Kaheawa Pastures Wind Energy Generation Facility

Habitat Conservation Plan

FY-2012 Annual Report: Year 7 HCP Implementation

State of Hawaii ITL No. ITL-08 and USFWS ITP No. TE118901-0

Prepared by

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KAHEAWA PASTURES WIND ENERGY GENERATION FACILITY
HABITAT CONSERVATION PLAN

YEAR 7 HCP IMPLEMENTATION
July 1, 2012 – June 30, 2013

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I. EXECUTIVE SUMMARY

In June 2006 Kaheawa Wind Power, LLC (KWP) began operating the island of Maui's first commercial wind energy generation facility in the Kaheawa Pastures area of West Maui. The State Board of Land and Natural Resources approved a Conservation District Use Application (CDUA) for the proposed facility, which is situated on State conservation lands, in January 2003. Pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, and under a similar program, Chapter 195-D, Hawai`i Revised Statutes, KWP developed a project-specific Habitat Conservation Plan (HCP) in cooperation with the USFWS, DLNR and the Hawai`i Endangered Species Recovery Committee (ESRC). Upon final approval of the HCP, the federal ITP (TE-118901-0) and state ITL (ITL-08) were issued in January 2006. The ITP and ITL were amended in April 2012 to reflect a reduction in the authorized take for Hawaiian petrels and Newell's shearwaters. The USFWS issued a separate ITP (TE72434A-0) while the DLNR amendment does not change reference to ITL-08. Both amended permits authorize the incidental take of 38 Hawaiian petrels and 8 Newell's shearwaters for the 20 year duration commencing at the time of original permit issuance. This report summarizes how KWP has implemented the provisions of the HCP during the seventh full year of project operations (July 1, 2012 through June 30, 2013), as specified under the HCP.

Direct take of four Nene, two Hawaiian Hoary Bats, and one Hawaiian Petrel were documented at KWP during Year 7. Incorporating the results of monitoring, Searcher Efficiency (SEEF), Carcass Removal (CARE), and Indirect Take, adjusted take for Nene is estimated to be between 6.18 – 9.62 during Year 7. Similar adjustments were used to estimate take of 1.54 – 1.75 Hawaiian Petrels, and 5.44 – 8.85 Hawaiian hoary bats in Year 7. No take of Newell's Shearwater have been documented. The latest fatality estimates indicate that the running average take for bats exceeds 1/yr, which triggers adaptive management as noted on page 73 of the HCP (Special Condition 7). No specific adaptive management measures are prescribed in the HCP at this level of take (within Baseline but currently exceeding a running average of 1/yr). KWP is recommending the use of search dogs to improve searcher efficiency and thus obtain better estimates of take.

In Year 6 the final mitigation plan for petrels and shearwaters at Makamaka'ole in West Maui was approved by DOFAW, USFWS and ESRC. Two sites were selected to install predator-resistant fences where social attraction would be used to attract birds to nest in artificial burrows. Enclosure A was completed in Year 7, with construction on Enclosure B beginning in early Year 8. Mitigation planning for seabirds is ongoing and includes contingency field studies and monitoring at other locations on Maui.

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.

8/2/2013

Mitchell Craig
Hawaii HCP Manager
First Wind Energy, LLC

II. INTRODUCTION

In June 2006 Kaheawa Wind Power, LLC (KWP) began operating the island of Maui's first commercial wind energy generation facility in the Kaheawa Pastures area of West Maui. The State Board of Land and Natural Resources approved a Conservation District Use Application (CDUA) for the proposed facility, which is situated on State conservation lands, in January 2003. One condition of the CDUA was a requirement to "comply with the Incidental Taking Permit requirements of the U.S. Fish and Wildlife Service, including the preparation of the Habitat Conservation Plan."

Pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, the U. S. Fish and Wildlife Service (USFWS) may permit, under certain terms and conditions, the "taking" of a listed species that is incidental to, and not the purpose of, an otherwise lawful activity. To qualify for a federal Incidental Take Permit (ITP) an applicant must develop, fund, and implement a USFWS-approved Habitat Conservation Plan (HCP) to minimize and mitigate the effects of the incidental take. Under a similar program, Chapter 195-D, Hawai`i Revised Statutes authorizes the Hawai`i Department of Land and Natural Resources (DLNR) to issue an Incidental Take License (ITL).

In fulfillment of this condition, KWP developed a project-specific HCP in cooperation with the USFWS, DLNR and the Hawai`i Endangered Species Recovery Committee (ESRC). Upon final approval of the HCP, the federal ITP (TE-118901-0) and state ITL (ITL-08) were issued in January 2006, each with a duration of twenty (20) years. Commercial operation of the project commenced in June 2006.

As described in Section VI of the HCP, KWP will provide annual monitoring and reporting on project activities. As specified in the federal permit, reporting will include a summary and discussion of incidental take, including "adjusted take calculations pursuant to Section V of the HCP; results of searcher efficiency and carcass removal trials; results and discussion of seabird colony searches and management activities; results of Nene nest surveys and protocols; vegetation monitoring of affected plant critical habitat areas; an overall summary of management activities; circumstances that triggered adaptive management and how the adaptive management was implemented; description of all occurrences of changed circumstances and how they were addressed; description of any unforeseen circumstances; progress made in achieving biological goals and objectives; any problems that occurred and how they were handled; description of cost expenditures and other information related to funding assurances; an annual work plan including an implementation schedule and entities responsible for implementation; and any other pertinent information such as actions taken by any State or Federal agencies related to implementation of the HCP.

This report summarizes how KWP has implemented the provisions of the HCP during the seventh year of project operations (July 1, 2012 through June 30, 2013). Year 7 activities have continued to include

measures to monitor and minimize the risks of adverse effects (i.e., take) on the four listed species, and mitigate for take to accomplish a net ecological benefit for each covered species.

Table 1 (below) provides a summary of the provisions contained in the HCP that ensure compliance under the terms of the ITL, ITP, and Implementing Agreement (IA), including impact avoidance, minimization, monitoring, mitigation measures, funding assurance, and reporting.

Table 1. HCP-prescribed timeline and current status of prescribed wildlife monitoring and mitigation initiatives at the end of Year 7, Kaheawa Wind Power HCP.

Compliance Measure	Timeline per HCP	Year 7 Status
WEOP Implementation [1, 2, 3, 4]	Life of Project	Ongoing
Downed Wildlife Surveys [3, 4]	Life of Project	Ongoing
Searcher Efficiency Studies [3, 4]	Years 1-2	Ongoing
Carcass Removal Trials [3, 4]	Years 1-2	Ongoing
Nene Interaction Surveys [3, 4]	Year 1	Completed June, 2007
Funding for Nene Release Pen [5]	Permit Issuance	Completed January, 2008
5-years of Annual Funding for Nene Gosling Production or Translocation [5]	Years 1-5	Completed February, 2011
Nene Contingency Fund [5]	Permit Issuance	Initiated January, 2006
Seabird Colony Searches and Mitigation [5]	Years 1-2 then implement management measures	In-progress
On-Site Seabird Radar Surveys [3, 4]	Year 1	Completed in Year 1
Seabird Contingency Fund [5]	Permit Issuance	Initiated January, 2006
On-Site Bat Surveys [3, 4]	Year 1	Completed in Year 1
Hoary Bat Research Fund [5]	Permit Issuance	Completed June, 2006
Hoary Bat Contingency Fund [5]	Permit Issuance	Initiated January, 2006
1 = impact minimization, 2 = impact avoidance, 3 = monitoring, 4 = documentation and reporting, 5 = mitigation		

III. AVIAN AND BAT FATALITY MONITORING

Monitoring Surveys to Document Downed Wildlife

KWP biologists have been implementing a year-round monitoring program to document downed (i.e., injured or dead) wildlife incidents involving HCP-listed and non-listed species on the project site and its vicinity since operations began in June, 2006.

Since systematic intensive surveys began in June, 2006, foot searches by trained monitoring personnel as prescribed in the HCP have been the standard method used to conduct surveys for downed wildlife around the 20 wind turbines at KWP. In addition, three meteorological (met) towers are surveyed in a circular pattern roughly 10 meters beyond their anchor points. Downed wildlife monitoring in Year 7 consisted of systematic searches of all 20 WTG search plots and three met towers search plots on a weekly basis in an attempt to maintain an average search interval of 7 days. The average search interval across all twenty turbines was 7.69 days. The average search interval was higher due to periods of high winds. No searching is conducted when winds are higher than 15 meters per second (m/s) for safety of personnel. There were two periods of extended high winds that prevented routine searchesduring Year 7, from 12/11/12 to 12/25/12 and 2/14/13 to 2/24/13. Other periods of high winds occurred but did not last more than five days.

Searchers fill out a daily search report with the date, time, temp, and other plot characteristics. The form is completed as searching occurs and is given to the Senior Wildlife Technician for entry into the master excel file. The information is then entered into the Excel file and then QA/QC'd internally.

Searcher Efficiency Studies

Searcher efficiency studies (SEEF) provide estimates of carcass detection probability and are an important component of downed wildlife monitoring at KWP. SEEF trials are controlled by a proctor and conducted in conjunction with the daily search plan. Searchers are not informed in advance that a trial is being conducted.

In Year 7 there were 29 SEEF trials performed at KWP using carcasses of large birds (CAGO N=8), medium-sized seabirds (WTSH, N=4), and small mammals (DOMO/NORA, N=17) (Appendix 2). The Figure below shows the overall SEEF percentages for all ground cover types. In general there is a steady decline in detection rates from bare ground to shrub. Results for large sized birds appear to have a lower detection rate than medium sized birds due to 50% of the large trials occurring in shrub, where detection is much less than trials conducted on bare ground.

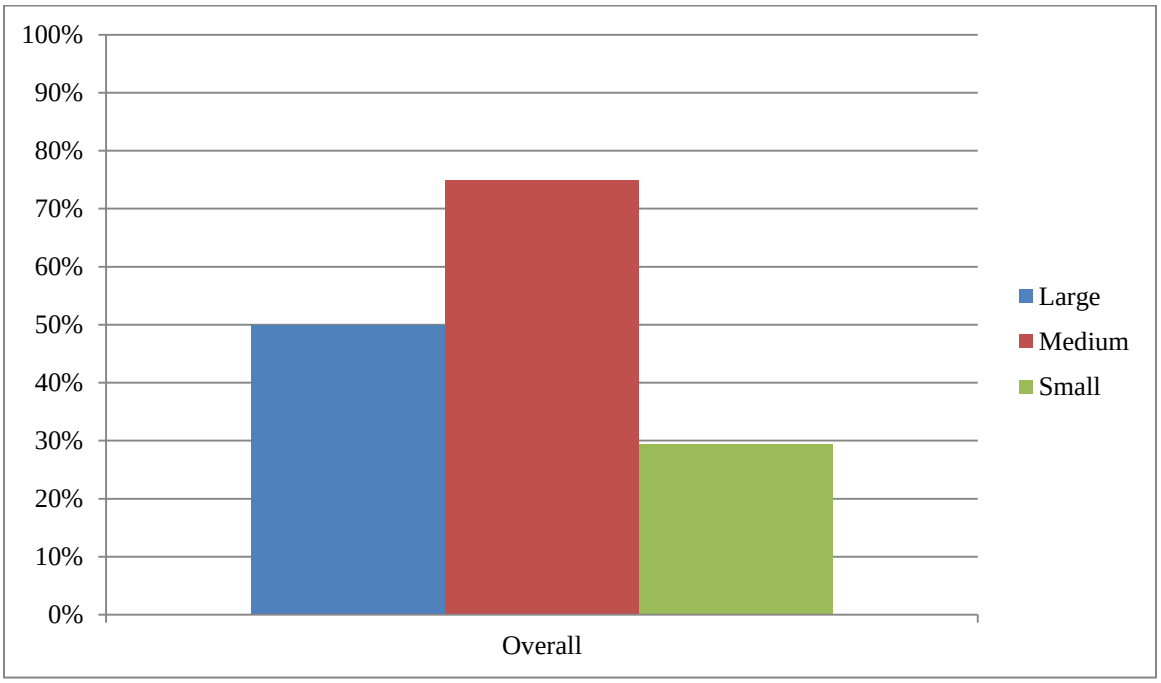

Figure 1. Overall SEEF Success

During Year 7, the size of small carcasses change after the bats takes experienced in April. It was found that the previous surrogates used were much smaller than the actual bat carcass. Rats came from Layne Laboratories, Inc. in California, a pet food company. We specifically request rats from Layne Labs that are brown and/or black and the small size category (up to 40 grams in mass and 4.5 inches in length) to approximate the body size and weight of Hawaiian Hoary Bats (Figure 3).

Figure 2. Small surrogate in relation to an actual bat take

Carcass Removal Trials

Trials to estimate the average time an avian or bat carcass remains detectable to searchers before being removed by scavengers or otherwise rendered undetectable (carcass persistence or CARE) were performed in Year 7 using eight small mammals (domestic mouse/rat), eight Lesser Canada Geese, and five Wedge-tailed shearwater carcasses as surrogates for bats, nene and seabirds, respectively. The length of time that carcasses remained visible to monitors was determined for each carcass used in the trial and is expressed in days. To estimate carcass persistence time, carcasses are checked every day with the exception of weekends. Trials lasted between 24 and 28 days (Appendix 3). On each day the carcass was checked the status and condition of carcasses are assessed based on presence/absence, evidence of scavenging and/or decomposition, change in the location, and overall condition of the carcass. Mean carcass persistence time was calculated for each carcass size class by summing the retention time for each carcass and dividing by the total number of carcasses used in the trial (Table 2).

Table 2. Carcass persistence times (in days) for trials conducted at KWP I in all years using small, medium, and large carcass surrogates.

KWP I	**Large**		**Medium**		**Small**	
	Average Retention Time (days)	Range (days)	Average Retention Time (days)	Range (days)	Average Retention Time (days)	Range (days)
Previous years (4-6)	23.19	13-119	13.01	2-28	7.5	0-21
Year 7	26.375	24 – 28	25.6	24 – 28	12.88	19 – 28
All Years	24.7825	13 – 119	19.305	2 – 28	10.19	0 – 28

Results of the trials across years vary in time and by surrogate. In Year 5, KWP ran a trial using two Lesser Canada Goose (i.e., large) carcasses for 119 days. Remnants of both carcasses were still deemed "detectable" at the end of the trial indicating that large carcass surrogates used for Nene can persist far beyond the search interval. In Year 7, KWP began running trials out to 28 days in an effort to make trials more similar to those specified in the KWP II HCP. These longer trial times yielded much higher average retention times for each species.

Direct Observations of Incidental Take

Downed wildlife incidents documented at KWP during Year 7 are summarized in Table 2. Six of these incidents involved HCP-covered species – three Nene, two Hawaiian Hoary Bats, and one Hawaiian Petrel.

Incidents involving HCP covered species were reported verbally and/or via email to DOFAW and USFWS within 24 hours, and written reports detailing each incident were submitted to DOFAW and USFWS within 3-5 calendar days of discovery. In one instance (feathers found on 6/14/13) the written report was not filed until 2-3 weeks after discovery due to uncertainty of species identification. Positive identification of this specimen is still pending and it has not been included in the table below.

Table 3. Documented wildlife fatalities at KWP in Year 7.

Species	Date	Location (WTG)	Distance to turbine (m)	Type of detection
HCP Covered Species				
Hawaiian Petrel	07/12/12	10/11	18	Incidental
Nene	01/03/13	20	29	Routine
Nene	01/15/13	15	31	Routine
Nene	01/30/13	7	n/a	Routine
Nene	03/12/13	6	46	Routine
Hoary Bat	04/11/13	8	33	Routine
Hoary Bat	04/17/13	2	39	Routine
MBTA and Non-Covered Species				
Ring-necked Pheasant	08/23/12	1	1	Incidental
Japanese White-eye	10/11/12	11	64	Incidental
Unknown	01/22/13	6	24	Routine
Unknown	01/30/13	MET 2	17	Routine
Sooty Tern	02/06/13	MECO Substation	123	Incidental
Eurasian Skylark	03/07/13	15	43	Routine
White-tailed Tropicbird	04/15/13	1	29	Incidental
Wedge-tail Shearwater	04/17/13	1	51	Routine
Unknown	04/22/13	5	73	Routine
Myna	05/08/13	12	37	Routine

HCP Covered Species

Hawaiian Petrel

In July 2012, a Hawaiian Petrel fatality was discovered between WTG-10 and -11 during a weekly operational inspection by a member of the Operations team. The carcass was relatively fresh with few insects present, suggesting the fatality occurred within the preceding 48 hours. Wind speed data gathered on site for 48 hours prior to the fatality ranged between 4-14 m/s from the northeast. Given the proximity to WTG-10 it is likely the Petrel collided with this turbine.

Hoary Bat

Two Hoary bats were discovered during routine searches in April 2013. The first fatality was discovered near WTG-8 on the 11th of April. The second fatality, found on the 17th of April, was located near WTG-2. Over this two week period the winds ranged from just below 2 m/s to nearly 11 m/s. Both carcasses had insects present and signs of decomposition. The cause of death of these bats was likely due to collision with the nearest turbine. The last recorded Anabat pass near WTG-2 and WTG-8 both occurred nearly 7 months prior, on 9/27/12 and 10/12/12 respectively. These detectors were verified to be working before and after the fatality occurred.

Nene

All four Nene fatalities occurred in early 2013, three in January and one in March. The first fatality on January 3rd was discovered near WTG-20. The carcass was highly degraded and insects were present. The skull, an unidentifiable bone and scattered feathers were the only remnants. Based on comparison with previous CARE trials the carcass was likely greater than two weeks old. Given the location it is possible that collision with WTG-20 was the cause of death. The plot was searched last on 12/7/12 due to an extended period of high winds.

Less than 2 weeks later, on the 15th of January, a second fatality was discovered just south of WTG-15. Similar to the first fatality, all that remained were feathers and yellow band #506. However, a small amount of red flesh was found suggesting that this fatality occurred within the preceding seven days. Wind speeds for the week prior were high, with speeds upwards of 19 m/s. Since the carcass was not intact it was difficult to assert the cause of death, however the combination of high winds and proximity to WTG-15 indicates that collision with a turbine was the probable cause. The last search of WTG 15 occurred on 1/7/13, eight days prior.

On January 30th a third fatality was found near the pad of WTG-7. The carcass was dismembered and parts were scattered on the pad and slope of the pad. Insects were present in the open body cavity. The left leg had a metal band with the #4007. This individual was sighted in a WEOP five days earlier. Winds speeds were low (<8 m/s) between the final WEOP sighting of the individual and the discovery

of its death. Collision with WTG-7 is the suspected cause of death. The last search of WTG 7 occurred on 1/22/13, eight days prior.

Almost two months later, on March 12th, a fourth fatality was discovered near WTG-6. The carcass was intact and there were no visible signs of decomposition. It was banded with a yellow YS tag and last observed on January 15th 2013. YS was often observed with female #216 (orange) who was reported pregnant and later verified to have a nest on site. Wind speed data gathered for the week prior to the 12th reported speeds between 3-10 m/s. It was reported that the bird's left wing and neck were broken, thus impact with nearby turbines WTG-5 or -6 was likely the cause of death. The last search conducted on WTG 6 occurred on 3/6/13, six days prior.

Estimating the Adjusted Take of Covered Species

The Observed Direct Take (ODT) is a fundamental variable that is adjusted by applying results of SEEF, Carcass Removal (CARE) Trials, and search frequency to estimate the Total Direct Take, as described in Section V of the HCP. In Year 7, there were seven (7) occurrences of Observed Direct Take (ODT) of Covered Species documented at KWP. In each case the cause of death is assumed to be project-related based on eye-witness reports and the proximity of the remains to project structures.

As presented in Section V of the HCP, the components that go into estimating the Adjusted Take are, a) Observed Direct Take, b) Unobserved Direct Take, c) Indirect Take, and d) Loss of Productivity. The SEEF and CARE results are used to estimate the Unobserved Direct Take (UDT). To calculate adjusted estimates of the number of fatalities that may have occurred at KWP in Year 7, based on 4 ODT of Nene, 1 ODT of Hawaiian Petrel, and 2 ODT of Hawaiian Hoary Bat, we used an estimator, *m*, as proposed by Shoenfeld (2004) and Kerns and Kerlinger (2003) to estimate fatality rates using the formula:

$$m = \left(\frac{N * I * C}{k * t * p}\right)\left(\frac{e^{I/t} - 1 + p}{e^{I/t} - 1}\right)$$

where *I* (search interval), represents the number of days between plot searches, *N* is equal to the number of turbine search plots, *k* is the number of plots searched (in the case of KWP, *N* and *k* are the same value), *t* is the mean carcass retention time, *p* is used to represent the detection probability (searcher efficiency), $e^{I/t}$ is a logarithmic value, and *C* is the actual number of carcasses observed (ODT). As a comparison to the estimates provided by Shoenfeld (2004), an estimator proposed by Huso (2008) was also used to calculate take of covered species using the same adjustment variables for carcass retention, searcher detection efficiency, and search frequency.

Indirect take resulting from the loss of eggs or dependent young is taken into consideration on a species-specific basis and is dependent on the time of year in which the take occurs. Timing of each incident provides a basis for applying indirect take, while necropsy or examination reports are expected to provide information on cause of death, condition of the individual, gender, maturity, and reproductive status. The Nene incidents in January, 2013 were documented during the known breeding season for Nene on Maui which makes it plausible that the downed birds may have been actively breeding. The petrel take documented in July, 2012 coincided with the period when many breeders have nests already established with eggs present, thus is it assumed that Indirect Take is possible, if not likely.

Because they are resident at Kaheawa on a year-round basis, Nene may be taken at any time during the year at KWP. Seabirds are present in the vicinity of the project area only between April-November, corresponding with their breeding season, and therefore take is only expected to occur during these months (roughly 60% of the year). Table 4 and 5 (below) provides a summary of the variables used in the Shoenfeld (2004) and Huso (2008) mortality estimator for Nene, Hawaiian Petrels, and Hawaiian Hoary bats in Year 7.

Table 4. Variables used in Shoenfeld (2004) to estimate Total Direct Take of Nene and Hawaiian Petrels at Kaheawa Wind Power during Year 7.

Species	C	N	K	I	t	p	$e^{t/I}$	Indirect take	m	Year 7 Total Adjusted Take
Hawaiian Petrel	1	20	20	7.69	25.6	.75	1.35	0.50	1.257834	1.886751
Nene	4	20	20	7.69	26.375	.50	1.338	0.10	5.77768	6.355448
Hoary Bat	2	20	20	7.69	12.88	.30	2.028	N/A	5.442343	5.442343

Table 5. Equation values used in the Huso (2008) estimator of mortality to estimate the Total Direct Take of Hawaiian Petrel, Nene, and Hawaiian Hoary Bats at KWP in fiscal year 7.

Parameter	Hawaiian Petrel	Nene	Hoary Bat	$\hat{m}_{ij} = \frac{c_{ij}}{\hat{r}_{ij}\hat{p}_{ij}\hat{e}_{ij}}$
Observed Direct Take (c_{ij})	1	4	2	
Carcasses Retained through *I* (r_{ij})	0.86	0.87	0.75	

Carcass Detection Probability (p_{ij})	0.75	0.50	0.30	
Search Interval (*I*)	7.69	7.69	7.69	
Proportion of Plots Searched	1.0	1.0	1.0	
Effective Search Interval (e_{ij})	1.0	1.0	1.0	
m_{ij} =	**1.54**	**9.22**	**8.85**	
Total including Indirect Take	**2.31**	**10.142**	**8.85**	

The take estimates reported here are based on calculations using mortality estimators proposed by Shoenfeld (2004) and Huso (2008). The Huso (2008) estimator generates a higher take estimate than the estimator proposed by Shoenfeld (2004) which appears driven by greater sensitivity to searcher efficiency.

Evidence of Absence

Created by the U.S. Geological Survey in 2013, Evidence of Absence software is an estimation tool for estimating bird and bat mortality at wind energy facilities when zero or very few carcasses are found during search periods. These low numbers or absence of fatality may or may not produce evidence that few downed wildlife events occur, depending on the quality of the searches.
KWP had the opportunity to discuss this new tool with the agencies in June 2013. Tables resulting from the tool are located in Appendix 4. Using data from prior year's results for Nene, Hawaiian petrel (HAPE), and Hawaiian Hoary Bats (HOBA) are shown in the table below.

Table 6. Evidence of Absence

Species	Total Observed Direct Take + Unobserved Take	Loss of Productivity	Adaptive Management Threshold	Over the Adaptive Management Threshold?
Nene	16.968	0	Running average of 3/year; greater than 8 in one year	No
HAPE	6.091	1.61	Running average of 2/year; greater than 5 in one year	No
HOBA	8.49	0	Running average of 1/year; greater than 2 in one year	Yes

IV. MITIGATION INITIATIVES

Nene Mitigation

Mitigation for the take of Nene at the Baseline level consists of providing funding to DOFAW for the construction of a release pen, and to support propagation and release of 50 Nene. Construction of a new release pen for Nene on Maui was completed and according to reports from DOFAW, the first group of 10 birds was released on May 5, 2011. An additional 12 birds were released in early September, 2011 followed by another eight birds in April, 2012 totaling 30 birds released at the site. Payments in the amount of $264,000 were made to DOFAW from 2008-2011 in accordance with the HCP, thus fulfilling KWP's mitigation obligation for the Baseline level.

Seabird Mitigation at Makamaka'ole

Mitigation for the two seabird species (Hawaiian petrel and Newell's shearwater) is being implemented in conjunction with KWP II. The primary mitigation entails construction and management of two 4-5 acre predator-free fenced enclosures (one for each species), provisioned with artificial burrows and social attraction, at the Makamaka'ole site in West Maui Permits for the enclosures were obtained in late 2012/early 2013. Construction of Enclosure A (Newell's enclosure) began in early 2013 and was subsequently put on hold during the rainy season. Construction recommenced in April and Enclosure A was completed in late May (Figure 2).

Figure 3. Enclosure A at the Makamaka'ole Seabird Mitigation Site, West Maui, completed in May 2013.

Supplemental Seabird Mitigation Investigations

In accordance with the approved KWP II HCP, during the first 5 years following ITP issuance, First Wind will conduct surveys consisting of at least 14 survey nights, and no more than 20 nights, not

necessarily consecutive, for each site where access is granted and evidence suggests birds are present in sufficient numbers between the months of May-August.

First Wind biologists initiated these efforts at the Kahakuloa study area in June 2012 by trialing the use of state-of-the-art acoustic detection technology. The use of remote detection devices reduces disturbance of habitats and intrusion into potentially sensitive habitats, and has the added advantages of being able to record over extended periods without repeated helicopter visits, overnight camping, and human safety risks. Using these methods to evaluate the presence/absence and activity levels of remotely nesting species (birds and bats) has emerged in recent years and is currently being utilized by DOFAW at Limahuli Valley, Kauai and near Hookipa, Maui to study seabirds. For the 2013 season KWP will be using these remote detection devices combined with human observation. Past data has indicated where birds might be nesting, however, the State has severely limited access to key portions of the Kahakuloa study area. KWP has also obtained a permit from The Nature Conservancy and will begin conducting surveys on the East Maui Mountains as time and weather permit.

Hawaiian Hoary Bat

Baseline mitigation for the Hawaiian hoary bat includes providing $20,000 in support of research. In October 2006 DLNR indicated that the payment should be made to the state's Endangered Species Trust Fund. Payment was made, in full, by KWP in December 2006.

Hawaiian Hoary Bats continue to be monitored using Anabat acoustic detection and recording instruments. Since bat monitoring using acoustic sensors began in 2008, two stations have been set up at KWP I and maintained as reference stations (Detectors 10 and 19).

Summary data provided in Table 10 (below) include the total qualifying bat passes recorded for operating detectors in Year 7. Passes are defined as call sequences containing three or more distinct call pulses. Detection rates were calculated for each detector based on the number of bat passes and the number of nights during the deployment period in which the detectors were fully operational (also known as 'detector nights').

Table 7. Frequency of Hawaiian Hoary bat passes recorded by Anabat acoustic detectors at KWP I, July 2012-June 2013

Detector ID	Deployment Dates	Detector Nights	Passes	Total Detection Rate (passes/detector night)
10	7/1/2012-6/30/2013	169	2	0.01
19	7/1/2012-6/30/2013	236	0	0.00
22	7/1/2012-6/30/2013	246	4	0.02
23	7/1/2012-6/30/2013	59	0	0.00
24	7/1/2012-6/30/2013	124	0	0.00
26	7/1/2012-6/30/2013	222	11	0.05

Overall, 17 qualifying bat passes were documented within the monitoring area from July 1, 2012 through June 30, 2013. The majority of the documented passes (59%) were recorded during October 2012 at two anabat stations (detector ID 22 & 26; Table 7); consequently October also had the highest mean detection rate.

V. WILDLIFE EDUCATION AND OBSERVATION PROGRAM

Personnel Orientations and Incidental Reporting

The Wildlife Education and Observation Program (WEOP) orientations include verbal and visual descriptions of the covered species, an overview of requirements and guidelines for minimizing interactions and disturbance to wildlife, and instructions for reporting observations of wildlife. In addition, all staff and project personnel are issued two laminated fact sheets explaining the natural history of each HCP covered species along with detailed procedures for promptly reporting any downed wildlife events. Throughout the year, and especially during the Nene breeding season, regular staff updates by KWP biologists, at times in coordination with DLNR/DOFAW, enable KWP and contractor personnel to anticipate the likelihood of encountering Nene on the site. These measures enable project personnel to report their observations and exchange important information with wildlife staff in a timely and proactive manner. During Year 7, 53 individuals were provided WEOP orientations (Table 11).

Table 8. Dates and affiliations of individuals that were provided WEOP orientations at KWP during Year 7.

Date	Name	Affiliation
7/11/2012	[redacted]	GE
7/11/2012	[redacted]	GE
8/23/2012	[redacted]	Aloha International

9/7/2012	[redacted]	Ropeworks
9/7/2012	[redacted]	Ropeworks
9/7/2012	[redacted]	Ropeworks
9/7/2012	[redacted]	Outland
9/7/2012	[redacted]	Outland
9/10/2012	[redacted]	FW
9/24/2012	[redacted]	XP
10/25/2012	[redacted]	Ropeworks
10/29/2012	[redacted]r	Ropeworks
11/12/2012	[redacted]	GE
2/13/2013	[redacted]	GBI
2/13/2013	[redacted]	GBI
2/13/2013	[redacted]	GBI
2/13/2013	[redacted]	GBI
2/13/2013	[redacted]	GBI
3/4/2013	[redacted]	Altres
3/7/2013	[redacted]	VIF
3/7/2013	[redacted]	VIF
3/8/2013	[redacted]	First Wind
3/8/2013	[redacted]	First Wind
3/8/2013	[redacted]	First Wind
3/25/2013	[redacted]	GE
4/10/2013	[redacted]	Altres
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	USEA
4/19/2013	[redacted]	USAID
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	MECO
4/19/2013	[redacted]	USAID Indonesia
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN
4/19/2013	[redacted]	PLN

4/19/2013	[redacted]	USEA
4/19/2013	[redacted]	JD DTG
4/19/2013	[redacted]	DU-WATTS Electric
5/16/2013	[redacted]	Kokomo Drywall
5/16/2013	[redacted]	First Wind
5/16/2013	[redacted]	Simplex Grinnell
5/16/2013	[redacted]	Zari Consulting Group
5/20/2013	[redacted]	First Wind
5/20/2013	[redacted]	First Wind
5/20/2013	[redacted]	First Wind
6/7/2013	[redacted]	GE
6/24/2013	[redacted]	First Wind

A Wildlife Observation Logbook is posted on site and enables all staff and contract personnel to record the details of their observations of HCP and non-HCP covered wildlife. The logbook contains fields for entering data that include:

- Observer Name, Date and Time of observations
- Species and Number of Individuals
- Location
- Proximity to Wind Turbine(s) and other Structures
- Apparent Behavior
- Estimated Height Above Ground (in meters) if observed in flight
- Flight Direction
- Pertinent Comments
- Weather

The Logbook has proven an effective means of obtaining observations that might otherwise have not been possible relying on verbal communication alone. Observations recorded for KWP in the WEOP logbook during Year 7 are summarized in Appendix 5. The WEOP guidelines and protocols have significantly improved our ability to track and monitor the movements of Nene and other wildlife on site, even when environmental staff can not directly observe their presence.

VI. BOTANICAL RESOURCES

Minimizing and Managing Invasive Species

Several small outbreaks of fireweed occurred in Year 7, mostly in areas of disturbance, specifically near roadsides. Throughout Year 7, during period of low winds, areas behind the maintenance building and along the roadways were sprayed in an effort to control fireweed.

Per the Approved Vegetation Management Protocol associated with the Year 4 Annual Report, KWP manages ground cover at a stature that will improve monitoring efficiency without compromising soil stability and minimize impacts to native plants. Due to Nene nesting season vegetation management activities within the plots are currently managed between the months of May to October, while areas associated with the turbines pads are managed year round in accordance with the Fire Management Plan.

Treatment of the plot areas for the 2012 season began in July, beginning with the mowing of vegetation in areas where grass had grown to a height that inhibited searching efforts. By mid-September areas that were accessible with the CAT 299C track loader with mower attachment had been mowed at least once. Other areas around the site that were inaccessible with the mower or contained large amounts of native vegetation were treated using weed whackers and hand clippers. Additional areas consisting of invasive trees, mostly Ironwoods, were cut down using chain saws and treated with Garlon. Photos depicting before and after treatments with the mower are shown below (Figure 4&5).

Figure 4. Before Treatment with Mower

Figure 5. After Treatment with Mower

VII. ADAPTIVE MANAGEMENT

Adaptive management provisions are an inherent and necessary component of the HCP, providing a mechanism to make adjustments to mitigation and other project functions as new information derived from monitoring and reporting becomes available.

The latest fatality estimates indicate that the running average take for bats exceeds 1/yr, which triggers adaptive management as noted on page 73 of the HCP (Special Condition 7). No specific adaptive management measures are prescribed in the HCP at this level of take (within Baseline but currently exceeding a running average of 1/yr). KWP proposes increasing searcher efficiency, through the use of carcass detector dogs, in order to yield more accurate fatality estimates. Procurement and training of a dog is in progress and is expected to arrive and begin searching at KWP in FY 2014.

VIII. CHANGED OR UNFORESEEN CIRCUMSTANCES

There were no events or circumstances that would be considered changed or unforeseen circumstances during the Year 7 reporting period at the KWP site.

IX. FUNDING

A summary of HCP-related expenditures for Year 7 is contained in Appendix 6. This summary lists costs (including staff labor) that KWP has expended toward fulfilling the terms of the HCP in Year 7. Spending on seabird mitigation has exceeded the originally-budgeted amounts due to the costs associated with assessment and planning at the Makamaka`ole site. Spending has also significantly exceeded budgeted amounts for fatality monitoring and is expected to remain above budgeted levels in the coming year as intensive monitoring continues, and with the addition of State compliance proctoring of SEEF and CARE trials. The HCP anticipated that the rate of spending on monitoring would decrease markedly and level off after two years; however KWP has continued intensive monitoring without interruption since the project began operations (7+ years) at the request of USFWS and DOFAW.

X. CONCLUSION

The HCP provides for a wide range of avoidance, minimization, and mitigation measures intended to result in a net conservation benefit for the four covered species. KWP has continued to implement these measures in accordance with the HCP and the recommendations provided by DLNR, USFWS, and the ESRC through the seventh year of implementation. Several specific items have been presented that

point to accomplishments and challenges encountered during Year 7. Finding innovative solutions and building on what has been learned through seven years of successful monitoring will result in overall program improvement.

KWP anticipates implementing an MOU with DOFAW in Year 8 that will enable the agency to perform SEEF and CARE trial proctoring for compliance monitoring.

XI. LITERATURE CITED

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Appendix 1. Downed Wildlife Monitoring and Search Frequency Log

July, 2012

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2-Jul	2-Jul	2-Jul	2-Jul	2-Jul	2-Jul	3-Jul	3-Jul	3-Jul	3-Jul	3-Jul	3-Jul	3-Jul	3-Jul	3-Jul	3-Jul	5-Jul	5-Jul	5-Jul	5-Jul
9-Jul	9-Jul	9-Jul	9-Jul	9-Jul	9-Jul	10-Jul	10-Jul	10-Jul	10-Jul	10-Jul	11-Jul	11-Jul	11-Jul	11-Jul	11-Jul	12-Jul	12-Jul	12-Jul	12-Jul
16-Jul	16-Jul	16-Jul	16-Jul	16-Jul	16-Jul	17-Jul	17-Jul	17-Jul	17-Jul	17-Jul	18-Jul	18-Jul	18-Jul	18-Jul	18-Jul	19-Jul	19-Jul	19-Jul	19-Jul
23-Jul	23-Jul	23-Jul	23-Jul	23-Jul	23-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	26-Jul	26-Jul	26-Jul	26-Jul	26-Jul	27-Jul	27-Jul	27-Jul	27-Jul

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1-Aug	1-Aug	1-Aug	1-Aug	2-Aug	2-Aug	2-Aug	2-Aug	2-Aug	2-Aug	2-Aug	3-Aug	3-Aug	3-Aug	3-Aug	3-Aug	3-Aug	3-Aug	3-Aug	3-Aug
6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	7-Aug	7-Aug	7-Aug	7-Aug	7-Aug	8-Aug	8-Aug	8-Aug	8-Aug	8-Aug	9-Aug	9-Aug	9-Aug	9-Aug
13-Aug	13-Aug	13-Aug	13-Aug	13-Aug	13-Aug	14-Aug	14-Aug	14-Aug	14-Aug	14-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	16-Aug	16-Aug	16-Aug	16-Aug
20-Aug	20-Aug	20-Aug	20-Aug	20-Aug	20-Aug	21-Aug	21-Aug	21-Aug	21-Aug	21-Aug	22-Aug	22-Aug	22-Aug	22-Aug	22-Aug	23-Aug	23-Aug	23-Aug	23-Aug
28-Aug	28-Aug	28-Aug	28-Aug	28-Aug	28-Aug	29-Aug	29-Aug	29-Aug	29-Aug	29-Aug	30-Aug	30-Aug	30-Aug	30-Aug	30-Aug	27-Aug	27-Aug	27-Aug	27-Aug

September, 2012

WTG Search Plot																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4-Sep	4-Sep	4-Sep	4-Sep	4-Sep	4-Sep	6-Sep	6-Sep	6-Sep	6-Sep	6-Sep	5-Sep	5-Sep	5-Sep	5-Sep	5-Sep	7-Sep	7-Sep	7-Sep	7-Sep
10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	12-Sep	12-Sep	12-Sep	12-Sep	12-Sep	13-Sep	13-Sep	13-Sep	13-Sep	13-Sep	13-Sep	13-Sep	13-Sep	13-Sep
18-Sep	18-Sep	18-Sep	18-Sep	18-Sep	18-Sep	19-Sep	19-Sep	19-Sep	19-Sep	19-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	21-Sep	21-Sep	21-Sep	21-Sep
25-Sep	25-Sep	25-Sep	25-Sep	25-Sep	25-Sep	26-Sep	26-Sep	26-Sep	26-Sep	26-Sep	27-Sep	27-Sep	27-Sep	27-Sep	27-Sep	28-Sep	28-Sep	28-Sep	28-Sep

October, 2012

WTG Search Plot																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	2-Oct	2-Oct	2-Oct	2-Oct	2-Oct	2-Oct	2-Oct	3-Oct	3-Oct	3-Oct	3-Oct
9-Oct	9-Oct	9-Oct	9-Oct	9-Oct	9-Oct	9-Oct	9-Oct	9-Oct	10-Oct	10-Oct	10-Oct	10-Oct	10-Oct	10-Oct	10-Oct	12-Oct	12-Oct	12-Oct	12-Oct
22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	24-Oct	25-Oct	25-Oct	25-Oct	25-Oct
29-Oct	29-Oct	29-Oct	29-Oct	29-Oct	29-Oct	29-Oct	29-Oct	29-Oct	30-Oct	30-Oct	30-Oct	30-Oct	30-Oct	30-Oct	31-Oct	31-Oct	31-Oct	31-Oct	31-Oct

November, 2012

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
7-Nov	7-Nov	7-Nov	7-Nov	7-Nov	7-Nov	7-Nov	7-Nov	7-Nov	6-Nov	6-Nov	6-Nov	6-Nov	6-Nov	6-Nov	11-Nov	11-Nov	11-Nov	11-Nov	11-Nov
11-Nov	11-Nov	11-Nov	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	12-Nov	12-Nov	12-Nov	12-Nov	12-Nov
13-Nov	13-Nov	13-Nov	15-Nov	15-Nov	15-Nov	15-Nov	20-Nov	20-Nov	20-Nov	20-Nov	20-Nov	20-Nov	20-Nov	21-Nov	20-Nov	21-Nov	21-Nov	21-Nov	21-Nov
27-Nov	27-Nov	27-Nov	28-Nov	28-Nov	28-Nov	28-Nov	28-Nov	28-Nov	29-Nov	29-Nov	29-Nov	29-Nov	29-Nov	29-Nov	30-Nov	30-Nov	30-Nov	30-Nov	30-Nov
Note: High Winds occurred from Nov 7-Nov 10, Nov 16-19, Nov 22-26 affecting search interval averages																			

December, 2012

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3-Dec	3-Dec	3-Dec	3-Dec	5-Dec	5-Dec	5-Dec	5-Dec	5-Dec	5-Dec	5-Dec	5-Dec	7-Dec	7-Dec	7-Dec	7-Dec	7-Dec	7-Dec	7-Dec	7-Dec
10-Dec	10-Dec	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW
HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	18-Dec	18-Dec	18-Dec	18-Dec	HW
HW	HW	HW	27-Dec	27-Dec	27-Dec	27-Dec	27-Dec	27-Dec	27-Dec	27-Dec	28-Dec	28-Dec	28-Dec	28-Dec	28-Dec	28-Dec	HW	HW	HW
31-Dec	31-Dec	31-Dec																	
Note: High Winds occurred from Dec. 11-17 and Dec. 19-26 affecting search interval averages																			

January, 2013

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
HW	HW	HW	3-Jan	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	1/3	1/3	1/3	1/3	1/3
9-Jan	9-Jan	9-Jan	9-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	7-Jan	10-Jan	10-Jan	10-Jan	10-Jan	10-Jan
	10-Jan	10-Jan		9-Jan	9-Jan	9-Jan	9-Jan	9-Jan											
14-Jan	14-Jan	14-Jan	14-Jan	14-Jan	14-Jan	14-Jan	15-Jan	15-Jan	15-Jan	15-Jan	15-Jan	15-Jan	15-Jan	15-Jan	17-Jan	17-Jan	17-Jan	17-Jan	17-Jan
22-Jan	22-Jan	22-Jan	25-Jan	22-Jan	22-Jan	22-Jan	22-Jan	23-Jan	23-Jan	23-Jan	23-Jan	23-Jan	23-Jan	25-Jan	25-Jan	25-Jan	25-Jan	25-Jan	25-Jan
30-Jan	30-Jan	30-Jan	30-Jan	30-Jan	30-Jan	30-Jan	30-Jan	31-Jan	31-Jan	31-Jan	31-Jan	31-Jan							
Note: High Winds occurred Jan. 1,2 and Jan. 4-8 affecting search interval averages																			

February, 2013

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
													1-Feb	1-Feb	1-Feb	1-Feb	HW	HW	HW
8-Feb	8-Feb	8-Feb	5-Feb	5-Feb	5-Feb	5-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb	6-Feb
13-Feb	13-Feb	13-Feb	11-Feb	11-Feb	11-Feb	11-Feb	11-Feb	11-Feb	11-Feb	11-Feb	11-Feb	12-Feb	12-Feb	12-Feb	12-Feb	12-Feb	12-Feb	13-Feb	13-Feb
HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW	HW
25-Feb	25-Feb	25-Feb	HW	HW	HW	HW	HW	HW	HW	HW	25-Feb	25-Feb	25-Feb	27-Feb	27-Feb	27-Feb	27-Feb	HW	HW
Note: High Winds occurred Feb. 14-24 affecting search interval averages																			

March, 2013

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
8-Mar	8-Mar	8-Mar	8-Mar	8-Mar	6-Mar	6-Mar	6-Mar	6-Mar	6-Mar	6-Mar	6-Mar	7-Mar	7-Mar	7-Mar	7-Mar	7-Mar	7-Mar	7-Mar	5-Mar
12-Mar	13-Mar	13-Mar	12-Mar	12-Mar	13-Mar	13-Mar	13-Mar	11-Mar	11-Mar	11-Mar	11-Mar	12-Mar	11-Mar	11-Mar	12-Mar	12-Mar	12-Mar	11-Mar	11-Mar
20-Mar	20-Mar	21-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	19-Mar	20-Mar	20-Mar	20-Mar
28-Mar	28-Mar	28-Mar	27-Mar	27-Mar	27-Mar	26-Mar	26-Mar	26-Mar	26-Mar	26-Mar	26-Mar	26-Mar	27-Mar	27-Mar	27-Mar	27-Mar	27-Mar	27-Mar	27-Mar

April, 2013

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4-Apr	4-Apr	4-Apr	2-Apr	2-Apr	3-Apr	2-Apr	3-Apr	5-Apr	3-Apr	2-Apr	2-Apr	2-Apr	3-Apr	3-Apr	3-Apr	3-Apr	3-Apr	3-Apr	3-Apr
10-Apr	10-Apr	10-Apr	11-Apr	11-Apr	11-Apr	11-Apr	11-Apr	9-Apr	9-Apr	9-Apr	10-Apr	9-Apr	9-Apr	9-Apr	9-Apr	10-Apr	10-Apr	10-Apr	10-Apr
17-Apr	17-Apr	18-Apr	18-Apr	18-Apr	18-Apr	18-Apr	15-Apr	15-Apr	16-Apr	16-Apr	16-Apr	16-Apr	16-Apr	16-Apr	18-Apr	16-Apr	17-Apr	17-Apr	17-Apr
24-Apr	25-Apr	25-Apr	22-Apr	22-Apr	22-Apr	22-Apr	23-Apr	23-Apr	23-Apr	23-Apr	23-Apr	22-Apr	22-Apr	22-Apr	22-Apr	23-Apr	23-Apr	25-Apr	25-Apr
30-Apr	30-Apr	30-Apr	29-Apr	29-Apr	29-Apr	29-Apr	29-Apr	29-Apr	30-Apr	30-Apr	30-Apr	29-Apr	29-Apr	29-Apr	29-Apr	30-Apr	30-Apr	30-Apr	

May, 2013

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
																			1-May
9-May	8-May	8-May	7-May	7-May	7-May	7-May	7-May	7-May	8-May	8-May	8-May	7-May	7-May	7-May	8-May	8-May	8-May	9-May	9-May
16-May	17-May	17-May	15-May	15-May	15-May	15-Jul	15-May	16-May	16-May	16-May	16-May	14-May	14-May	14-May	15-May	15-May	16-May	16-May	16-May
21-May	22-May	22-May	20-May	20-May	20-May	20-May	20-May	21-May	21-May	21-May	21-May	20-May	20-May	20-May	21-May	21-May	21-May	22-May	22-May
29-May	29-May	31-May	30-May	30-May	30-May	30-May	30-May	30-May	29-May	29-May	29-May	29-May	29-May	29-May	30-May	30-May	31-May	31-May	31-May

June, 2013

WTG Search Plot																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11-Jun	11-Jun	11-Jun	4-Jun	4-Jun	4-Jun	4-Jun	5-Jun	5-Jun	10-Jun	11-Jun	3-Jun	3-Jun	4-Jun	4-Jun	4-Jun	11-Jun	11-Jun	11-Jun	14-Jun
12-Jun	12-Jun	13-Jun	14-Jun	13-Jun	13-Jun	13-Jun	13-Jun	13-Jun	13-Jun	13-Jun	11-Jun	14-Jun	13-Jun	13-Jun	13-Jun	14-Jun	14-Jun	14-Jun	17-Jun
20-Jun	20-Jun	20-Jun	17-Jun	17-Jun	17-Jun	18-Jun	18-Jun	18-Jun	19-Jun	19-Jun	19-Jun	17-Jun	17-Jun	18-Jun	13-Jun	18-Jun	18-Jun	19-Jun	19-Jun
27-Jun	27-Jun	26-Jun	24-Jun	24-Jun	24-Jun	24-Jun	25-Jun	25-Jun	25-Jun	25-Jun	26-Jun	24-Jun	24-Jun	24-Jun	24-Jun	25-Jun	25-Jun	26-Jun	26-Jun
Note: High Winds occurred June 5-10, affecting search interval averages																			

Appendix 2. Searcher Efficiency

WTG	TERRAIN	FOUND?	DROP DAY	DROP DATE	SEARCH DAY	SEARCH DATE	Size
19		Missing	Wednesday	8/15/2012	Thursday	8/16/2012	Medium
19	Shrub	Y	Wednesday	8/15/2012	Thursday	8/16/2012	Medium
14	Grass	Y	Tuesday	8/21/2012	Wednesday	8/22/2012	Medium
14	Shrub	Y	Tuesday	8/21/2012	Wednesday	8/22/2012	Large
7		Missing	Tuesday	9/4/2012	Thursday	9/6/2012	Small
9	Shrub	Y	Tuesday	9/4/2012	Thursday	9/6/2012	Medium
9	Grass	N	Tuesday	9/4/2012	Thursday	9/6/2012	Small
1	Shrub	N	Tuesday	9/18/2012	Tuesday	9/18/2012	Large
1	Shrub	N	Tuesday	9/18/2012	Tuesday	9/18/2012	Medium
2	Shrub	N	Tuesday	9/18/2012	Tuesday	9/18/2012	Large
2	Shrub	N	Tuesday	9/18/2012	Tuesday	9/18/2012	Large
13	Bare	Y	Thursday	9/20/2012	Thursday	9/20/2012	Large
13	Grass	Y	Thursday	9/20/2012	Thursday	9/20/2012	Large
15	Shrub	N	Thursday	9/20/2012	Thursday	9/20/2012	Large
6	Grass	Y	Monday	3/18/2013	Tuesday	3/19/2013	Large
8	Bare	Y	Monday	3/18/2013	Tuesday	3/19/2013	Small
10	Shrub	Y	Monday	3/18/2013	Tuesday	3/19/2013	Large
12		Missing	Monday	3/18/2013	Tuesday	3/19/2013	Small
1	Bare	N	Wednesday	4/3/2013	Thursday	4/4/2013	Small
2	Bare	N	Wednesday	4/3/2013	Thursday	4/4/2013	Small
11		Missing	Monday	4/6/2013	Wednesday	4/7/2013	Small
11	Grass	Y	Wednesday	5/16/2013	Wednesday	5/16/2013	Small
17	Grass	N	Wednesday	5/16/2013	Wednesday	5/16/2013	Small
1	Shrub	Y	Tuesday	5/28/2013	Wednesday	5/29/2013	Small
2	Grass	N	Tuesday	5/28/2013	Wednesday	5/29/2013	Small
15	Shrub	N	Tuesday	5/28/2013	Wednesday	5/29/2013	Small
8	Bare	Y	Tuesday	5/28/2013	Wednesday	5/29/2013	Small
16	Shrub	N	Tuesday	6/4/2013	Tuesday	6/4/2013	Small
16	Shrub	Y	Tuesday	6/4/2013	Friday	6/14/2013	Small
5	Grass	N	Monday	6/24/2013	Monday	6/24/2013	Small
6	Grass	N	Monday	6/24/2013	Monday	6/24/2013	Small
10	Grass	N	Monday	6/24/2013	Tuesday	6/25/2013	Small
11	Bare	N	Monday	6/24/2013	Tuesday	6/25/2013	Small

Appendix 3. Carcass Removal

KWP I	1			2			3			4			5			6			7			8		
Carcass Type WTG	Large/CAGO 10			Large/CAGO 12			Large/CAGO 17			Large/CAGO 19			Large/CAGO 3			Large/CAGO 4			Large/CAGO 4			Large/CAGO 20		
Vegetation Type	Bare/Grass			Shrub/Grass			Bare/Grass			Shrub/Grass			Grass			Bare			Shrub			Shrub		
Proctor										AR			AR			AR			SE			SE		
	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	8/7		P	8/7		P	8/7		P	2/6		P	2/6		P	2/6		P	3/11		P	3/11	
day 1	P	8/8		P	8/8		P	8/8		P	2/7		P	2/7		P	2/7		P	3/12		P	3/12	
day 2	P	8/9		P	8/9		P	8/9		P	2/8		P	2/8	I	P	2/8	I	P	3/13	I	P	3/13	I
day 3	P	8/10		P	8/10	I	P	8/10	I		2/9	NC	P	2/9	NC		2/9	NC	P	3/14	I, L	P	3/14	I, L
day 4	P	8/11		P	8/11	I	P	8/11	I		2/10	NC	P	2/10	NC		2/10	NC	P	3/15	B, S	P	3/15	B, S
day 5	P	8/12		P	8/12	I	P	8/12	I	P	2/11	D	P	2/11	B, S	P	2/11	I		3/16	NC		3/16	NC
day 6	P	8/13		P	8/13	I	P	8/13	I	P	2/12	D	P	2/12	B, S	P	2/12	I		3/17	NC		3/17	NC
day 7	P	8/14	I	P	8/14	I	P	8/14	I	P	2/13	D	P	2/13	B, S	P	2/13	I	P	3/18	B, S	P	3/18	B, S
day 8	P	8/15	I	P	8/15	I	P	8/15	F, I	P	2/14	D	P	2/14	B, S	P	2/14	I	P	3/19	B, S	P	3/19	B, S
day 9	P	8/16	I	P	8/16	I	P	8/16	F, I	P	2/15	D	P	2/15	B, S	P	2/15	I	P	3/20	B, S	P	3/20	B, S
day 10	P	8/17	I	P	8/17	I	P	8/17	F, I		2/16	NC		2/16	NC		2/16	NC	P	3/21	B, S	P	3/21	B, S
day 11	P	8/18	F, I, L	P	8/18	I	P	8/18	F, I		2/17	NC		2/17	NC		2/17	NC	P	3/22	B, S	P	3/22	B, S
day 12	P	8/19	F, I, L	P	8/19	F, I, L	P	8/19	F, I		2/18	NC		2/18	NC		2/18	NC		3/23	NC		3/23	NC
day 13	P	8/20	F, I, L	P	8/20	F, I, L	P	8/20	F, I	P	2/19	D	P	2/19	B, S	P	2/19	I		3/24	NC		3/24	NC
day 14	P	8/21	F, I, L	P	8/21	F, I, L	P	8/21	F, I	P	2/20	D	P	2/20	B, S	P	2/20	I	P	3/25	B, S	P	3/25	B, S
day 15	P	8/22	F, I, L	P	8/22	F, I, L	P	8/22	F, I	P	2/21	D	P	2/21	B, S	P	2/21	I	P	3/26	B, S	P	3/26	B, S

day 16	P	8/23	F, I, L	P	8/23	F, I, L	P	8/23	F, I	P	2/22	D	P	2/22	B, S	P	2/22	I	P	3/27	B, S	P	3/27	B, S	
day 17	P	8/24	F, I, L	P	8/24	F, I, L	P	8/24	F, I	P	2/23	D	P	2/23	B, S	P	2/23	I	P	3/28	B, S	P	3/28	B, S	
day 18		8/25	NC		8/25	NC		8/25	NC	P	2/24	D	P	2/24	B, S	P	2/24	I	P	3/29	B, S	P	3/29	B, S	
day 19		8/26	NC		8/26	NC		8/26	NC	P	2/25	D	P	2/25	B, S	P	2/25	I		3/30	NC		3/30	NC	
day 20	P	8/27	F, I, L	P	8/27	F, I, L	P	8/27	F, I	P	2/26	D	P	2/26	B, S	P	2/26	I		3/31	NC		3/31	NC	
day 21	P	8/28	F, I, L	P	8/28	F, I, L	P	8/28	F, I, L	P	2/27	D	P	2/27	B, S	P	2/27	I	P	4/1	B, S	P	4/1	B, S	
day 22	P	8/29	F, I, L	P	8/29	F, I, L	P	8/29	F, I, L	P	2/28	D	P	2/28	B, S	P	2/28	I	P	4/2	B, S	P	4/2	B, S	
day 23	P	8/30	F, I, L	P	8/30	F, I, L	P	8/30	F, I, L		3/1	NC		3/1	NC		3/1	NC	P	4/3	B, S	P	4/3	B, S	
day 24	P	8/31	F, I, L	P	8/31	F, I, L	P	8/31	F, I, L		3/2	NC		3/2	NC		3/2	NC	P	4/4	B, S	P	4/4	B, S	
day 25											3/3	NC		3/3	NC		3/3	NC	P	4/5	B, S	P	4/5	B, S	
day 26											3/4	NC		3/4	NC		3/4	NC	P	4/6	B, S	P	4/6	B, S	
day 27										P	3/5	D	P	3/5	B, S	P	3/5	I	P	4/7	B, S	P	4/7	B, S	
day 28													P	3/6	B, S	P	3/6	I	P	4/8	B, S	P	4/8	B, S	
																								Average
Retention (days)	***24***			***24***			***24***			***27***			***28***			***28***			***28***			***28***		**26.38**

KWP I	1			2			3			4			5		
Carcass Type	Medium/WTSH			Medium/WTSH			Medium/WTSH			Medium/WTSH			Medium/WTSH		
WTG	8			14			20			20			14		
Vegetation Type	Grass			Grass			Bare/Grass			Shrub/Grass			Grass		
Proctor										AR			AR		
	P/A	date	Notes	P/A	date	Notes	P/A	date	Notes	P/A	date	Notes	P/A	date	Notes
day 0	P	8/7		P	8/7		P	8/7		P	2/6		P	2/6	
day 1	P	8/8		P	8/8		P	8/8		P	2/7		P	2/7	
day 2	P	8/9	D	P	8/9		P	8/9		P	2/8		P	2/8	I
day 3	P	8/10	D	P	8/10	A	A	8/10	M		2/9	NC		2/9	NC
day 4	P	8/11	D	P	8/11	A	A	8/11	M		2/10	NC		2/10	NC
day 5	P	8/12	D	P	8/12	A	A	8/12	M	P	2/11	D	P	2/11	I
day 6	P	8/13	D	P	8/13	A	A	8/13	M	P	2/12	D	P	2/12	I
day 7	P	8/14	D	P	8/14	A	A	8/14	M	P	2/13	D	P	2/13	I
day 8	P	8/15	D	P	8/15	A	A	8/15	M	P	2/14	D	P	2/14	I
day 9	P	8/16	D	P	8/16	A	P	8/16	B,S	P	2/15	D	P	2/15	I
day 10	P	8/17	D	P	8/17	A	P	8/17	B,S		2/16	NC	P	2/16	I
day 11	P	8/18	F, S	P	8/18	A	P	8/18	B,S		2/17	NC	P	2/17	I
day 12	P	8/19	F, S	P	8/19	A	P	8/19	B,S		2/18	NC	P	2/18	I
day 13	P	8/20	F, S	P	8/20	A	P	8/20	B,S	P	2/19	D	P	2/19	I
day 14	P	8/21	F, S	P	8/21	A	P	8/21	F, S	P	2/20	D	P	2/20	I
day 15	P	8/22	F, S	P	8/22	A	P	8/22	F, S	P	2/21	D	P	2/21	I
day 16	P	8/23	F, S	P	8/23	A	P	8/23	F, S	P	2/22	D	P	2/22	I
day 17	P	8/24	F, S	P	8/24	A	P	8/24	F, S	P	2/23	D	P	2/23	I

A	ants	H	hair loss
B	body feathers	I	Insects
C	dirt covered	L	fly larvae
D	desiccated	M	moved
F	feather dispersal	S	skeleton
P/A	Present/Absent	W	wing feathers
NC	Not checked		

day 18		8/25	NC		8/25	NC		8/25	NC	P	2/24	D	P	2/24	I	
day 19		8/26	NC		8/26	NC		8/26	NC	P	2/25	D	P	2/25	I	
day 20	P	8/27	F, S	P	8/27	A	P	8/27	F, S	P	2/26	D	P	2/26	I	
day 21	P	8/28	F, S	P	8/28	A	P	8/28	F, S	P	2/27	D	P	2/27	I	
day 22	P	8/29	F, S	P	8/29	A	P	8/29	F, S	P	2/28	D	P	2/28	I	
day 23	P	8/30	F, S	P	8/30	A	P	8/30	F, S		3/1	NC		3/1	NC	
day 24	P	8/31	F, S	P	8/31	A	P	8/31	F, S		3/2	NC		3/2	NC	
day 25											3/3	NC		3/3	NC	
day 26											3/4	NC		3/4	NC	
day 27										P	3/5	D	P	3/5	I	
day 28										P	3/6	D	P	3/6	I	
																Average
Retention (days)	***24***			***24***			***24***			***28***			***28***			**25.6**

KWP I	1			2			3			4			5			6			7			8		
Carcass Type	Small/NORA			Small/NORA			Small/NORA			Small/NORA			Small/NORA			Small/NORA			Small/DOMO			Small/DOMO		
WTG	3			6			10			13			15			18			7			17		
Vegetation Type	Shrub			Grass			Bare			Shrub			Grass			BARE			Bare			Grass		
Proctor	SE			SE			SE			SE			SE			SE			SE			SE		
	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	6/25	-	P	6/25	-	P	6/25	-	P	6/25		P	6/25		P	6/25	-	P	3/11		P	3/11	
day 1	P	6/26	A	P	6/26	-	P	6/26	-	P	6/26	A	P	6/26	A	P	6/26	-	P	3/12	I	P	3/12	I
day 2	P	6/27	A	P	6/27	-	P	6/27	-	P	6/27	A	P	6/27	A	P	6/27	-	P	3/13	I	P	3/13	I
day 3	P	6/28	A	P	6/28	-	P	6/28	-	P	6/28	A	P	6/28	A/S	P	6/28	-	P	3/14	I	P	3/14	I
day 4	P	6/29	NC	P	6/29	NC	P	6/29	NC	P	6/29	NC	P	6/29	NC	P	7/1	-	P	3/15	I	P	3/15	I
day 5	P	6/30	NC	P	6/30	NC	P	6/30	NC	P	6/30	NC	P	6/30	NC	P	7/2	M		3/16	NC		3/16	NC
day 6	P	7/1	A	P	7/1		P	7/1	-	P	7/1	A/S/M	P	7/1	H	P	7/3	NC		3/17	NC		3/17	NC
day 7	P	7/2	A	A	7/2		P	7/2	I	A	7/2	-	P	7/2	H	P	7/4	NC	P	3/18	I	P	3/18	I
day 8	P	7/3	NC				A	7/3	H				P	7/3	NC	p	7/5	S	P	3/19	I	P	3/19	I
day 9	P	7/4	NC										P	7/4	NC	P	7/6	NC	P	3/20	I	P	3/20	I
day 10	P	7/5	L										P	7/5	F	P	7/7	NC	P	3/21	I	P	3/21	I
day 11	P	7/6	NC										P	7/6	NC	P	7/8	M	P	3/22	I	P	3/22	I
day 12	P	7/7	NC										P	7/7	NC	A	7/9	-		3/23	NC		3/23	NC
day 13	P	7/8	L/S										P	7/8	H/A					3/24	NC		3/24	NC
day 14	A	7/9	-										A	7/9	-				P	3/25	I	P	3/25	I
day 15																			P	3/26	I	P	3/26	I
day 16																			P	3/27	I	P	3/27	I
day 17																			P	3/28	I	P	3/28	I

day 18																					P	3/29	I	P	3/29	I, L	
day 19																						3/30	NC		3/30	NC	
day 20																						3/31	NC		3/31	NC	
day 21																					A	4/1		P	4/1	I, L	
day 22																								P	4/2	I, L	
day 23																								P	4/3	I, L	
day 24																								P	4/4	I, L	
day 25																								P	4/5	I, L	
day 26																									4/6	NC	
day 27																									4/7	NC	
day 28																								P	4/8	I, L	
																											Average
Retention (days)		***13***			***6***			***7***			***6***			***13***			***11***			***19***			***28***		**12.88**

KWP I	1			2			3			4			5			6			7			8		
Carcass Type WTG	NORA 3			NORA 6			NORA 10			NORA 13			NORA 15			NORA 18			DOMO 7			DOMO 17		
Vegetation Type	Shrub			Grass			Bare			Shrub			Grass			BARE			Bare			Grass		
Proctor	SE			SE			SE			SE			SE			SE			SE			SE		
	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	6/25	-	P	6/25	-	P	6/25	-	P	6/25		P	6/25		P	6/25	-	P	3/11		P	3/11	
day 1	p	6/26	A	p	6/26	-	p	6/26	-	p	6/26	A	P	6/26	A	P	6/26	-	P	3/12	I	P	3/12	I
day 2	p	6/27	A	p	6/27	-	p	6/27	-	p	6/27	A	p	6/27	A	p	6/27	-	P	3/13	I	P	3/13	I
day 3	p	6/28	A	p	6/28	-	p	6/28	-	p	6/28	A	p	6/28	A/S	p	6/28	-	P	3/14	I	P	3/14	I
day 4	p	7/1	A	p	7/1	A	p	7/1	-	p	7/1	A/S/M	p	7/1	H	p	7/1	-	P	3/15	I	P	3/15	I
day 5	p	7/2	A	A	7/2		p	7/2	I	A	7/2	-	p	7/2	H	p	7/2	M		3/16	NC		3/16	NC
day 6	p	7/3	NC				A	7/3	H				p	7/3	NC	p	7/3	NC		3/17	NC		3/17	NC
day 7	p	7/4	NC										p	7/4	NC	p	7/4	NC	P	3/18	I	P	3/18	I
day 8	p	7/5	L										p	7/5	F	p	7/5	S	P	3/19	I	P	3/19	I
day 9	p	7/8	L/S										p	7/8	H/A	p	7/8	M	P	3/20	I	P	3/20	I
day 10	A	7/9	-										A	7/9	-	A	7/9	-	P	3/21	I	P	3/21	I
day 11																			P	3/22	I	P	3/22	I
day 12																				3/23	NC		3/23	NC
day 13																				3/24	NC		3/24	NC
day 14																			P	3/25	I	P	3/25	I
day 15																			P	3/26	I	P	3/26	I
day 16																			P	3/27	I	P	3/27	I
day 17																			P	3/28	I	P	3/28	I
day 18																			P	3/29	I	P	3/29	I, L

day 19							3/30 NC	3/30 NC	
day 20							3/31 NC	3/31 NC	
day 21							A 4/1	P 4/1 I, L	
day 22								P 4/2 I, L	
day 23								P 4/3 I, L	
day 24								P 4/4 I, L	
day 25								P 4/5 I, L	
day 26								4/6 NC	
day 27								4/7 NC	
day 28								P 4/8 I, L	
									Average
Retention (days)	***9***	***4***	***5***	***4***	***9***	***9***	***19***	***28***	**10.875**

Appendix 4. Calculations to Estimate Adjusted Take of Covered Species

Nene

Carcass Count (X)	14	Sampling Dates	Prior distribution		Posterior Distribution	
Sampling coverage (phi)	0.83	0	m	P(M = m)	Mean	16.969
searcher proficiency (f)	0.697	7.69	0	0.003905	P(observe|arrive)	0.828822
k	1	15.38	1	0.008597	95th percentile	20
Sampling dates	Formula	23.07	2	0.013313	m	P(M = m)
interval	7.69	30.76	3	0.017715	0	0
span	2554	38.45	4	0.021644	1	0
persistence distribution	Weibull	46.14	5	0.02503	2	0
a	14	53.83	6	0.027856	3	0
b	100	61.52	7	0.030134	4	0
arrival function	Uniform	69.21	8	0.031895	5	0
a	NA	76.9	9	0.03318	6	0
b	NA	84.59	10	0.034035	7	0
prior distribution	Negative Binomial	92.28	11	0.034508	8	0
a	2.4599	99.97	12	0.034646	9	0
b	0.1049	107.66	13	0.034494	10	0
		115.35	14	0.034096	11	0
		123.04	15	0.033489	12	0
		130.73	16	0.032711	13	0
		138.42	17	0.031795	14	0.064798
		146.11	18	0.030767	15	0.163421
		153.8	19	0.029656	16	0.218594
		161.49	20	0.028483	17	0.206094
		169.18	21	0.027267	18	0.153627
		176.87	22	0.026027	19	0.096321
		184.56	23	0.024775	20	0.052786
		192.25	24	0.023525	21	0.02595
		199.94	25	0.022287	22	0.01166
		207.63	26	0.021069	23	0.004855
		215.32	27	0.019879	24	0.001894

Hawaiian Petrel

Carcass Count (X)	4	Sampling Dates	Prior distribution		Posterior Distribution	
Sampling coverage (phi)	0.83	0	m	P(M = m)	Mean	6.091
searcher proficiency (f)	0.768	7.69	0	0.018194	P(observe|arrive)	0.699261
k	1	15.38	1	0.032631	95th percentile	9
Sampling dates	Formula	23.07	2	0.043137	m	P(M = m)
interval	7.69	30.76	3	0.050246	0	0
span	1683	38.45	4	0.05458	1	0
persistence distribution	Weibull	46.14	5	0.056713	2	0
a	1.926	53.83	6	0.057147	3	0
b	17.35174	61.52	7	0.056302	4	0.164711
arrival function	Uniform	69.21	8	0.054521	5	0.257357
a	NA	76.9	9	0.052082	6	0.23397
b	NA	84.59	10	0.049207	7	0.161754
prior distribution	Negative Binomial	92.28	11	0.046069	8	0.094214
a	2.1087	99.97	12	0.042802	9	0.04872
b	0.1495	107.66	13	0.039507	10	0.023072
		115.35	14	0.036262	11	0.010208
		123.04	15	0.03312	12	0.004278
		130.73	16	0.030121	13	0.001715

Hawaiian Hoary Bat

Carcass Count (X)	4	Sampling Dates	Prior distribution		Posterior Distribution	
Sampling coverage (phi)	0.9	0	m	P(M = m)	Mean	8.49
searcher proficiency (f)	0.42	7.69	0	0.050712	P(observe|arrive)	0.421754
k	1	15.38	1	0.085757	95th percentile	14
Sampling dates	Formula	23.07	2	0.103306	m	P(M = m)
interval	7.69	30.76	3	0.107696	0	0
span	1924	38.45	4	0.103541	1	0
persistence distribution	Weibull	46.14	5	0.094509	2	0
a	1.23126	53.83	6	0.083201	3	0
b	12.5849	61.52	7	0.071318	4	0.033095
arrival function	Uniform	69.21	8	0.059894	5	0.08734
a	NA	76.9	9	0.04949	6	0.133383
b	NA	84.59	10	0.040359	7	0.154264
prior distribution	Negative Binomial	92.28	11	0.032555	8	0.149826
a	2.3546	99.97	12	0.02602	9	0.128857
b	0.2818	107.66	13	0.020635	10	0.101271
		115.35	14	0.016254	11	0.074229
		123.04	15	0.012728	12	0.05146
		130.73	16	0.009915	13	0.034086
		138.42	17	0.007688	14	0.021736
		146.11	18	0.005937	15	0.013421
		153.8	19	0.004568	16	0.008061
		161.49	20	0.003503	17	0.004726
		169.18	21	0.002678	18	0.002714
		176.87	22	0.002042	19	0.001529

Appendix 6. 2013 HCP Budget

KWP I	2013Budget	Notes
Permit Compliance	$94,720	
Seabird Bird Management	$36,610	An additional $582,633 was spent between 2012 and 2013 for seabird mitigation at Makamaka'ole.
Vegetative Management	$10,679	
Fatality Monitoring	$12,352	
Equipment and Supplies	$38,409	
Subtotal	$192,770	
Labor	$130,980	
Total Budget	**$323,750**	