9
8/30/2013	21	short	Rat	1		201	Human
8/30/2013	19	short	Rat	0		214	K9
8/30/2013	19	short	Rat	0		215	K9
8/30/2013	28	short	Rat	1		222	K9
9/12/2013	7	short	Rat	1		241	Human
9/12/2013	6	short	Rat	0		243	Human
9/12/2013	7	short	Bird	1		232	Human
9/12/2013	12	short	Bird	1		246	Human
9/12/2013	4	short	Rat	1		245	K9
9/12/2013	10	short	Rat	1		237	K9
9/20/2013	22	medium	Rat		0	291	Human
9/20/2013	30	medium	Rat		0	398	K9
9/27/2013	26	short	Rat	1		288	Human
9/27/2013	28	short	Rat	1		390	Human

10/8/2013	24	short	Rat	0		287	Human
10/8/2013	26	medium	Rat		0	391	Human
10/8/2013	19	medium	Bird	1		394	K9
10/8/2013	21	short	Rat	1		282	K9
10/11/2013	24	short	Rat	1		287	Human
10/17/2013	8	medium	Rat		1	300	Human
10/17/2013	1	medium	Rat		0	395	Human
10/17/2013	14	medium	Rat		1	399	K9
10/17/2013	12	short	Bird	1		296	K9
10/29/2013	21	short	Rat	0		275	Human
10/29/2013	20	short	Rat	0		281	Human
10/29/2013	17	medium	Bird		1	380	Human
10/29/2013	16	medium	Rat		0	387	Human
11/5/2013	19	medium	Rat		0	379	Human
11/5/2013	18	medium	Rat		1	377	K9
11/5/2013	19	short	Bird	1		269	K9
11/12/2013	19	short	Rat	1		265	K9
11/12/2013	16	medium	Bird		1	285	K9
11/12/2013	30	medium	Rat		1	366	K9
11/19/2013	23	medium	Rat		0	384	Human
12/6/2013	19	medium	Rat		1	259	K9
12/12/2013	12	short	Rat	1		372	Human
12/12/2013	10	short	Rat	1		383	K9
12/12/2013	8	short	Rat	1		299	K9
12/17/2013	26	medium	Rat		1	256	K9
12/19/2013	1	short	Rat	1		235	Human
12/19/2013	6	short	Rat	0		211	K9
12/20/2013	18	medium	Rat		1	207	K9
12/20/2013	19	medium	Rat		1	210	K9
12/20/2013	26	short	Rat	1		220	K9
1/2/2014	11	short	Rat	1		208	Human
1/2/2014	15	short	Rat	1		202	K9
1/2/2014	7	short	Rat	1		205	K9
1/6/2014	1	medium	Rat		0	294	Human
1/6/2014	6	short	Rat	0		295	K9
1/6/2014	8	short	Rat	1		297	K9
1/7/2014	19	short	Rat	1		214	K9
1/7/2014	25	short	Rat	1		233	K9
1/10/2014	16	medium	Rat		0	230	Human
1/10/2014	26	short	Rat	1		236	Human
1/10/2014	21	short	Rat	1		231	K9
1/13/2014	13	short	Rat	1		224	Human
1/13/2014	3	medium	Rat		0	228	K9
1/13/2014	8	short	Rat	0		221	K9
1/16/2014	12	medium	Rat		1	292	Human
1/16/2014	4	short	Rat	1		386	Human
1/17/2014	17	medium	Rat		0	227	Human
1/17/2014	19	medium	Rat		1	223	K9
1/17/2014	25	short	Rat	1		240	K9
1/21/2014	7	medium	Bird		1	284	Human

1/21/2014	3	medium	Rat		1	290	K9
1/21/2014	9	short	Rat	0		284	K9
1/28/2014	17	short	Rat	1		249	Human
1/28/2014	28	short	Rat	1		222	K9
1/28/2014	22	short	Rat	1		266	Human
1/30/2014	1	short	Rat	1		268	Human
1/30/2014	4	short	Rat	1		245	Human
1/30/2014	13	short	Rat	1		239	K9
1/30/2014	9	medium	Rat		1	234	K9
1/31/2014	17	bare	Rat	1		249	Human
1/31/2014	30	short	Rat	1		352	K9
1/31/2014	19	Short	Rat	1		254	K9
2/5/2014	10	short	Rat	1		237	Human
2/5/2014	8	short	Rat	1		226	K9
2/5/2014	7	medium	Rat		0	232	K9
2/5/2014	12	short	Rat	1		246	K9
2/6/2014	19	medium	Rat		1	259	K9
2/6/2014	23	short	Rat	1		274	K9
2/6/2014	25	short	Rat	1		278	K9
2/7/2014	22	medium	Rat		1	291	K9
2/11/2014	21	short	Rat	1		275	K9
2/11/2014	21	medium	Rat		0	307	K9
2/13/2014	11	short	Rat	0		261	Human
2/13/2014	9	medium	Rat		1	270	K9
2/13/2014	10	short	Rat	0		273	K9
2/13/2014	1	short	Rat	1		268	K9
2/14/2014	17	short	Rat	1		249	Human
2/14/2014	25	short	Bird	1		247	Human
2/14/2014	19	short	Rat	1		254	K9
2/14/2014	25	short	Bird	1		247	Human
2/18/2014	10	bare	Rat	1		273	K9
2/18/2014	10	short	Rat	1		278	K9
2/19/2014	30	medium	Rat		1	366	Human
2/19/2014	18	medium	Rat		1	377	K9
2/19/2014	25	short	Rat	1		247	K9
2/19/2014	23	medium	Rat		0	336	K9
2/20/2014	10	short	Bird	1		383	Human
2/20/2014	1	medium	Rat		0	276	Human
2/20/2014	14	short	Rat	1		257	K9
2/20/2014	6	short	Bird	1		271	K9
2/21/2014	24	short	Rat	1		287	Human
2/21/2014	17	short	Rat	1		293	Human
2/25/2014	23	medium	Rat		1	598	Human
2/25/2014	16	short	Rat	0		594	K9
2/27/2014	12	short	Rat	1		292	Human
2/27/2014	13	short	Rat	1		279	K9
2/27/2014	1	short	Rat	1		276	K9
2/27/2014	7	short	Rat	1		260	K9
2/27/2014	7	short	Rat	1		264	K9
2/27/2014	5	short	Rat	0		283	K9

2/27/2014	7	medium	Bird		1	385	K9
3/10/2014	6	short	Rat	1		248	Human
3/10/2014	14	short	Rat	1		263	Human
3/10/2014	15	short	Rat	1		252	K9
3/11/2014	24	short	Rat	1		591	Human
3/11/2014	19	medium	Rat		1	587	K9
3/14/2014	24	short	Rat	1		277	Human
3/14/2014	23	short	Rat	1		384	K9
3/20/2014	7	medium	Rat		1	241	K9
3/20/2014	13	medium	Rat		1	206	K9
3/20/2014	14	short	Rat	1		218	K9
3/21/2014	21	medium	Rat		1	282	Human
3/21/2014	21	medium	Rat		1	289	Human
3/21/2014	19	medium	Rat		1	265	K9
3/27/2014	8	short	Rat	1		300	Human
3/27/2014	14	short	Rat	1		258	Human
3/27/2014	5	short	Rat	1		272	K9
3/28/2014	28	short	Rat	1		576	Human
3/28/2014	25	short	Rat	1		577	Human
3/28/2014	25	medium	Bird		1	575	Human
3/28/2014	30	short	Rat	1		574	K9
4/1/2014	25	short	Rat	1		280	Human
4/1/2014	26	short	Rat	1		288	K9
4/3/2014	15	short	Rat	1		597	Human
4/3/2014	5	medium	Rat		1	600	K9
4/3/2014	11	medium	Rat		1	599	K9
4/4/2014	25	medium	Rat		1	301	Human
4/4/2014	23	medium	Rat		1	336	Human
4/4/2014	21	medium	Rat		1	282	K9
4/8/2014	25	short	Rat	1		238	Human
4/8/2014	20	medium	Rat		1	281	K9
4/8/2014	21	short	Rat	1		570	K9
4/8/2014	30	short	Rat	1		573	K9
4/10/2014	4	short	Rat	0		242	K9
4/10/2014	6	short	Rat	1		243	K9
4/10/2014	10	short	Rat	1		213	K9
4/14/2014	12	short	Rat	0		296	Human
4/14/2014	15	medium	Rat		1	267	K9
4/14/2014	10	short	Rat	1		383	K9
4/18/2014	29	bare	Rat	1		569	Human
4/18/2014	23	short	Bird	1		388	Human
4/25/2014	21	medium	Rat		1	565	K9
4/25/2014	22	short	Rat	1		568	K9
4/25/2014	16	short	Rat	1		566	K9
4/29/2014	26	short	Rat	0		391	Human
4/29/2014	20	short	Rat	0		342	K9
4/29/2014	26	short	Rat	1		391	Human
5/1/2014	1	medium	Rat		0	595	Human
5/1/2014	2	short	Rat	1		596	Human
5/1/2014	12	medium	Bird		1	359	K9

5/6/2014	28	short	Rat	1		410	Human
5/6/2014	16	medium	Rat		0	404	K9
5/6/2014	16	short	Rat	0		405	K9
5/8/2014	5	medium	Rat		0	395	Human
5/8/2014	7	medium	Rat		1	355	Human
5/8/2014	7	medium	Rat		0	590	Human
5/8/2014	14	medium	Rat		0	397	Human
5/8/2014	13	medium	Rat		0	589	Human
5/8/2014	8	short	Rat	1		299	Human
5/8/2014	8	short	Rat	1		592	Human
5/13/14	30	bare	Rat	1		416	Human
5/13/14	20	Medium	Rat		0	411	K9
5/13/14	16	Bare	Rat	1		409	K9
5/15/14	12	short	Rat	1		585	Human
5/15/14	5	short	Rat	1		586	Human
5/15/2014	5	short	Bird	1		349	Human
5/21/14	9	medium	Rat		0	402	Human
5/22/14	2	short	Rat	1		408	K9
5/22/14	13	short	Rat	1		407	K9
5/23/14	25	short	Rat	1		442	Human
5/23/14	17	medium	Rat		0	418	Human
5/23/14	16	short	Rat	1		414	Human
5/23/14	19	medium	Rat		1	419	K9
5/28/14	24	short	Rat	1		432	Human
5/28/14	28	short	Rat	1		431	K9
5/29/14	15	short	Rat	1		417	Human
5/29/14	1	short	Rat	0		420	Human
5/29/14	2	short	Rat	1		426	Human
6/3/14	17	medium	Rat		1	424	Human
6/3/14	30	short	Rat	0		422	Human
6/3/14	20	medium	Rat		1	423	K9
6/3/14	17	medium	Rat		0	421	Human
6/5/14	10	short	Rat	1		582	Human
6/5/14	5	short	Rat	1		581	K9
6/6/14	30	short	Rat	1		422	K9
6/10/14	16	medium	Bird		0	378	Human
6/10/14	28	medium	Rat		0	558	Human
6/13/14	24	short	Rat	0		425	Human
6/13/14	21	short	Rat	1		428	K9
6/13/14	22	medium	Bird		1	446	K9
6/24/14	24	short	Rat	1		425	Human
6/24/14	30	short	Rat	1		422	K9
6/26/14	3	short	Rat	1		571	K9
6/26/14	9	medium	Rat		1	564	K9
6/26/14	10	short	Rat	1		567	K9
6/26/2014	6	medium	Bird		1	348	Human

Appendix 7. Hawaiian hoary bat nights with detections and total nights at KAW in FY 2013 and 2014 (WTG 1-30 ground detectors are numbered 1-30 and a second detector at the WTG's are 101-126 (i.e., 101 is at WTG 1), WTG 1-30 nacelle detectors are 1N-30N, and detectors at gulches are 1G-30G (i.e.,1G is nearest to WTG 1).

Detector Location (WTG)	Start Date	Detector Nights with Activity	Total Detector Nights	Detector Nights with Activity/ Total Detector-Nights
1	7/19/2013	26	285	0.091
2	12/4/2012	21	538	0.039
3	7/12/2013	28	252	0.111
4	7/5/2013	53	347	0.153
5	7/19/2013	24	308	0.078
6	7/17/2013	46	314	0.146
7	7/17/2013	32	334	0.096
8	12/21/2012	41	549	0.075
9	7/17/2013	25	294	0.085
10	7/16/2013	34	349	0.097
11	7/16/2013	31	331	0.094
12	12/5/2012	95	450	0.211
13	7/5/2013	153	337	0.454
14	7/17/2013	63	323	0.195
15	7/11/2013	27	352	0.077
16	7/11/2013	8	326	0.025
17	12/4/2012	4	541	0.007
18	7/19/2013	55	326	0.169
19	12/5/2012	29	534	0.054
20	7/19/2013	21	306	0.069
21	12/5/2012	36	535	0.067
22	7/19/2013	44	304	0.145
23	12/4/2012	63	542	0.116
24	6/12/2013	21	352	0.060
25	5/20/2013	67	339	0.198
26	12/12/2012	49	530	0.092
27	7/18/2013	39	320	0.122
28	7/18/2013	57	345	0.165
29	12/22/2012	55	480	0.115
30	7/5/2013	28	284	0.099
Total		1275	11427	0.112

Detector Location (WTG)	Start Date	Detector Nights with Activity	Total Detector Nights	Detector Nights with Activity/Total Detector-Nights
101	8/17/2013	22	413	0.053
103	8/17/2013	12	415	0.029
105	9/13/2013	13	351	0.037
107	9/13/2013	27	368	0.073
109	9/13/2013	36	322	0.112
111	9/13/2013	49	391	0.125
113	9/13/2013	40	341	0.117
115	8/17/2013	21	372	0.056
116	8/31/2013	6	365	0.016
117	8/17/2013	9	399	0.023
118	8/31/2013	70	392	0.179
120	8/31/2013	33	385	0.086
121	8/31/2013	45	388	0.116
122	8/18/2013	79	366	0.216
123	8/17/2013	46	409	0.112
124	8/17/2013	30	406	0.074
125	8/17/2013	34	401	0.085
126	8/17/2013	29	404	0.072
Total		601	6888	0.087

Detector Location (WTG)	Start Date	Detector Nights with Activity	Total Detector Nights	Detector Nights with Activity/Total Detector-Nights
1N	8/7/2013	1	224	0.004
2N	8/28/2013	0	274	0.000
3N	8/12/2013	2	323	0.006
4N	8/13/2013	15	308	0.049
5N	8/18/2013	4	316	0.013
6N	8/19/2013	6	165	0.036
7N	8/22/2013	3	313	0.010
8N	8/20/2013	5	85	0.059
9N	8/20/2013	4	294	0.014
10N	8/8/2013	6	304	0.020
11N	8/8/2013	8	327	0.024
12N	8/8/2013	16	327	0.049
13N	7/21/2013	24	330	0.073
14N	8/7/2013	51	328	0.155
15N	8/7/2013	3	328	0.009
16N	8/7/2013	11	235	0.047
17N	7/24/2013	3	218	0.014
18N	8/7/2013	13	328	0.040
19N	8/7/2013	9	328	0.027
20N	8/7/2013	21	283	0.074
21N	8/7/2013	12	306	0.039
22N	8/5/2013	26	330	0.079
23N	5/8/2013	21	372	0.056
24N	4/29/2013	1	395	0.003
25N	5/7/2013	9	360	0.025
26N	5/6/2013	21	409	0.051
27N	7/22/2013	7	330	0.021
28N	7/26/2013	7	340	0.021
29N	7/26/2013	5	277	0.018
30N	7/26/2013	8	280	0.029
Total		322	9037	0.036

Nearest WTG/MET	Start Date	Detector Nights with Activity	Total Detector Nights	Detector Nights with Activity/Total Detector-Nights
1G	8/17/2013	6	286	0.021
4G	8/5/2013	43	301	0.143
14G	8/6/2013	97	329	0.295
15G	8/18/2013	36	290	0.124
17G	8/18/2013	34	258	0.132
MET2G	9/1/2013	14	231	0.061
22G	8/18/2013	23	288	0.080
23G	8/5/2013	49	293	0.167
26G	9/1/2013	20	269	0.074
26G2	9/1/2013	5	262	0.019
29G	9/1/2013	79	286	0.276
30G	8/18/2013	79	263	0.300
Total		485	3356	0.145

Appendix 8. Capture and Tracking of a Female Hawaiian Hoary Bat from ‘Uko’a Wetland
June 28, 2013 – July 5, 2013

On 12 June 2013 we started our first of three 15-day Hawaiian Hoary bat mist netting sessions at the Ukoa Wetlands, on the North Shore of Oahu.

Nets and Site Selection

Each night HT Harvey Ecological Consultants and First Wind HCP personnel set up 5 nets at one of 5 locations to sample the perimeter of the Wetland (Figure 1). We deployed a combination of 4 different net sizes: 2.6m x 6m, 2.6m x 9m, and 2.6m x 12m, as well as one 6m x 15m net. Each location had 5 nets placed in suspected flyways to capture bats as they flew along roads or corridors. One of the 5 nets was a 2.6m x 12m net with an Avisoft Ultrasoundgate ultrasonic speaker placed near it broadcasting social calls to lure bats.

Each night we opened mist nets at approximately sunset and closed nets 4 hours later. At the net with social call playback, we started broadcasting calls approximately half an hour after sunset and continued until the nets are closed.

Bat Capture

On June 28, 2013 at 22:58 we captured a lactating female Hawaiian Hoary bat at the call playback net at site G, along Kamehameha highway (Figure 1).

After removing it from the net we measured it, took hair and tissue samples, banded it with 3 split bands, attached a radio transmitter and LED light to her back, released her and tracked her very briefly.

Day 1: June 29, 2013

We were able to find her during the day at her roost site (Figure 2). The roost site is located in a small gulch situated between Pupukea and Alapio Roads near Waimea Valley. The gulch had steep walls and consisted of large ironwood trees (*Casuarina equisetifolia)*. We were not able to pin point the exact tree that night, but we were able to see her leave the roost area and then tracked her throughout that night. Please note – for all the maps the pins are the location where we were standing when receiving her radio signal. This does not mean that bat was at the exact point, but rather in the area in a known direction from the point.

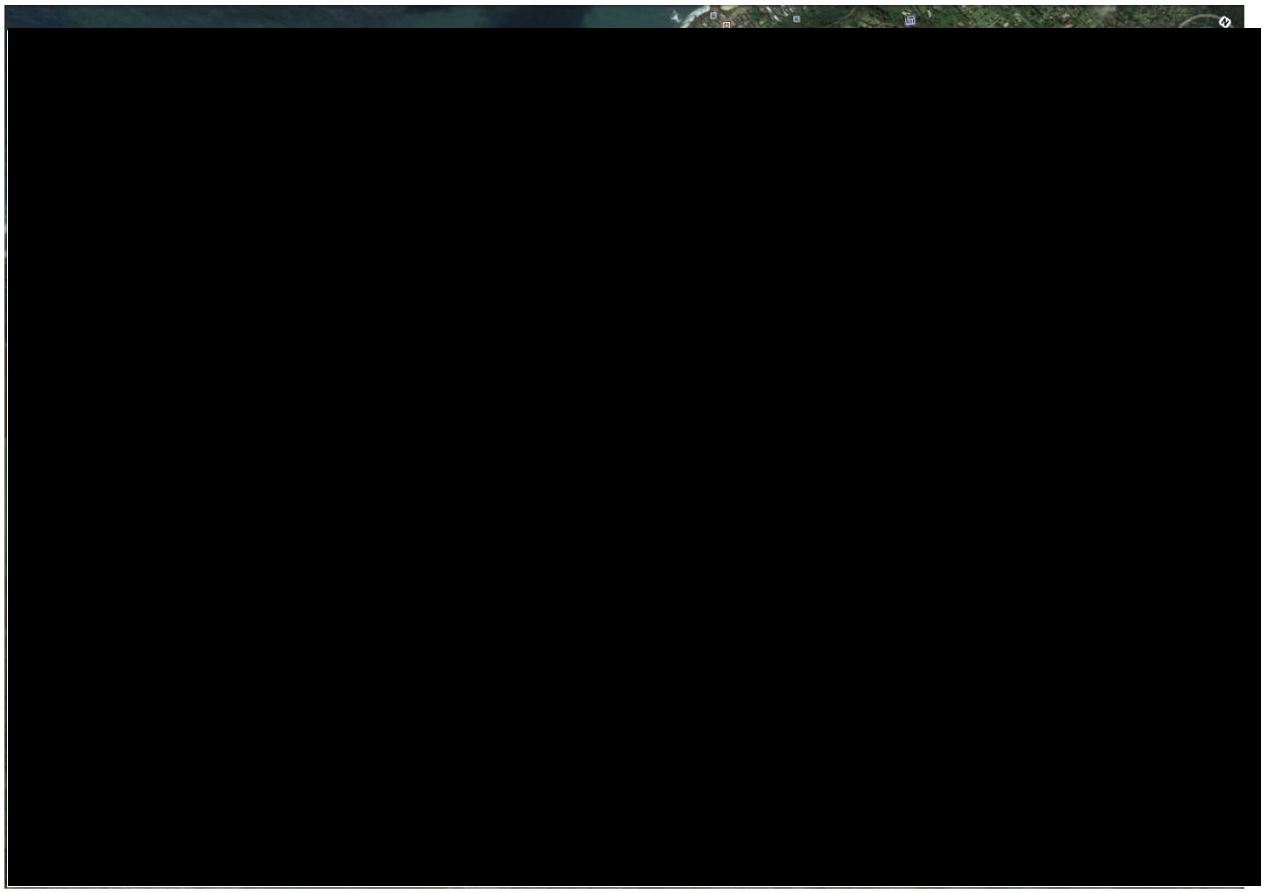


Figure 2 – Activity for night of 6/29

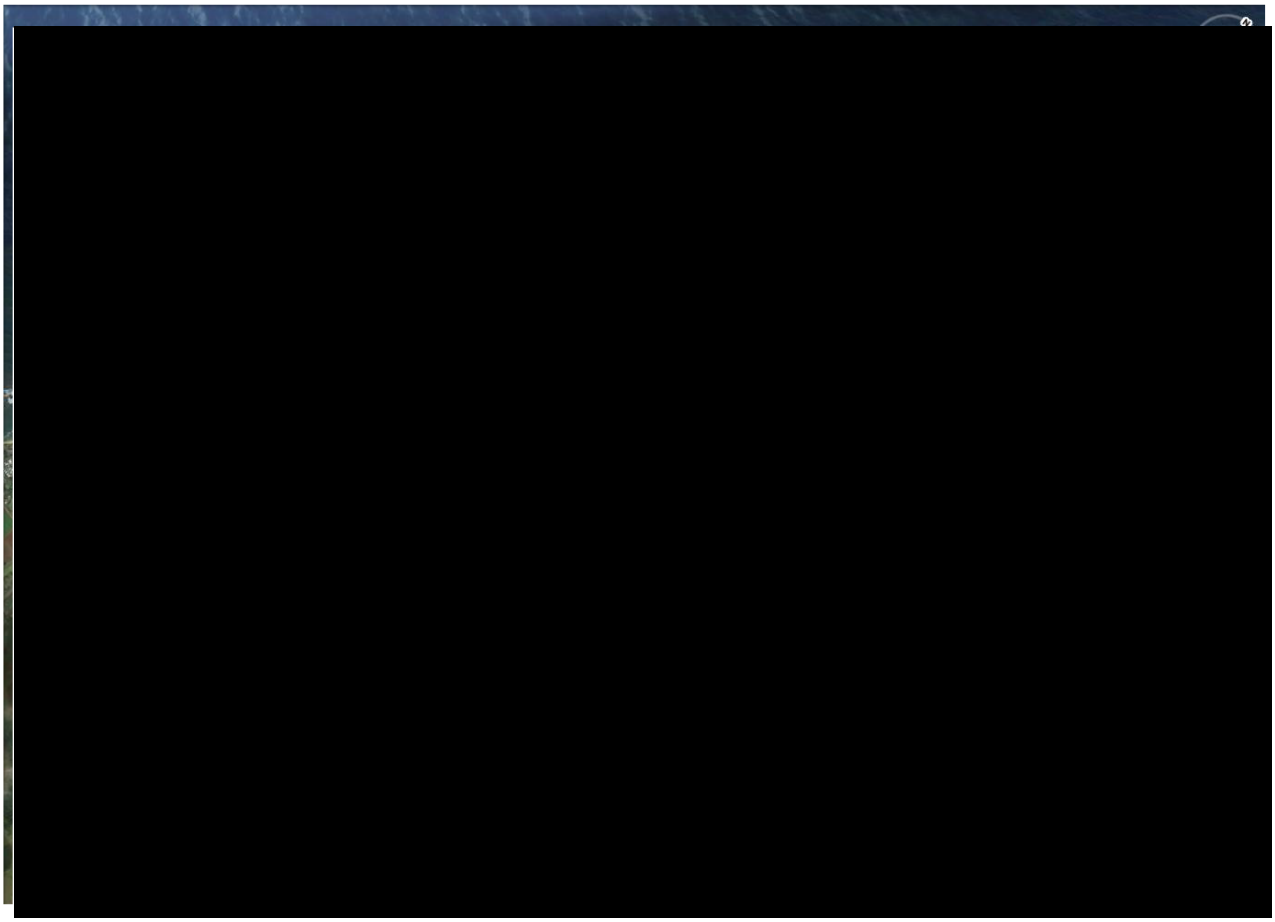
Between 10:48 and midnight she was detected flying near the wind farm probably somewhere between towers 14 and 30. Then she started to fly east. We next found her roosting at the previous day roost tree and determined that she was not actively flying, ending tracking for that.

Day 2: June 30, 2013

We returned to the day roost tree to search for her and her babies and characterize the habitat. We were unable to spot her, but she appeared to start flying at 7:28 pm. She appeared to fly back and forth along the gulch until around 9:00 pm. We weren't getting any movement after 9:00 pm and decided at 10:00 pm that the transmitter must have fallen off.

Day 3: July 1, 2013

We were able to locate her in the day roost tree and see her two pups. They were between 30 to 35 m up a large ironwood tree (35 to 40 m tall) on a small branch that extended to the west. There was not a dense overhead canopy cover as has been found in mainland hoary bat roosts. We then tracked her throughout the night (Figure 3).



We tracked her again to near the Kawailoa wind farm while the winds were very strong. She appeared to be flying low and may have been in one of the gulches for a long time. At 11:49 pm the signal faded and we found her next at midnight at her day roost tree.

Day 4: July 2, 2013

We detected her flying at 7:30 pm and saw her flying over the trees at 7:35 pm (Figure 4. At 7:45 pm we lost the signal and searched for her. We located her at 10:42 pm at the opening to Waimea Valley. Here both tracking teams attempted to triangulate her position. She was flying back and forth along the opening to the valley until 11:40 pm. We were unable to locate the signal again anywhere we checked, including the day roost tree and stopped searching at 12:40 pm.

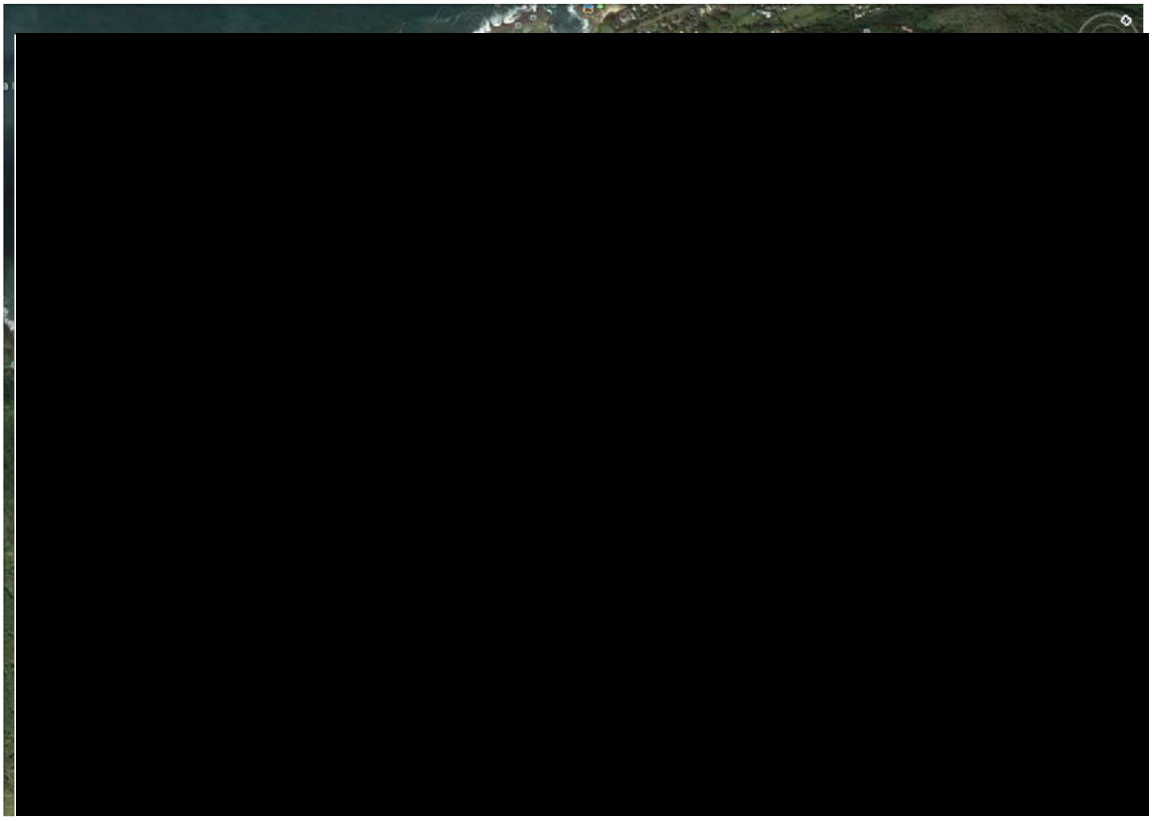


Figure 4 - Activity for night of 7/2/13

Day 5: July 3, 2013

We returned to the roost at 7:00 pm and were unable to detect a signal. However at 7:30 pm we saw her flying above the roost. The transmitter had finally fallen off which we confirmed with 2 sets of telemetry equipment.

As far as we know, this was the first capture of a bat on Oahu in about 100 years, and the first confirmation that they are breeding on the island. We were able to collect valuable data about her roosting habitat and location, activity patterns, and movement patterns. Below are larger maps of our entire tracking progress from 6/29 – 7/3, and a closer look at the activity near the wind farm.

Map showing capture site, roost site, and tracking efforts from 6-28-13 – 7-2-13. Please note the points are where we were standing at the time of detection. This does not mean the bat was at the exact point, but rather in the area in a particular direction from the point (except for the Roost Site and Capture Site – those both had visual confirmation).

Map of Kawailoa detections. The pins represent the position of the receiver and the red lines show the direction of reception. Each line is extended to give a better representation of where she might have been based on topography and interference (the longest line stretches 0.5miles).

Appendix 9. Capture and Tracking of a Male Hawaiian Hoary Bat from Kawailoa near WTG 29 September 9, 2013 – October 5, 2013.

On 9 September 2013 we started our third of three 15-day Hawaiian Hoary bat mist netting sessions at the Uko'a Wetlands, on the North Shore of Oahu. We also started our second of three 10-day mist netting sessions at Kawailoa Wind Energy Facility on the 16th of September.

Nets and Site Selection of Uko'a

Each night HT Harvey Ecological Consultants and First Wind HCP personnel set up 5 nets at one of 5 locations to sample the perimeter of the Wetland (Figure 1). We deployed a combination of 4 different net sizes: 2.6m x 6m, 2.6m x 9m, and 2.6m x 12m, as well as one 6m x 15m net. Each location had 5 nets placed in suspected flyways to capture bats as they flew along roads or corridors. One of the 5 nets was a 2.6m x 12m net with an Avisoft Ultrasoundgate ultrasonic speaker placed near it broadcasting social calls to lure bats. We only conducted 14 out of the 15 nights due to the capture of a male Hawaiian Hoary bat at Kawailoa on the 14th night of netting.

Figure 1 – Net site Llcations at Uko'a wetlands

Each night we opened mist nets at approximately 9:30pm and closed nets 4 hours later. At the net with social call playback, we started broadcasting calls as soon as nets were open and continued until the nets were closed. No bats were caught at Uko'a.

Nets and Site Selection of Kawailoa

Kawailoa monitoring started on September 15, 2013 and went until September 27, 2013. We chose sites based on acoustic detector activity, and probable flyways. Each location had at least two nets, a low net and a high net, deployed ranging in sizes. A choice of either a 2.6m x 9m or 2.6m x 12m was selected for the low net. The high net was either 50x20ft, or 30x100ft, depending on the landscape. On all nights we used social call playback at either 9m or 12m mist nets. One adult male bat was captured.

Figure 2 – Net site locations at Kawailoa

Bat capture

On September 27, 2013 at 00:15 we captured an adult reproductive male Hawaiian Hoary bat, identified by swollen testes (Photo 1). He was caught at a call playback 9m net at site 3, along the gulch road east of WTG 29 (Figure 2).

Photo 1 – Male Hawaiian Hoary bat

After removing it from the net we collected hair, tissue and fecal samples, recorded measurements (forearm length of 50mm, and a mass of 17.2 g), and banded it with one yellow/blue band on its left wing (Photo 2). We were also successful in attaching a radio transmitter (Photo 2) and miniature LED light (Photo 3) to the bat. We released the bat at 2:15 at the capture site, and we saw it fly to the north to an ironwood tree where it night roosted for approximately 2 hours. At 4:29 it flew away from the tree and despite extensive searching we were unable to locate a signal again that night and called the search off at sunrise, 6:30am.

Photo 2 – Male Hawaiian Hoary bat with left yellow/blue band and radio transmitter

Photo 3 – Male Hawaiian Hoary bat with LED light on abdomen

Roost searching

For the next five days we had two teams searching the North Shore area to locate his day roost. We were able to cover a very large area, driving all accessible public and military roads. We were able to cover seven miles to the north, all the way to Turtle Bay, 5 miles to the south and west covering Waialua and Haleiwa and only three miles to the east due to lack of military roads. However, we were unable to locate the signal over those five days before the transmitter was assumed to be no longer active. He could have traveled much farther away, or more likely he was roosting too far away from any roads for us to detect a signal.

Radio tracking on Kawailoa

The purpose of radio tracking on Kawailoa is to learn about foraging behavior and habitat use on the wind facility, to hopefully develop more targeted and effective mitigation strategies. During our time tracking we had three teams positioned around Kawailoa to achieve maximum coverage of the site while scanning for the bat. We started each evening just prior to sunset and when the bat was detected we started taking simultaneous bearings every three minutes. If only one team was picking up the signal we moved other teams into positions closer to start triangulating. We determined to end the tracking periods based on several factors. First, if the bat had a successful foraging bout early in the night, it is less likely to be active later on. Second, if we didn't detect the bat by 12:30 we figured the bat was unlikely to show up based on previous night's activity. Finally, if we had a strong presence early in the night and went more than one hour without a signal, we ended at that time.

Points were plotted in LOAS v3.0.4.8 (Ecological Software Solutions, 2010). The range of the receivers varies due to terrain, altitude of the bat, and altitude of the receiver; but is likely to be about ¼ - 2 miles depending on these factors. We are including in this report

tracks of continuous foraging bouts lasting longer than half an hour. We will include a more thorough analysis of all activity in the final report concluding mist netting efforts.

Radio Tracking Night 1 - September 28.
All teams were on site and in position at 18:30, and our first detection was at 20:30. He was detectable on the site until 21:40. We had very few triangulated points this night due to the time spent moving people around the site to pick up the signal. However, we were able to determine good positions for triangulating with all the movement and utilized these spots over the remaining time spent tracking. We did not detect the bat for the rest of the night.

Radio Tracking Night 2 - September 29.
All teams were on site and in position at 18:30, right before sunset. We did not detect the bat at all on this night and we ended the night at 00:30.

Radio Tracking Night 3 - September 30.
All teams were on site and in position at 18:30, right before sunset. We detected the bat during three separate time periods this night. The first detection was from 18:48 to 20:20; second detection was from 23:07 to 23:54 (Figure 3); and the third detection was from 01:37 to 01:55. We ended the night at 02:45.

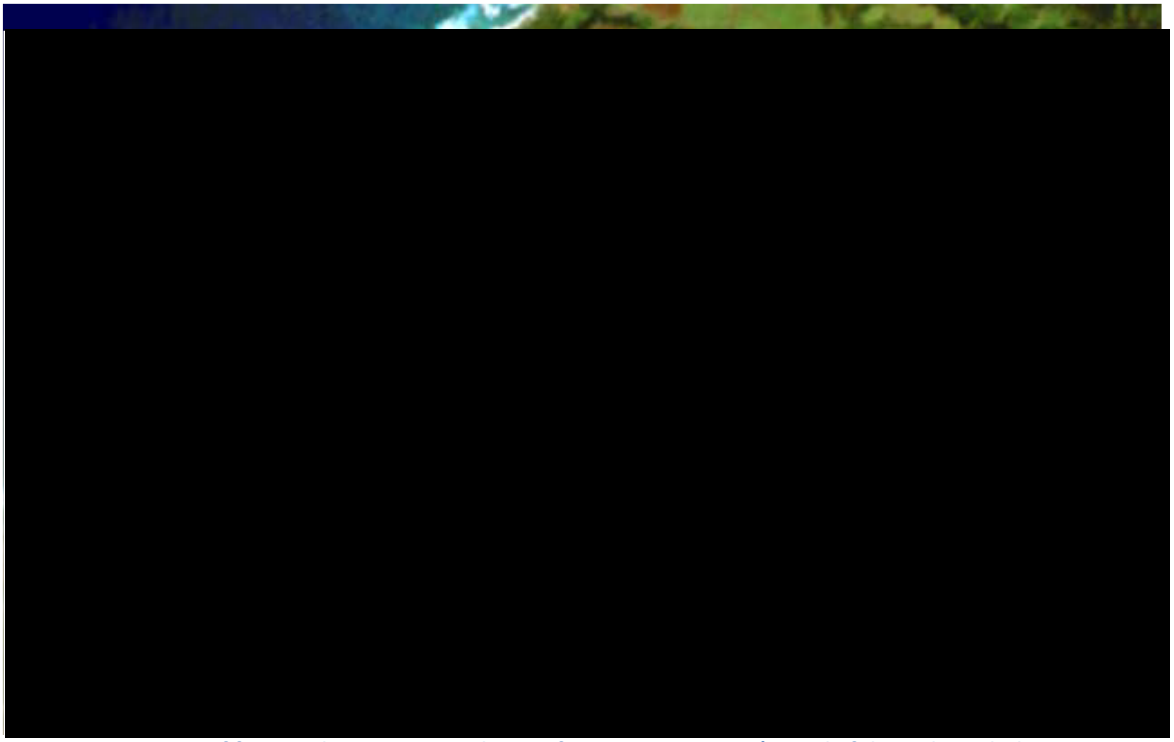


Figure 3 - Map of foraging bout on September 30, from 23:09 to 23:54 (period of the night with the most triangulation data). Red squares represent the point of intersection from triangulation, and the arrows show the direction bat was moving.

Radio Tracking Night 4 - October 1.

All teams were on site and in position by 18:30, just before sunset. We detected the bat during three separate periods during the night. The first detection was from 18:49 to 20:50 (Figure 4); second detection was from 01:21 to 01:24; the third detection was from 02:39 to 02:50, and briefly at 03:20. We ended monitoring at 03:30.

Figure 4 - Map of foraging bout on October 1 from 19:56 to 20:50 (period of the night with the most triangulation data). The offshore point is likely due to error from close triangulation angles for some points. Grey squares represent the point of intersection from triangulation, and the arrows show the direction bat was moving.

Radio Tracking Night 5 - October 2.

All teams were onsite and in position by 18:30, right before sunset. We detected the bat during two separate periods. The first was from 20:48 to 22:49 (Figure 5), and the second was from 23:33 to 00:33. We attempted to follow it off site to try and gain an idea of where it might be day roosting, but the signal disappeared and we were still unable to locate it. We ended the night at 01:45.

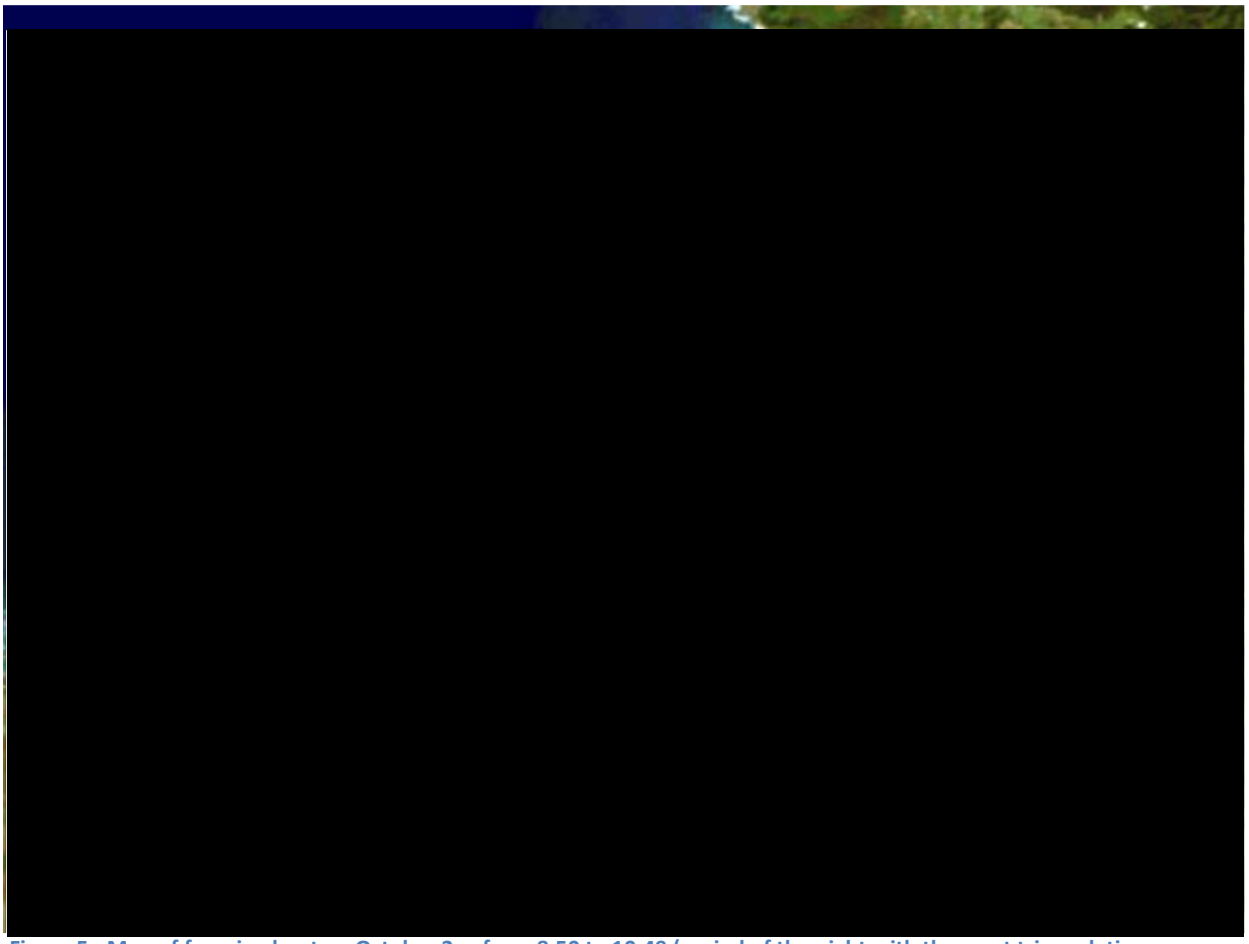


Figure 5 - Map of foraging bout on October 2 , from 8:50 to 10:49 (period of the night with the most triangulation data). Yellow squares represent the point of intersection from triangulation, and the arrows show the direction bat was moving.

Date	Start Time	Time of Detection (1)	Time of Detection (2)	Time of Detection (3)	Time of Detection (4)	End Time
September 28, 2013	18:30	20:30 – 21:40	N/A	N/A	N/A	02:45
September 29, 2013	18:30	N/A	N/A	N/A	N/A	00:30
September 30, 2013	18:30	18:48 – 20:20	23:07 – 23:54	01:37 – 01:55	N/A	02:45
October 1, 2013	18:30	18:49 – 20:50	01:21 – 01:24	02:39 – 02:50	03:20	03:30
October 2, 2013	18:30	20:48 – 22:49	23:33 – 00:33	N/A	N/A	01:45
October 3, 2013	18:30	N/A	N/A	N/A	N/A	00:30
October 4, 2013	18:30	N/A	N/A	N/A	N/A	00:30
October 5, 2013	18:30	N/A	N/A	N/A	N/A	00:30

Table 1 – Time periods of bat tracking and detections at Kawailoa

Radio Tracking Nights 6 -8 - October 3 - October 6.
We conducted three more nights of radio tracking from 18:30 to 00:30 with no more detections of the signal. The radio likely fell off the bat at this point.

As far as we know, this was the first capture of a male bat on Oahu in about 100 years. Even though we were unsuccessful in finding his roost we were able to collect valuable data about his foraging and activity patterns in reference to the wind facility.

Appendix 10. Ukoa Predator Control Program

1-Month Trap-Out Report

Prepared for: First Wind, Kawailoa Wind Energy LLC

By: Grey Boar Wildlife Services LLC

July 2014

CONTENTS

INTRODUCTION

The purpose of this predator control program is to protect native and migratory waterbirds, including the federally endangered Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, and Hawaiian duck, as well as the endangered hoary bat, at Ukoa Pond, Oahu. Black-crowned night herons and Pacific golden plovers, protected under the federal Migratory Bird Treaty Act, have also been observed at Ukoa. The focus is on implementing an extensive and adaptive predator control program to protect nesting birds, chicks, and bat roosts within the fenced area.

Predator control at Ukoa Pond is being done in accordance with the Kawailoa Wind Power Facility Habitat Conservation Plan, which is administered by First Wind. First Wind has contracted Grey Boar Wildlife Services to conduct predator control activities and report results. This report describes the management actions, results of bait/trap trails, and target species removal efforts conducted during a 1-month trap-out at the beginning of this program. A subsequent report will be developed at the end of the 6-month contract.

OBJECTIVES

1. Increase survival and nesting success of waterbirds by removing pigs, as well as controlling mongoose, feral cats, rats and mice.

2. Increase survival and nesting success of native Hoary Bats by controlling foraging ungulates, feral cats, & rats that have potential for disturbing bat roosts.

PHASE 1

Phase 1 included strategic scoping for trap placement, tracking tunnel set-up, trap set-up and pre-baiting pig traps paired with Game Cameras to identify populations of predators and their movements throughout the fenced unit. Tracking tunnels were utilized to assess rat, mongoose and cat populations throughout the wetland. Phase 1 also included a perimeter fence check to identify any recent pig incursions or breaches. Identified areas were reported to First Wind for repair.

TRACKING TUNNEL SET-UP

Tunnel locations were determined using the ArcGIS “Create Random Points” tool. The parameters used were: 30 tunnel locations spaced at least 50 meters apart. The tool was unable to create random points for any number of tunnels greater than 30 with the 50 meter spacing due to the size of Ukoa. Of the 30 tunnel locations, two were within the open pond area; therefore, these locations were discarded. A total of 28 tunnels were then set out in the field. Locations were marked with pink flagging and a GPS point was recorded (Figure 1).

Figure 1. Map of Tracking Tunnel locations

The tracking tunnels used for this project were constructed by Grey Boar Wildlife Services using 2.0 millimeter (mm) corrugated black plastic cut into 16 inch by 20 inch

sections. Tunnels were then folded into four equal sides and taped at the joins to make a rectangle. Tunnels were secured to the ground with metal stakes.

Figure 2. Tracking tunnels being placed in the field.

TRAP SET-UP AND PLACEMENT

Traps used for this project included: corral and box traps, Goodnature Automatic-24s (A-24), live cages, DOC-250s and body grip traps (Coni-boxes). DOC-250s and Coni-boxes were alternated and spaced 100 meters from each other along the fence line and interior wetland. Corral and box traps were strategically placed based on observation of pig sign during phase one. A-24s were then placed in-between the DOC-250s and Coni-boxes, at a spacing of 100 meters from each A-24. This resulted in an overall trap placement of: DOC-250, A-24, Coni-box, A-24, DOC-250, etc., with 50 meters between each trap (Figure 2).

PIG TRAPS (CORRAL AND BOX)

A total of four corral and two box traps were constructed and strategically placed at Ukoa Pond for the removal of feral pigs. Corral traps were constructed using three 16-foot hog panels and 10 t-posts. One panel was bent to also serve as the door (this is called a circle 6 trap) (Figure 4).

Figure 4. Example of circle 6 gate configuration; picture taken using game camera.

One box trap was constructed out of hog fence panels and a wooden guillotine door was used. The other box trap was made from fencing welded to angle iron and a spring assisted saloon door (Figure 5 and 6).

Figure 5. Picture of pig box trap #1 taken with game camera.

Figure 6. Picture of pig box trap #2 taken with game camera.

GOODNATURE AUTOMATIC-24

A-24 traps were used for the removal of rodents, including mice, black rats, Norway rats and Polynesian rats. A total of 57 A-24s were placed at Ukoa; 46 were placed around the perimeter at a spacing of 100 meters, 11 were strategically placed in the interior of the wetland at least 100 meters apart. Goodnature Peanut Butter (GNPB) was used in all traps for the 1-month trap-out period.

Figure 7. A-24 set on white plastic stake in the interior of the wetland.

LIVE CAGES

A total of 12 live cages were used at Ukoa to catch feral cats and mongoose. Havahart brand 32-inch long traps were selected for use. This size trap seems to allow for more captures of feral cats. Traps were evenly spaced around the perimeter of the wetland, approximately 400 meters apart. In two instances traps were placed within 20 meters due to presence of increased cat sign.

DOC-250

DOC-250s require the use of custom boxes for the trap to function. Plans for building the boxes can be found at http://www.predatortraps.com/. Boxes were constructed by Grey Boar Wildlife Services using ¾-inch PlyForm plywood and three sheets of ½-inch galvanized hardware cloth. 3 ¼-inch entrance holes were cut out of the hardware cloth to exclude non-target species, including water birds, dogs and cats. DOC-250s were spaced 200 meters apart.

CONI-BOXES

To make the coni-boxes more effective, custom boxes were constructed using ¾-inch PlyForm plywood and two sheets of ½-inch galvanized hardware cloth. A galvanized stake was used to funnel the animal towards the trigger of the trap. A 3 ¼-inch hole was cut out of the entrance to exclude non-target species including water birds, dogs and adult cats. Coni-boxes were set 200 meters apart.

GAME CAMERAS

Six Scout Guard SG580MB wireless cameras were used to monitor the pig traps for activity. Cameras were installed so that the entrances to traps and immediate surrounding areas could be monitored. These cameras use a SIM card that allows for pictures to be sent via text message and email. This technology allows sites to be monitored continuously and for real-time management decisions to be made.

FENCE CHECK

A fence check was conducted prior to the 1-month trap-out to identify any damage in the fence. Three areas in need of repair were identified and GPS points and pictures were reported to First Wind.

PHASE 2 (TRAP-OUT)

TRAP CHECK FREQUENCY AND SCHEDULE

During the trap-out phase, all traps were checked at least five days per week for a total of 23 trap checks. The schedule was Friday-Sundays, Tuesdays and Thursdays. This allowed for continual coverage while maintaining no more than a 48-hour interval on live traps per U.S. Fish and Wildlife Service recommendations.

RESULTS

1 MONTH TRAP OUT CATCHES

After one month of trapping a total of 341 target animals were captured and removed from Ukoa, including: 224 mongoose, 15 cats, 51 pigs, 30 rats, and 21 mice. Additionally, there were a total of 16 non-target animals, including 6 Spotted Doves and 10 Mynahs birds. Catches were highest during the first week of the trap-out and began to decrease during week 2.

DATE	CAT	Mongoose	Mouse	PIG	RAT	Total
6/6/14	1	12		10		23
6/7/14	1	51		9		61
6/8/14	3	42		2	1	48
6/9/14	1	4		3		8
6/10/14	1	36		4	2	43
6/11/14		4			2	6
6/12/14	1	16	2	2		21
6/13/14		12	2	6		20
6/14/14	2	9		2		13
6/15/14		6		3		9
6/17/14	1	10	2		3	16
6/19/14		5	3		3	11
6/20/14		1		2	1	4
6/21/14					2	2
6/22/14		1	4		1	6
6/24/14	3	3	1		3	10
6/26/14		1			2	3
6/27/14		2		2	2	6
6/28/14			1	2		3
6/29/14			1		4	5
7/1/14		6	3	1	3	13
7/2/14				3		3
7/3/14	1	3	2		1	7
Total	**15**	**224**	**21**	**51**	**30**	**341**

Table 1. Total catches of target species during trap-out period.

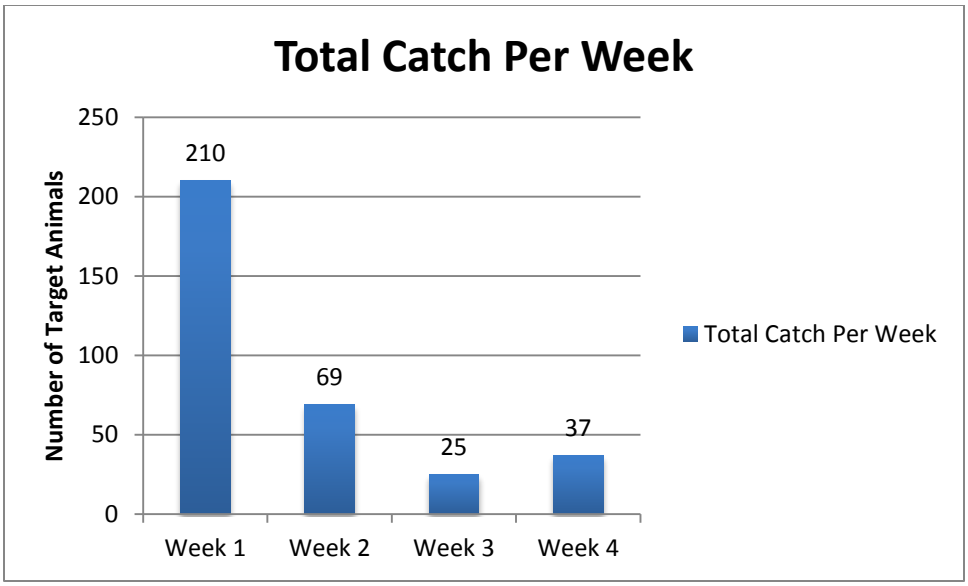


Figure 8. Total Catches per week of target animals during the trap-out period

TRACKING TUNNELS

Tracking cards were placed just prior to the trap-out and again during the last week of the trap-out. The cards were used to assess the presence of rodents, mongoose and cats within the wetland. Cards were set out for a total of three nights. The first night cards were baited with peanut butter then collected the following day; new cards were then baited with fish paste, immediately redeployed, and collected two days later. Tracks were then counted and recorded. Percent activity is shown as the number of cards with tracks divided by the total number of cards.

Date	Rats	Mongoose	Mice	Cats
5/31/14	67.86%	28.57%	21.43%	7.14%
6/27/13	35.71%	0.00%	39.29%	0.00%

Table 2. Percent of tracking cards with activity by species set with Peanut Butter (after 1 night).

Date	Rats	Mongoose	Mice	Cats
6/3/14	21.43%	89.29%	0.00%	0.00%
6/29/14	42.86%	0.00%	42.86%	0.00%

Table 3. Percent of tracking cards with activity by species set with Fish Paste.

During the initial trial, all four species were found to be present after the 1st night with peanut butter. During the last trial only rat and mice presence was observed. During the initial trial with fish paste, mongoose visited nearly every tunnel and were removing the bait from the cards. During the final trail with fish paste, almost all cards still had bait when checked, and no mongoose presence was observed. It is therefore likely that

the increase in rat and mouse presence on final trail is due to the bait being left on the cards and not a result of an increase in these species numbers. Tracking cards will continued to be monitored on monthly schedule.

BAIT TRIALS

A bait trial using cat food with fish oil (CF) and a custom-made preserved fish paste (FP) was conducted. The baits were used for the DOC-250s, Coni-boxes and live traps. All odd numbered traps were baited with FP and all even numbered traps were baited with CF. This baiting regimen allowed for mostly equal representation throughout the wetland.

Figure 9. Photographs showing mongoose captured in two Coni-box traps using two different baits (cat food with fish oil on the left, fish paste on the right).

After one month of effort, traps baited with CF captured 134 (55.6%) target animals, including: 111 mongoose, 14 cats and 9 rats. Traps baited with FP captured 107 (44.4%) target animals, including: 101 mongoose, 0 cats and 6 rats. CF seemed to be slightly more attractive than the FP for capturing all species; however, the FP appeared to be less prone to removal by mice and ants. In some instances, trays of CF would only last 1-2 days before bait was fully removed while the FP would last much longer, 3-7 days. However it appeared that the FP would not be very fragrant after about 2 days.

Based on the results of the trail, all traps will subsequently be baited with CF. To minimize the amount of CF being stolen by non-target species, larger trays with a covering placed over the bait will be used.

DOC-250 VERSES CONI-BOX TRIAL

A trial was conducted between two different trap types, DOC-250s and Coni-boxes, to determine which trap was more effective at catching target species. There were a total of 55 traps used, including 28 DOC-250s and 27 Coni-boxes.

After one month of trapping, the DOC-250s captured a total of 132 (65.7%) targets, including: 121 mongoose and 11 rats. The Coni-boxes captured a total of 69 (34.3%) targets, including: 61 mongoose, 4 rats, and 4 cats. The DOC-250s captured 5 non-targets and the Coni-boxes captured zero non-targets. The DOC-250s were found to be a much more effective trap, catching almost twice as many mongoose as the Coni-boxes. For the time being, both Doc 250s and Coni-boxes will continue to be used. However, in the future when traps need to be reordered or replaced DOC 250's will be preferred.

PANS VERSES TRIGGERS

A trial was conducted between two trigger types to determine which type was more effective, triggers fastened with metal step-on pans and traditional triggers.

Figure 10. View of the two different trigger types taken from the trap entrance with hardware cloth removed.

It was found that both pans and triggers delivered good trap position when closed on the target species (Figure 11).

Figure 11. Sprung trap position of the pan (left) and trigger (right).

After one month of trapping, the Coni-boxes with pans captured a total of 41 (59%) target animals, including: 37 mongoose, 2 cats, and 2 rats. The Coni-boxes with triggers captured a total of 28 (41%) target animals, including: 24 mongoose, 2 cats, and 2 rats. There was a slight difference in the catches of mongoose between the two trigger types, and no difference for cats and rats. Use of both triggers will be continued and results will be monitored. If further monitoring indicates that one trigger type is much more effective than all traps will be modified with that trigger type.

GOODNATURE A-24

All A-24s were checked for presence of carcasses each trap day. Carcasses from rats, mice and mongoose were found under several different traps (Figure 12). Since A-24s are still a relatively new tool in Hawaii close attention was paid to the bait and CO_2 cartridge with each trap. Counters were not installed on the traps; therefore, we could only look for presence of carcasses. The traps were manually triggered once a week to ensure each CO_2 cartridge was still functional. Only one trap had no remaining CO_2

when triggered three days after initial trap baiting. A new CO_2 was installed and the trap did hold CO_2 for the remainder of the trap-out period. The trap probably had a temporary CO_2 leak and was not a result of 24 triggerings in 3 days.

Figure 12. Black rat found under A-24 during trap check.

After one month of trapping, a total of 47 carcasses were found under the A-24s, including: 15 rats, 21 mice, and 11 mongoose. Of the 11 mongoose, three were found alive and stunned moving around the area near the trap. These animals were euthanized using a pellet gun. The amount of rats and mice found beneath A-24s began to increase as the trap-out progressed, likely due to less scavenging of carcasses by mongoose. It is estimated that all target species loss from A-24s is under-documented due to scavenging. However, since no counters or cameras are installed, there is no way of documenting the total amount of target species killed by these traps.

PIGS

After the trap out a total of 51 pigs were captured, 28 in corral traps and 23 in box traps. Of the 51 pigs captured there were 5 adult sows, 9 adult boars, 4 sub-adults and 33 piglets. It is estimated that there are a considerable amount of pigs still remaining within the fenced area, efforts will continue to capture these animals. Game feeders and the use of a remote cell phone gate trigger system will be installed on some of the traps.

NON-TARGET SPECIES

Non-target captures only included the capture of 6 Spotted Doves and 10 Mynah birds. 11 of these were captured in live cages, and were released alive with no apparent injuries. The remaining 5 were caught in DOC-250s. Based on the low level of non-targets caught, no adjustments are recommended at this time. However, additional measures will be taken to avoid areas of breeding waterbird activity if present within the wetland.

FENCE CHECKS

Weekly fence checks were conducted while checking traps. The fence was visually inspected for any signs of ungulate disturbance, damage, or vandalism (cutting). First Wind was notified of any areas in need of repair and given a photo and GPS point. Grey Boar Wildlife Services also patched one of these holes due to observations of pig tracks entering through the hole in the fence.

Figure 13. Pictures of fence where vandalism occurred.

VANDALISM

On Tuesday, June 10, 2014 an adult cat was captured in a live cage near a homeowner's residence. The homeowner was looking for his cat and found the live cage; he then took his cat home and the live cage as well. The trap was returned later that day. Due to the proximity of the residence the trap was moved to a further location.

On Tuesday, June 24, 2014, at 6:40 pm two hunters with several dogs were seen on the camera at Corral Trap 3. They proceeded to steal the camera and the camera from Box Trap 2. At 8:20 pm a picture with an identifiable face was sent from the stolen Corral trap camera to Grey Boar Wildlife Services via email. First Wind was notified the following morning. With help from First Wind staff, the hunting community and forum boards, the individual was identified and contacted. The cameras were returned the following night, Wednesday, June 25th.

During a fence check on Sunday June 29, 2014, four sections of fence were found intentionally cut. Three sections consisted of hog wire and each strand was cut near a corner pole. The other area that was cut was the black plastic skirting near a rock. First Wind was notified that day.

FUTURE ACTIONS AND RECOMMENDATIONS

Over the next five months, Grey Boar Wildlife Services will continue to conduct predator control efforts at Ukoa pond. While the level of effort will be reduced from that during the trap out phase, it is anticipated that trapping efficacy will continue to be high. The following highlights some of the new approaches taken after the trap out:

- When identified by First Wind biologists and contractors, bat roost and waterbird breeding activity will be provided to Grey Boar Wildlife Services. Trap locations and effort may be altered slightly so as to better protect bat roost and waterbird nests/broods.
- Due to reduced presence at Ukoa, and the need to check live traps every 48 hours, live traps will be discontinued.
- Given the high number of feral pigs remaining in fenced area, efforts will remain high to remove these animals. Game feeders and gate triggers will be used to help increase efficacy.
- Bait in the A-24s may be replaced with a custom made peanut butter or cat food/fish oil mix as the Goodnature Peanut Butter bait runs low.
- Cat Food will be used for all Coni-boxes and DOC-250s due to the results of the bait trial.
- Tracking tunnels will continue to be conducted on a monthly basis.

Grey Boar Wildlife Service will continue to maintain consistent communication with First Wind to ensure predator control efforts are consistent with Kawailoa Habitat Conservation Plan and sufficient to meet the goals of the waterbird and Hawaiian hoary bat protection efforts.

APPENDIX

All target species captures by trap type, sex, and age class:

Row Labels	CAT	Mongoose	Mouse	PIG	RAT	Grand Total
A-24		11	21		15	47
Female		9	9		6	24
ADULT		9	9		5	23
IMMATURE					1	1
Male		1	3		7	11
ADULT		1	3		6	10
IMMATURE					1	1
Unknown		1	9		2	12
ADULT		1	9		1	11
IMMATURE					1	1
Coni-Box	4	61			4	69
Female	2	33			2	37
ADULT	1	31			2	34
IMMATURE	1					1
JUV		2				2
Male	2	25			2	29
ADULT	1	24			2	27
IMMATURE	1					1
JUV		1				1
Unknown		3				3
ADULT		3				3
Corral Trap				28		28
Female				12		12
ADULT				3		3
IMMATURE				7		7
JUV				2		2
Male				16		16
ADULT				4		4

IMMATURE				10		10
JUV				2		2
DOC-250		121			11	132
Female		74			3	77
ADULT		63			3	66
JUV		11				11
Male		41			6	47
ADULT		37			6	43
JUV		4				4
Unknown		6			2	8
ADULT		6			2	8
Live Trap	10	31				41
Female	5	15				20
ADULT	3	8				11
JUV	2	7				9
Male	4	15				19
ADULT	3	13				16
JUV	1	2				3
Unknown	1	1				2
ADULT	1	1				2
Pig Box Trap				23		23
Female				11		11
ADULT				2		2
IMMATURE				9		9
Male				12		12
ADULT				5		5
IMMATURE				7		7
Grand Total	**14**	**224**	**21**	**51**	**30**	**340**

Note: 1 cat was opportunistically shot with a pellet gun near a trap during the trap-out period. This animal is counted towards the total count (341), however is not in this table by trap-type.

Appendix 8.

Appendix 11. June 2014 insect trapping results at Ukoa Wetland.

		size range (mm)	3-4.4	4.6-5.8	6.4-8.6	5.6-6.2	7.4-8.9	9.5-11.8	6.4-8.6	4.9-5	6.4-6.7	4.6-5.6	4-4	3.7-4.4	3.7-3.7	4.3-4.3	3.6-3.6	3.8-3.8	6.1-6.1	15.5-19.5	9.8-11.1	6.8-8.9	11.5-14.9	7.4-10.1	12.3-12.3	10.4-10.8	13-13	4.6-4.6	6.7-6.7	8.1-11.1	5-6.4	10.8-10.8	7-7	7.7-7.7	9-9	4-4.9	5.6-5.6	3.7-4.1	4.7-5.3	4.7-6.5
			Lepidoptera	Lepidoptera	Lepidoptera	Lepidoptera	Lepidoptera	Lepidoptera	Lepidoptera	Lepidoptera	Lepidoptera	Diptera	Diptera	Diptera	Diptera	Diptera	Diptera	Diptera	Diptera	Blattaria	Blattaria	Blattaria	Orthoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Coleoptera	Isoptera	Diptera	Hemiptera	Hemiptera	Hemiptera	Hemiptera	Hymenoptera	Hymenoptera
sample	time	date	Gelechioidea	Tortricidae (small)	Tortricidae (large)	Opogona (small)	Opogona (large)	Geometridae: Macaria abydata	Crambidae	long palpi	Pterophoridae	Limoniidae: Styringomyia	Limoniidae: Dicranomyia	Limoniidae:Erioptera	Chironomidae	Dolichopodidae: Chrysosoma globiferum	Drosophilidae	Lauxaniidae	Muscidae: Lispocephala (native)	Blaberidae: Pycnoscelus indicus	Blatellidae: Balta notulata	Blatellidae: Blatella	Gryllidae	Cerambycidae: dark brown, mottled	Cerambycidae: light brown	Bostrichidae male	Bostrichidae female	Bruchidae	Curculionidae	Elateridae	Nitidulidae	Scarabaeidae	Kalotermitidae: Incisitermes immigrans	Syrphidae: Volucella	Cicadellidae	Flatidae	Lygaeidae: Remaudiereana	Membracidae	Formicidae: other alate	Ichneumonidae
Wet In	night	Jun-14	66	9	4	4	1		3	2		8	4		1	1				2	2	1	1	1											1	1					1
Wet Out	night	Jun-14	140		3	2			2		4	10	4	4	1				1	1	3	3	3	8				1			1	1	1		1	2	2		3	
Up 10	night	Jun-14	64	8	2		1		1			2				2	1	1		11		3		1		1					3		1			6		2		1
Up DOT	night	Jun-14	52	4		1		2	1			2	1							3		1		4	1	2	1		1	2						3				7

Appendix 12. Expenditures at KAW in FY 2014.

Category	Amount ($)
HCP Labor	481,204
Fatality Monitoring	56,106
Permit Compliance	5,283
Non-Bat Mitigation	278,636
Equipment and Supplies	53,918
Bat Mitigation	606,199
Travel	2,000
Total	1,483,346