Kahuku Wind Power, LLC

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Kahuku, Hawaii 96731

August, 2013

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.

David P. Cowan
Vice President, Environmental Affairs
First Wind Energy, LLC

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## *Executive Summary*

Kahuku Wind Power, LLC (KAH) has been implementing a Habitat Conservation Plan (HCP) since approval May 27, 2010. A federal Biological Opinion (2010-F-0190) and a Hawaii State Incidental Take License (ITL-10) were approved in May and June 2010, respectively. The project was constructed in 2010 and early 2011, and began commercial operations on March 23, 2011.

Fatality monitoring search plots have been marked in straight line transects out to 64 and 96 meters from the wind turbine generators' (WTG) centers (50 % and 75 % of the maximum turbine and blade height, respectively) and 40 meters from the permanent meteorological tower (MET) (50 % of the tower height). The 50% areas are searched twice per week and the 75% areas are searched every two weeks, in accordance with the monitoring protocol prescribed in the HCP.

The mean and standard deviation of search interval in days for the 50 % radius plots in Q1 was 3.60 (SD = 1.14) in July and August and 6.58 (SD = 0.98) in September. For the 75% radius plots (searched in July and August only) the mean and standard deviation of search interval was 14.61 days (SD = 2.89).

On August 1, 2012 a fire on site shut down energy generation. Beginning September 1, 2012 fatality monitoring plots were searched one time per week only within the 50 % plots, by agreement with USFWS and DOFAW, due to the reduced risk of collision with non-operating turbines and shorter fall distances. Full search protocols will resume when the project comes back into operation. The mean and standard deviation of search interval in days for the 50 % radius plots in Q2 was 7.11 (SD = 1.00); Q3 was 7.04 (SD = 1.31); Q4 was 6.80 (SD = 1.24) and overall was 6.94 (SD = 1.18).

No covered bat or bird species listed in the ITL and Biological Opinion (BO) were found in FY 2013. The fatality estimate using the Huso Evidence of Absence estimator for the 3 bats previously documented is 3.99 adults and 0.30 juveniles.

In FY 2013 we conducted 32 carcass retention (CARE) trials using 12 birds and 20 rats. For bat fatality estimation however we only use CARE and SEEF trials accumulated through July 31, 2012. For all CARE trials in fiscal years 2011, 2012 and July in FY 2013 the mean and standard deviation of retention period in days for 18 rats pre-trapping On-pad was 2.94 (SD = 1.59) and for 17 rats post-trapping On-pad was 10.24 (SD = 4.47). The mean and standard deviation of retention period for 8 rats pre-trapping Off-pad was 1.75 (SD = 1.91) and for 15 rats post-trapping Off-pad was 7.93 (SD = 5.16). For FY 2011-2013 the mean and standard deviation of 25 birds On-Pad was 13.28 (SD = 2.35) and Off-Pad for 23 birds was 11.83 (SD = 4.49).

In FY 2013 we placed 81 searcher efficiency (SEEF) trials using 37 birds and 44 rats. The mean SEEF for small carcass trials in FY 2011, 2012 and July of FY 2013 was 69.2 % (36 of 52) On-pad and 34.5 % (10 of 29) Off-pad. For FY 2011-2013 the mean SEEF On-Pad for medium carcasses was 95.8 % (46 of 48) and Off-Pad for medium carcasses was 83.5 % (35 of 42).

Installed and monitored 14 Anabat™ and 4 Wildlife Acoustics™ SM2 ultrasonic recorders detected Hawaiian hoary bats on 23 nights during 10141 detector nights from February 2011 through June 2013.

First Wind biologists issued 22 wildlife education trainings in FY 2013. KAH staff observed 1 Laysan Albatross loafing on the access road at the facility and found a Common Barn Owl dead but uninjured along the access road over 400m from the nearest WTG.

KAH contributed $153,500 to DOFAW on January 19, 2013 to complete the first 3 years of the waterbird mitigation obligations. Mitigation for Newell's Shearwater and Hawaiian Petrel will began in Q1 FY 2014. KAH contributed $25,000 to Hawaii Wildlife Rehabilitation Center to benefit Pueo. DOFAW will use the previously contributed $25,000 for Pueo research on Oahu.

We continually manage vegetation within all the fatality monitoring plots. We provided quarterly reports for FY 2013 Q1, Q2, Q3, and Q4. KAH initiated the use of a trained dog in June 2013 to assist with fatality searches.

### *Introduction*

This report summarizes work performed by KAH under the terms of the approved Habitat Conservation Plan (HCP) dated May 27, 2010 and pursuant to the obligations contained in the project's Incidental Take License (ITL-10) and Biological Opinion (BO 2010-F-0190) at the conclusion of the 2013 State of Hawaii fiscal year (July 2012- June 2013, Year 2).

The BO and ITL were issued for the project in May and June, 2010, respectively. The ITL and BO cover seven federally-listed threatened and endangered species and one state-listed endangered species: the Hawaiian stilt or ae'o (*Himantopus mexicanus knudseni*), Hawaiian coot or 'alae ke'oke'o (*Fulica alai*), Hawaiian duck or koloa maoli (*Anas wyvilliana*), Hawaiian moorhen or 'alae 'ula (*Gallinula chloropus sandvicensis*), Newell's shearwater or 'a'o (*Puffinus auricularis newelli*), Hawaiian petrel or 'ua'u (*Pterodroma sandwichensis*), Hawaiian hoary bat or 'ope'ape'a (*Lasiurus cinereus semotus*) and the Hawaiian short-eared owl or Pueo (*Asio flammeus sandwichensis*), respectively.

KAH began construction shortly after issuance of the ITL and BO, including initiation of monitoring and mitigation measures as prescribed by the HCP. During construction KAH retained SWCA Environmental Consultants to assist with monitoring and compliance as prescribed under the HCP and consistent with other environmental permit requirements. First Wind hired a Senior Wildlife Biologist in December 2010, followed by a Wildlife Technician in January 2011, a second Wildlife Technician in January 2012, and a Senior Wildlife Technician in April 2012. Due to the reduced monitoring protocol temporarily in effect only the HCP Compliance Manager and Hawaii HCP Manager currently staff the KAH HCP program.

KAH began commercial operations on March 23, 2011.

### *Fatality Monitoring*

In January 2011 we established the perimeters of circular downed wildlife search plots around each WTG and the MET tower, and set transect markers. WTG search plot perimeters have radii of 64 and 96 meters from the base of the turbines, corresponding to 50 % and 75 % of the maximum rotor-swept height of the WTGs. The MET tower is searched to a distance of 40 meters from the base, which corresponds to 50 % of its height (Figure 1).

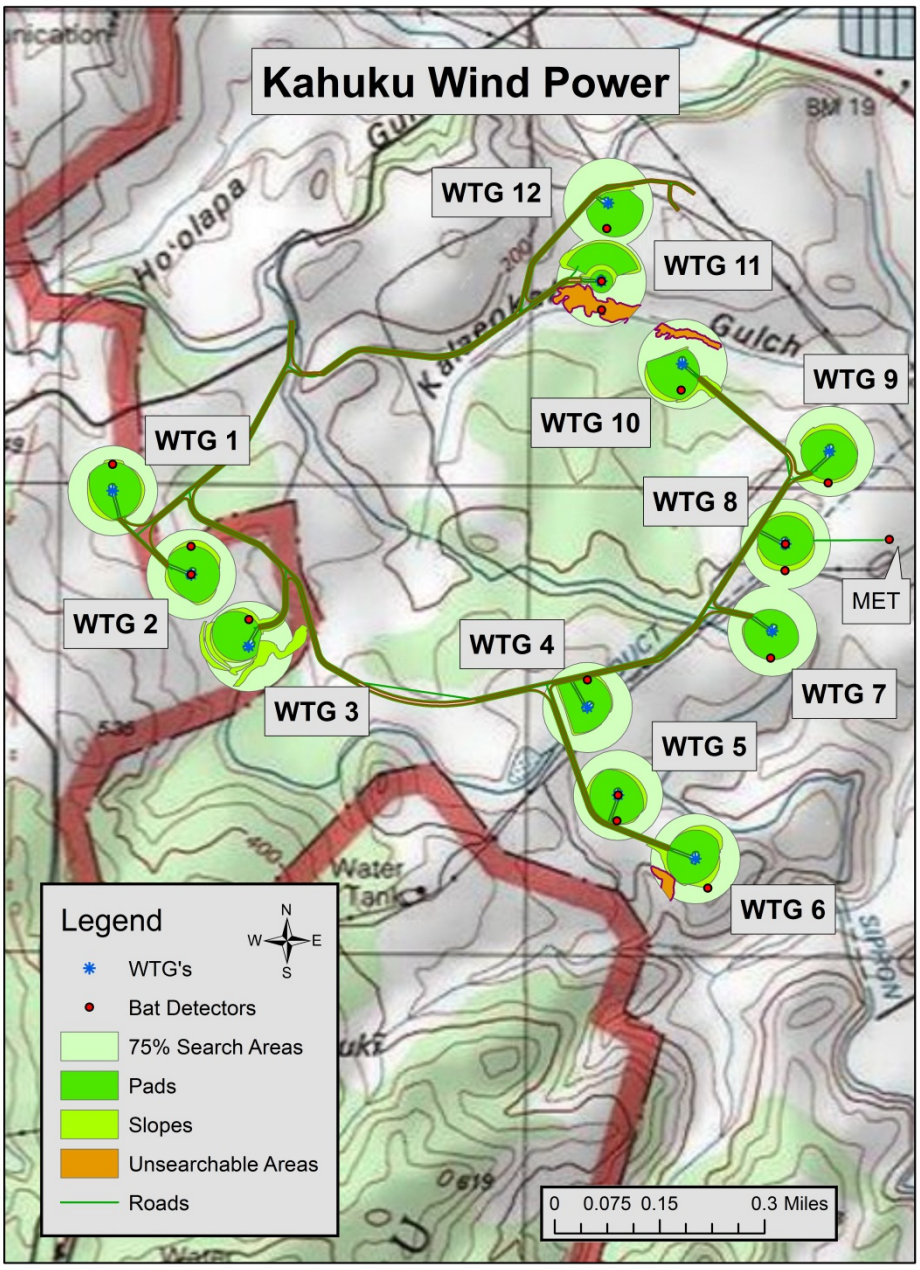


Figure 1. KAH roads, WTG's, MET tower, fatality monitoring plots and Bat detector locations.

Straight-line transects within the search plots are spaced every 14 meters and clearly marked with stakes. When searching we follow these transect markers and unmarked transects half way between so that the maximum distance between searched transects is 7 meters. Searching is conducted either by foot or all-terrain

vehicles (ATV's), by one or two persons. Slopes that are too steep to drive with ATV's are walked horizontally along the contours following transects that are also no greater than 7 meters apart.

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 SDHC cards, downloaded to a central computer, backed up on external hard drives, and analyzed with AnalookW™ 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 "status" file (that shows detector operation times) and QA/QC'd by the HCP supervisor and report author.

As a result of the fire August 1, 2012 the project was taken off-line and did not generate power for the remainder of the permit year. While off-line the blades of the non-operating turbines are kept in a "feathered" position; they don't catch the wind and rotor rotation is minimal (note, however, that some rotation is necessary in order to properly circulate lubricating fluids within the gearboxes). By agreement with USFWS and DOFAW, starting September 2012 searches around the WTG's and MET tower were reduced to the 50 % radius and once each week (Appendix 1). This reduced search protocol will continue while the project is off-line, provided the operational mode of the turbines continues as described above and blade rotation is minimized.


Figure 2. Transect marking stakes at KAH WTG 2. Staked rows are 14 meters apart. The yellow arrow shows the alignment of posts for one marked transect.

The mean and standard deviation of search interval in days for the 50 % radius plots in Q1 was 3.60 (SD = 1.14) in July and August and 6.58 (SD = 0.98) in September. For the 75% radius plots (searched in July and

August only) the mean and standard deviation of search interval was 14.61 days (SD = 2.89). The mean search interval in days for the 50 % radius plots in Q2 was 7.11 (SD = 1.00); Q3 was 7.04 (SD = 1.31); Q4 was 6.80 (SD = 1.24) and overall was 6.94 (SD = 1.18).

A canine assisted fatality monitoring program at KAH began in August 2012 with the purchase of Honey, a German shepherd. We implemented a training program in consultation with a Hawaii Civil Defense Search and Rescue team leader and with a contracted local dog trainer who specializes in odor training. After demonstrating high searcher efficiency finding rats and birds we received permission from DOFAW and USFWS to implement canine assisted fatality monitoring at Kahuku.

Table 1 shows inter-search intervals in days for the 50 % search plots for each WTG and the MET tower search plot during the period between September 1, 2012 and June 30, 2013.

| | WTG | | | | | | | | | | | | MET | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | | |
| **Mean** | 6.93 | 6.91 | 6.93 | 6.91 | 6.95 | 6.93 | 6.95 | 6.93 | 6.98 | 6.95 | 6.98 | 6.95 | 6.89 | 6.94 |
| **SD** | 1.17 | 1.24 | 1.17 | 1.10 | 1.16 | 1.21 | 1.20 | 1.23 | 1.21 | 1.16 | 1.17 | 1.18 | 1.28 | 1.18 |

Table 1. Inter-search Interval (in days) for 50 % fatality monitoring search plots in FY 2013 at KAH.

### *Wildlife Fatalities and Injuries*

There was no take of any of the eight species listed in the ITL this FY. A total of three Hawaiian Hoary bat fatalities have been found at the site since operation began. We found 1 Common Barn Owl emaciated and dead by the access road more than 400m from WTG 11. As prescribed in the HCP, KAH had initiated adaptive management (see Adaptive Management, pg. 14 below) measures to reduce bat fatalities at the site prior to the August 1, 2012 operations shut down.

### *Hawaiian Hoary Bat Take Estimation*

The estimated adjusted take for the 3 Hawaiian Hoary bat fatalities found in FY 2012 using Huso's Absence of Evidence Estimator (2013) is 3.99 adult bats and 0.30 juvenile bats (Table 2). The adjusted take estimate used the mean search interval for 3 separate periods and the mean for all of the CARE and the SEEF results through July 31, 2012 (Appendix 2). Each period was weighted according to the proportion of the total days between January 18, 2011 and July 31, 2012.

We chose the persistence distributions to approximate the extinction curve made using the CARE data for rat trials Pre-trapping and Post-trapping (Appendices 3 and 4).

| | Period 1 | Period 2 | Period 3 |
|---|---|---|---|
| EvAb Mean | 4.754 | 3.326 | 3.443 |
| Days | 242 | 184 | 122 |
| Proportion | 0.444 | 0.333 | 0.223 |
| Mean Proportion | **2.111** | **1.108** | **0.768** |
| Unobserved Direct Take | 1.754 | 0.326 | 0.443 |
| 0.3 Indirect Take multiplier | 0.526 | 0.098 | 0.133 |
| Indirect Take Proportion | **0.234** | **0.033** | **0.030** |
| Period Total EstimatedTake | 2.344 | 1.140 | 0.797 |
| Total Estimated Take | **4.29** | | |

Table 2. Estimated take calculation for three periods having different search intervals.

The annual Baseline take allowed under the ITL is 4 adult and 3 juvenile bats; therefore the Baseline *rate* of take for adult bats has been exceeded and Adaptive Management has been triggered in accordance with the HCP.

### ***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's) are used as surrogates for Coots, Moorhens, Shearwaters and Petrels as the medium size class. Ducks such as Scaups and Mallards represent Pueo and Hawaiian Ducks /Mallards in the medium size class. WTSH carcasses originally came from Sea Life Park on Oahu. 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 of Hawaiian Hoary Bats (Figure 3). Various species of ducks were provided by the USDA-APHIS in Alaska. We possess state and federal wildlife collection permits for Kahuku, numbers WL13-02 and MB40087A-0, respectively, to allow the use of migratory bird species as surrogates in our trials.


Figure 3. A Hawaiian hoary bat and a rat used as a bat surrogate in CARE and SEEF trials.

In FY 2013 we conducted 32 carcass retention (CARE) trials using 12 birds and 20 rats (Appendices 5-8). For bat fatality estimation however we only use CARE trials accumulated through July 31, 2012. After July 31, 2012 the WTGs were not operating and therefore bats were not at risk of being killed.

We also stopped trapping scavengers at this time so subsequent CARE trials were conducted under different conditions than when bats could have been killed. For all CARE trials in fiscal years 2011, 2012 and July in FY 2013 the mean and standard deviation of retention period in days for 18 rats pre-trapping On-pad was 2.94 (SD = 1.59) and for 17 rats post-trapping On-pad was 10.24 (SD = 4.47). The mean and standard deviation of retention period in days for 8 rats pre-trapping Off-pad was 1.75 (SD = 1.91) and for 15 rats post-trapping Off-pad was 7.93 (SD = 5.16) (Table 3).

For FY 2011-2013 the mean and standard deviation of retention period in days On-Pad for 25 birds was 13.28 (SD = 2.35) and Off-Pad for 23 birds was 11.83 (SD = 4.49) (Table 4). We considered an avian carcass "present" until < 10 of its body feathers and < 2 of its wing feathers remained (Young et al, 2012).

| | | Rat | | |
|---|---|---|---|---|
| | Days | Overall | Pre-Trap | Post Trap |
| On-pad | Mean | 6.49 | 2.94 | 10.24 |
| | SD | 4.93 | 1.59 | 4.47 |
| | N | 35 | 18 | 17 |
| Off-pad | Mean | 5.78 | 1.75 | 7.93 |
| | SD | 5.21 | 1.91 | 5.16 |
| | N | 23 | 8 | 15 |

Table 3. Rat CARE trial means and standard deviations (in days) at KAH, FY 2011-July FY 2013.

| | | Bird | | |
|---|---|---|---|---|
| | Days | Overall | Pre-Trap | Post Trap |
| On-pad | Mean | 13.28 | 13.17 | 13.38 |
| | SD | 2.35 | 2.59 | 2.22 |
| | N | 25 | 12 | 13 |
| Off-pad | Mean | 11.83 | 8.88 | 13.4 |
| | SD | 4.49 | 6.1 | 2.32 |
| | N | 23 | 8 | 15 |

Table 4. Bird CARE trial means and standard deviations (in days) at KAH, FY 2011- 2013.

### *Searcher Efficiency Trials*

SEEF trials at KAH are proctored by staff that does not search fatality monitoring plots. SWCA Environmental Consultants generated 200 random GPS point locations for each vegetation class within all WTG search plots to direct carcass placement. Vegetation classes are On-Pad (short) and Off-Pad (medium). Short vegetation generally covers the flat, graded areas (pads) immediately around the WTG's. These pads are consistently mowed every 2-3 weeks to maintain grass as short as 5cm. 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 50cm when mowed consistently.

Proctors place carcasses (see CARE above) in random locations on-site in the early morning before KAH HCP Compliance Technicians and Manager 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 searchers send a text message to proctors indicating the WTG number and approximate location. After searches are complete for the day proctors verify that carcasses are still in place. If a carcass is missing the trial is not counted.

In FY 2013 we placed 81 searcher efficiency (SEEF) trials using 37 birds and 44 rats (Table 4). For bat fatality estimation however we only use SEEF trials accumulated through July 31, 2012. SEEF trials after July 31, 2012 do not represent the period when bats had been or could have been killed and therefore are not used for bat fatality estimation. The mean SEEF for small carcass trials in FY 2011, 2012 and July of FY 2013 was 69.2 % (36 of 52) On-pad and 34.5 % (10 of 29) Off-pad. For FY 2011-2013 the mean SEEF On-Pad for medium carcasses was 95.8 % (46 of 48) and Off-Pad for medium carcasses was 83.5 % (35 of 42) (Table 5).

Since beginning canine assisted fatality monitoring in Q4 FY 2013 we have also placed SEEF trials for the dog Honey. Table 4 shows SEEF values by carcass and vegetation class for humans before FY 2013 and during FY 2013 and also canine assisted trials in FY 2013 (Table 4) (Appendix 9).

| | Rat | | | | Bird | | | |
|---|---|---|---|---|---|---|---|---|
| | On-Pad | | Off-Pad | | On-Pad | | Off-Pad | |
| **FY2013** | **Mean** | **N** | **Mean** | **N** | **Mean** | **N** | **Mean** | **N** |
| **Human** | 0.57 | 14 | 0.33 | 3 | 0.93 | 15 | 1.00 | 3 |
| **Canine** | 0.75 | 20 | 0.57 | 7 | 0.90 | 10 | 0.89 | 9 |
| ***FY2013*** | ***0.68*** | ***34*** | ***0.50*** | ***10*** | ***0.92*** | ***25*** | ***0.92*** | ***12*** |
| **FY2011-12** | 0.74 | 42 | 0.33 | 27 | 1.00 | 23 | 0.80 | 30 |

Table 5. SEEF Trials at KAH in FY 2011-12 and FY 2013.

***Hawaiian Hoary Bat Monitoring***

KAH biologists have deployed 14 Titley Scientific Anabat™ SD-1's or SD-2's and 4 Wildlife Acoustics™ SM2+BAT's ultrasonic bat detectors on site since January 2011 (locations shown in Figure 1). Twelve detectors with 1 mic are each approximately 55 meters from each WTG, either north (facing southwest) or south (facing northwest), attached to metal poles and positioned 6.5 meters from the ground. Two detectors are at 40 and 80 meters height on the MET tower, these were not functioning in Q3 but were repaired and continue in operation. Four SM2+BAT detectors are mounted on wind turbine nacelles just above the rear door at 80 meters height and facing backwards (away from the rotor). No bats were detected in Q4 FY 2013. Hawaiian hoary bats were detected on 23 nights during 10141 detector nights from January 2011 through FY 2013. Bat detections have occurred only from June through October (Figure 4). Accumulated bat detection rates since 2011 are shown in Appendix 8.

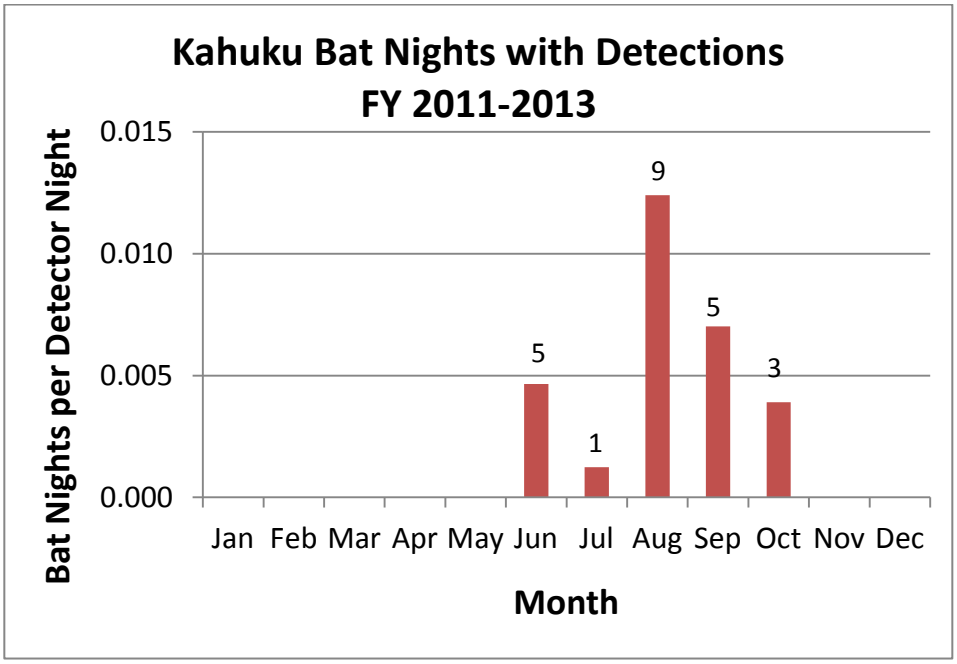


Figure 4. Hawaiian hoary bat nights with detections rates by at KAH in FY 2011 through 2013 (bat detection night numbers are above bars).

***Wildlife Education and Observation Program***

First Wind biologists began implementing WEOP trainings on February 15, 2011 for all permanent or transient personnel on site. Twenty-two WEOP training orientations have been administered in FY2013.

First Wind HCP staff observed a Laysan Albatross standing on the site access road and found a Common Barn Owl dead but uninjured along the access road over 400m from the nearest WTG.

***Mitigation***

*Newell's Shearwater and Hawaiian Petrel*

According to the HCP, KAH mitigation options for NESH and Hawaiian Petrel (HAPE) include participation in colony-based protection and management measures on Kauai. In Q1 FY 2014 the DOFAW Kauai Endangered Seabird Project will deploy Wildlife Acoustic™ Songmeters at 4 or more locations on Kauai to determine activity (Appendix 12). Once suitable sites are confirmed, colony protection funded by Kahuku Wind Power is expected to begin next year.

*Waterbirds*

In January 2013, KAH made the last of three total annual payments for $153,500 to DOFAW to provide support for waterbird mitigation funding as outlined in the HCP. DOFAW began to use these funds in July, 2011 and hired a biologist to conduct waterbird population monitoring, manage vegetation, and control predators at Hamakua Marsh State Wildlife Sanctuary and provide quarterly reports of vegetation management, predator trapping activity and fledgling numbers (Q4 FY 2013 is Appendix 13). On March 9, 2012 the USFWS determined that rat baiting as stipulated in the HCP is not appropriate at Hamakua Marsh. Consequently First Wind has

agreed to pay an additional $26,500 per year to fund live rat trapping. The $153,500 payment made in January 2013 includes funding of two full years and a partial year of this additional cost.

*Pueo*

The $25,000 provided in December 2010 to DOFAW to initiate Pueo research, as outlined in the HCP, is to be used on Oahu (personal communication from Lasha Salbosa, DOFAW, May 15, 2013). In July 2013 we contributed an additional $25,000, with DOFAW consent (Lasha Salbosa, pers comm, June 26, 2013), to the Hawaii Wildlife Rehabilitation Center on Hawaii Island.

*Hawaiian Hoary Bat*

KAH has paid the full obligation for bat mitigation to be conducted by DOFAW at Kahikinui, Maui. On September 16, 2011 $150,000 was paid to DOFAW.

***Vegetation Management***

The HCP for KAH stipulates that the fatality monitoring plots around the WTG's and MET tower be mowed every month. Areas around the WTG's that are well-graded and flat (On-pad) are mowed every 2-3 weeks to 5cm. Graded slopes that cannot be mowed are weed trimmed to 5-8cm. Other areas outside the pads and graded slopes (Off-pad) are mowed with the turf-mower at 5 to 10cm and /or brush cut-mowed with the Compact Track Loader to 5 to 15cm every 3 to 6 weeks. Herbicides have also been used to retard growth.

The Kalaheokahipu Gulch that passes through the WTG 10 and 11 fatality monitoring plots is considered unmanageable and adjustments to take of covered species will be made to account for fatalities that may occur but are not recovered from this unsearchable area (Figure 5).


Figure 5. Kalaheokahipu Gulch near WTG 11 at KAH.

### *Adaptive Management*

The third Hawaiian hoary bat fatality occurred April 23, 2012. According to fatality estimate calculations the Baseline annual take of 4 was exceeded, triggering Adaptive Management. In accordance with the HCP, curtailment of all turbines up to a wind speed of 5 m/s began April 27, 2012 and is being implemented between sunset and sunrise from April through October.

### *Agency Site Visits and Reporting*

We provided quarterly reports for FY 2013 Q1, Q2 and Q3 on October 30, 2012, February 1, 2013, and May 9, 2013.

### *Expenditures*

KAH executed two Letters of Credit (LCs) of $500,000 each on October 21, 2010 to fulfill the contingency fund requirements under the HCP. Both LCs name the State of Hawaii Division of Forestry and Wildlife (DOFAW) as the beneficiary. These LC's were renewed for 1 year in 2011, 2012 and 2013.

First Wind fulfilled the initial 3 years of its waterbird mitigation obligation under the HCP with a Memorandum of Agreement and payments made in December 2010, January 2012, and January 2013 to DOFAW totaling for $341,500. Details for all other HCP expenditures are in Appendix 13.

### *Citations*


Huso[1], M. M. D. Dalthorp. 2013. Evidence of Absence Users Guide: U.S. Geological Survey Data Series XXX.

Kahuku Wind Power, LLC. 2011. Kahuku Wind Power Habitat Conservation Plan-ITL 10: FY 2011 Progress Report. First Wind Energy, LLC, Kahuku, HI 96731.

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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 KAH in FY 2013 Q1, Q2, Q3 and Q4 (black colored dates are searches within the 50% perimeter, red are within the 75% perimeter, shaded red are missed searches when WTG 11 and 12 were off-limits, purple dates are searches 1X/ week in the 50 % area).

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

**Appendix 1 (cont.)**

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

## Appendix 1 (cont.)

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

## Appendix 1 (cont.)

| WTG | | | | | | | | | | | | MET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| 4/4 | 4/4 | 4/4 | 4/4 | 4/4 | 4/4 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| 4/11 | 4/11 | 4/11 | 4/11 | 4/11 | 4/11 | 4/12 | 4/12 | 4/12 | 4/12 | 4/12 | 4/12 | 4/12 |
| 4/15 | 4/15 | 4/15 | 4/15 | 4/16 | 4/16 | 4/16 | 4/16 | 4/18 | 4/18 | 4/18 | 4/18 | 4/16 |
| 4/22 | 4/22 | 4/22 | 4/22 | 4/24 | 4/24 | 4/24 | 4/24 | 4/25 | 4/25 | 4/25 | 4/25 | 4/24 |
| 4/29 | 4/29 | 4/29 | 4/29 | 4/30 | 4/30 | 4/30 | 4/30 | 5/2 | 5/2 | 5/2 | 5/2 | 4/30 |
| 5/6 | 5/6 | 5/6 | 5/6 | 5/7 | 5/7 | 5/7 | 5/7 | 5/9 | 5/9 | 5/9 | 5/9 | 5/7 |
| 5/13 | 5/13 | 5/13 | 5/13 | 5/14 | 5/14 | 5/14 | 5/14 | 5/16 | 5/16 | 5/16 | 5/16 | 5/14 |
| 5/20 | 5/20 | 5/20 | 5/20 | 5/21 | 5/21 | 5/21 | 5/21 | 5/23 | 5/23 | 5/23 | 5/23 | 5/21 |
| 5/28 | 5/28 | 5/28 | 5/28 | 5/29 | 5/29 | 5/29 | 5/29 | 5/30 | 5/30 | 5/30 | 5/30 | 5/29 |
| 6/3 | 6/3 | 6/3 | 6/3 | 6/4 | 6/4 | 6/4 | 6/4 | 6/6 | 6/6 | 6/6 | 6/6 | 6/4 |
| 6/10 | 6/10 | 6/10 | 6/10 | 6/11 | 6/11 | 6/11 | 6/11 | 6/13 | 6/13 | 6/13 | 6/13 | 6/11 |
| 6/18 | 6/18 | 6/18 | 6/18 | 6/20 | 6/20 | 6/20 | 6/20 | 6/21 | 6/21 | 6/21 | 6/21 | 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 |
| 7/1 | 7/1 | 7/1 | 7/1 | 7/2 | 7/2 | 7/2 | 7/2 | 7/3 | 7/3 | 7/3 | 7/3 | 7/2 |

**Appendix 2.** Hawaiian Hoary Bat Evidence of Absence Fatality Estimation at KAH in FY 2013 (Period 1).

| Carcass Count (X) | **3** | Sampling Dates | Prior distribution | | Posterior Distribution | | | |
|---|---|---|---|---|---|---|---|---|
| Sampling coverage (phi) | **0.9** | 0 | m | P(M = m) | **Mean** | **4.754** | | |
| searcher proficiency (f) | **0.74** | 3.51 | 0 | 0.064704 | P(observe\| arrive) | 0.428429 | | |
| k | **1** | 7.02 | 1 | 0.167445 | 95th percentile | 7 | | |
| Sampling dates | **Formula** | 10.53 | 2 | 0.225681 | m | P(M = m) | 1 minus accumu-lated P | % Confi-dence |
| interval | **3.51** | 14.04 | 3 | 0.210882 | 0 | 0 | 1 | 0 |
| span | **242** | 17.55 | 4 | 0.153468 | 1 | 0 | 1.00 | 0.00 |
| persistence distribution | **Log-Logistic** | 21.06 | 5 | 0.092654 | 2 | 0 | 1.00 | 0.00 |
| a | **1.8295** | 24.57 | 6 | 0.048279 | 3 | 0.180185 | 0.82 | 18.02 |
| b | **2** | 28.08 | 7 | 0.022305 | 4 | 0.299798 | 0.52 | 48.00 |
| arrival function | **Uniform** | 31.59 | 8 | 0.009317 | 5 | 0.258634 | 0.26 | 73.86 |
| a | **NA** | 35.1 | 9 | 0.003571 | 6 | 0.154056 | 0.11 | 89.27 |
| b | **NA** | 38.61 | 10 | 0.00127 | 7 | 0.071193 | 0.04 | 96.39 |
| prior distribution | **Negative Binomial** | 42.12 | 11 | 0.000423 | 8 | 0.027197 | 0.01 | 99.11 |
| a | **24.0286** | 45.63 | | | 9 | 0.008937 | 0.00 | 100.00 |
| b | **0.8923** | 49.14 | | | | | | |

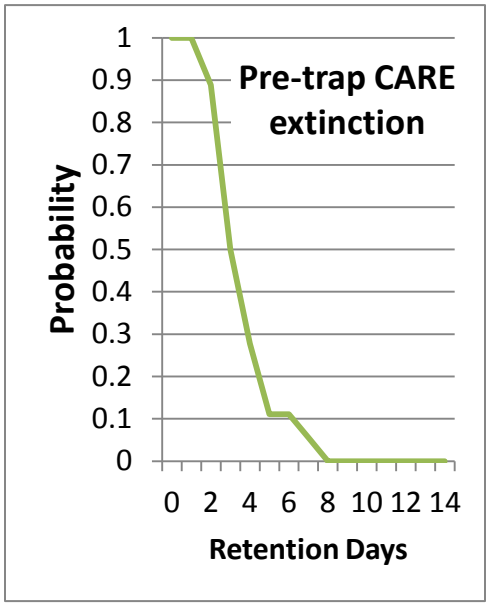
**Appendix 2.** (Period 2, cont).

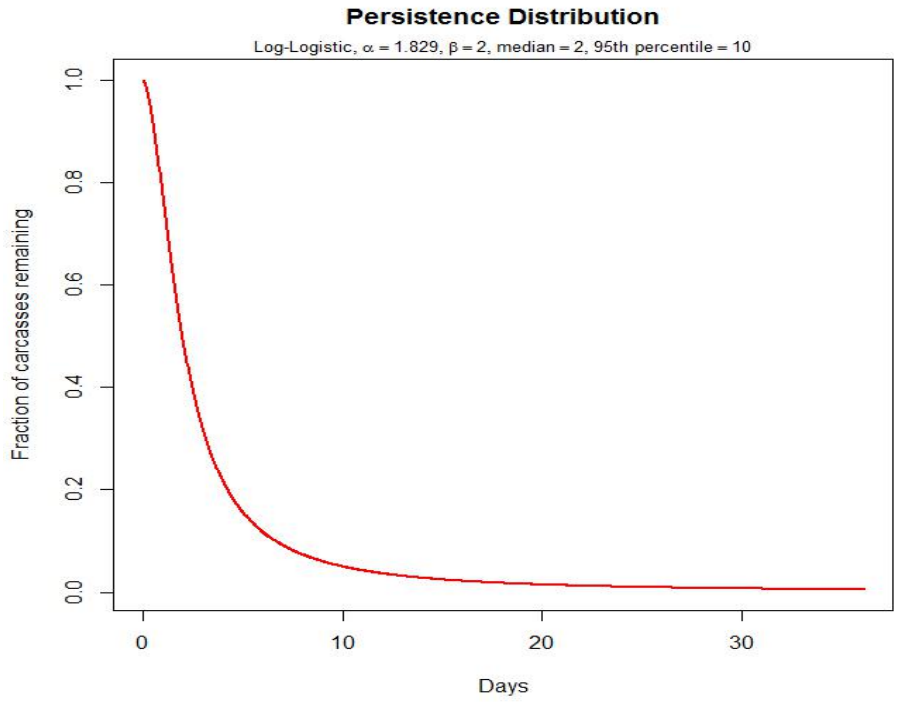
| Carcass Count (X) | **3** | Sampling Dates | Prior distribution | | Posterior Distribution | | | |
|---|---|---|---|---|---|---|---|---|
| Sampling coverage (phi) | **0.9** | 0 | m | P(M = m) | **Mean** | **3.326** | | |
| searcher proficiency (f) | **0.74** | 2.49 | 0 | 0.165541 | P(observe\| arrive) | 0.865849 | | |
| k | **1** | 4.98 | 1 | 0.246566 | 95th percentile | 4 | | |
| Sampling dates | **Formula** | 7.47 | 2 | 0.223458 | m | P(M = m) | 1 minus accum. P | % Confidence |
| interval | **2.49** | 9.96 | 3 | 0.159077 | 0 | 0 | 1 | 0 |
| span | **184** | 12.45 | 4 | 0.097783 | 1 | 0 | 1.00 | 0.00 |
| persistence distribution | **Weibull** | 14.94 | 5 | 0.054404 | 2 | 0 | 1.00 | 0.00 |
| a | **3** | 17.43 | 6 | 0.028153 | 3 | 0.718705 | 0.28 | 71.87 |
| b | **10** | 19.92 | 7 | 0.013787 | 4 | 0.237061 | 0.04 | 95.58 |
| arrival function | **Uniform** | 22.41 | 8 | 0.006465 | 5 | 0.044234 | 0.00 | 100.00 |
| a | **NA** | 24.9 | 9 | 0.002927 | | | | |
| b | **NA** | 27.39 | 10 | 0.001287 | | | | |
| prior distribution | **Negative Binomial** | 29.88 | 11 | 0.000552 | | | | |
| a | **4.6099** | 32.37 | | | | | | |
| b | **0.6769** | 34.86 | | | | | | |

**Appendix 2.** (Period 3, cont).

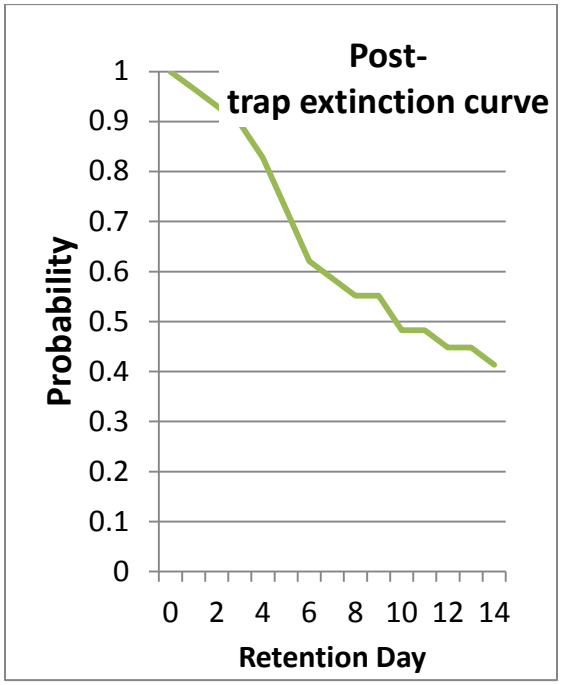
| Carcass Count (X) | **3** | Sampling Dates | Prior distribution | | Posterior Distribution | | | |
|---|---|---|---|---|---|---|---|---|
| Sampling coverage (phi) | **0.9** | 0 | m | P(M = m) | **Mean** | **3.433** | | |
| searcher proficiency (f) | **0.74** | 3.5 | 0 | 0.211494 | P(observe\|arrive) | 0.827314 | | |
| k | **1** | 7 | 1 | 0.260331 | 95th percentile | 5 | | |
| Sampling dates | **Formula** | 10.5 | 2 | 0.210284 | m | P(M = m) | 1 minus accum. P | % Confidence |
| interval | **3.5** | 14 | 3 | 0.140197 | 0 | 0 | 1 | 0 |
| span | **122** | 17.5 | 4 | 0.083582 | 1 | 0 | 1.000 | 0.00 |
| persistence distribution | **Weibull** | 21 | 5 | 0.046293 | 2 | 0 | 1.000 | 0.00 |
| a | **3** | 24.5 | 6 | 0.024334 | 3 | 0.654386 | 0.346 | 65.44 |
| b | **10** | 28 | 7 | 0.012301 | 4 | 0.26948 | 0.076 | 92.39 |
| arrival function | **Uniform** | 31.5 | 8 | 0.006032 | 5 | 0.064436 | 0.012 | 98.83 |
| a | **NA** | 35 | 9 | 0.002887 | 6 | 0.011698 | 0.000 | 100.00 |
| b | **NA** | 38.5 | 10 | 0.001355 | | | | |
| prior distribution | **Negative Binomial** | 42 | 11 | 0.000625 | | | | |
| a | **3.2005** | 45.5 | 12 | 0.000285 | | | | |
| b | **0.6154** | 49 | | | | | | |

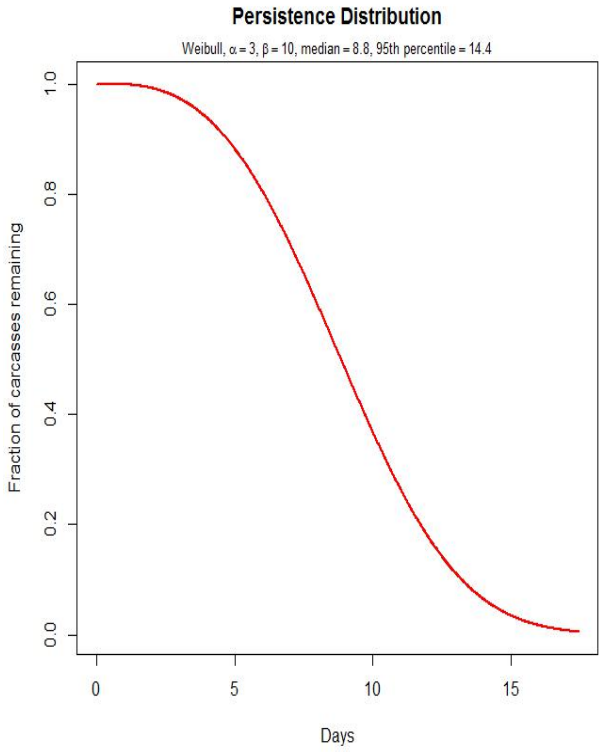
**Appendix 3.** Pre-Trap extinction curves (Rat CARE trial and Evidence of Absence fitted curve).



**Appendix 4.** Post-Trap extinction curves (Rat CARE trial and Evidence of Absence fitted curve).



**Appendix 5.** CARE M at KAH in FY 2013

| CARE M | | 1 | | 2 | 3 | | 4 | | 5 | | 6 | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carcass Type | | Rat | | WTSH | Rat | | Rat | | Teal | | Rat | Rat | | WTSH | | Rat | | Rat | | Duck | | Rat | |
| WTG | | 1 | | 2 | 3 | | 4 | | 5 | | 6 | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | |
| Vegetation, Distance from WTG | Off-pad, 64 m | Present /Absent | | Present /Absent | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | |
| Day | Date | | | | | | | | | | | | | | | | | | | | | | |
| day 0 | 7/24 | | Notes | | | Notes | | Notes | | Notes | | | Notes | | Notes | | Notes | | Notes | | Notes | | Notes |
| day 1 | 7/25 | P | M | P | P | A, H, L | P | A, H, L | P | | P | P | A, H, C | P | | P | H, A | P | H, A | P | | P | L |
| day 2 | 7/26 | P | A | P | P | | P | C | P | | ***Absent*** | P | | P | A | P | | P | | P | M | P | L, A |
| day 3 | 7/27 | P | | P | ***Absent*** | | P | | P | | | P | | P | | P | S | P | S | P | Scav, B | P | C |
| day 4 | 7/28 | P | | P | | | ***Absent*** | | P | | | P | D,S | P | | P | | P | | P | | P | C |
| day 5 | 7/29 | P | | P | | | | | P | | | P | | P | | P | | P | | P | | ***Absent*** | |
| day 6 | 7/30 | P | | P | | | | | P | | | P | | P | | P | | P | | P | | | |
| day 7 | 7/31 | P | | P | | | | | P | | | P | | P | | P | | P | | P | | | |
| day 8 | 8/1 | P | S | P | | | | | P | | | P | S,H | P | | P | | P | | P | | | |
| day 9 | 8/2 | ***Absent*** | | P | | | | | P | | | P | | P | | P | S, H | P | | P | | | |
| day 10 | 8/3 | | | P | | | | | P | | | P | | P | | P | | P | | P | | | |
| day 11 | 8/4 | | | P | | | | | P | | | P | | P | | P | | P | | P | | | |
| day 12 | 8/5 | | | P | | | | | P | | | P | | P | | P | | P | | P | | | |
| day 13 | 8/6 | | | P | | | | | P | | | P | | P | | P | | P | | P | | | |
| day 14 | 8/7 | | | ***Present*** | | | | | ***Present*** | Scav | | ***Present*** | S | ***Present*** | | ***Present*** | S | ***Present*** | S | ***Present*** | > 10 B | | |
| ***Retention (days)*** | | ***8*** | | ***14*** | ***2*** | | ***3*** | | ***14*** | | ***1*** | ***14*** | | ***14*** | | ***14*** | | ***14*** | | ***14*** | | ***4*** | |

**Appendix 6.** CARE N at KAH FY 2013.

| CARE N | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | 11 | | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carcass Type | | Rat | | Rat | | Rat | | Rat | | Rat | | Rat | | Rat | | Rat | | Rat | | Rat | Rat | | Rat | |
| WTG | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | 11 | | 12 | |
| Vegetation, Distance from WTG | On-Pad, 20 m | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | | Present /Absent | Present /Absent | | Present /Absent | |
| Day | Date | | | | | | | | | | | | | | | | | | | | | | | |
| day 0 | 8/20 | | Notes | | Notes | | Notes | | Notes | | Notes | | Notes | | Notes | | Notes | | Notes | | | Notes | | Notes |
| day 1 | 8/21 | P | L | P | | P | L | P | A,L,H | P | | P | | P | | P | | P | | ***Absent*** | P | | P | L |
| day 2 | 8/22 | P | | P | | P | H, A | P | C | P | | P | | P | | P | H | P | | | P | H | P | |
| day 3 | 8/23 | ***Absent*** | | P | H, A | P | | P | | P | H | P | H | P | | P | | P | | | P | | P | |
| day 4 | 8/24 | | | P | | P | | ***Absent*** | | P | | ***Absent*** | | P | | P | | P | | | P | | P | |
| day 5 | 8/25 | | | P | | P | D | | | P | | | | ***Absent*** | | ***Absent*** | | ***Absent*** | | | P | | P | |
| day 6 | 8/26 | | | P | D | P | M | | | P | | | | | | | | | | | P | | P | |
| day 7 | 8/27 | | | P | | P | | | | P | | | | | | | | | | | P | S | P | H |
| day 8 | 8/28 | | | P | | P | S | | | P | S | | | | | | | | | | P | | P | |
| day 9 | 8/29 | | | P | | P | | | | P | | | | | | | | | | | P | | P | |
| day 10 | 8/30 | | | ***Absent*** | | P | | | | P | | | | | | | | | | | P | | P | |
| day 11 | 8/31 | | | | | P | | | | P | | | | | | | | | | | P | | P | |
| day 12 | 9/1 | | | | | P | | | | P | | | | | | | | | | | P | | P | |
| day 13 | 9/2 | | | | | P | | | | P | | | | | | | | | | | P | | P | |
| day 14 | 9/3 | | | | | ***Present*** | | | | ***Present*** | | | | | | | | | | | ***Present*** | | ***Present*** | |
| ***Retention (days)*** | | ***2*** | | ***9*** | | ***14*** | | ***3*** | | ***14*** | | ***3*** | | ***4*** | | ***4*** | | ***4*** | | ***0*** | ***14*** | | ***14*** | |

**Appendix 7.** CARE O at KAH FY 2013.

| **CARE O** | | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|---|
| Carcass Type | | wtsh | duck | wtsh | wtsh | duck | |
| WTG | | 2 | 5 | 6 | 8 | 11 | |
| Vegetation, Distance from WTG | On-Pad, 55 m | Present /Absent | Present /Absent | Present /Absent | Present /Absent | Present /Absent | |
| day 0 | 11/5 | | | | | | Notes |
| day 1 | 11/6 | P | P | P | P | P | |
| day 2 | 11/7 | P | P | P | P | P | L |
| day 3 | 11/8 | P | P | P | P | P | |
| day 4 | 11/9 | P | P | P | P | P | |
| day 5 | 11/10 | P | P | P | P | P | |
| day 6 | 11/11 | P | P | P | P | **P** | |
| day 7 | 11/12 | P | P | P | P | A | |
| day 8 | 11/13 | P | P | P | P | | |
| day 9 | 11/14 | P | P | P | P | | |
| day 10 | 11/15 | P | P | P | P | | |
| day 11 | 11/16 | P | P | P | P | | |
| day 12 | 11/17 | P | P | P | P | | |
| day 13 | 11/18 | P | P | P | P | | |
| day 14 | 11/19 | P | P | P | P | | |
| Retention (days) | | ***14*** | ***14*** | ***14*** | ***14*** | ***6*** | |

**Appendix 8.** CARE P at KAH in FY 2013.

| CARE P 2013 | | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|---|
| Carcass Type | | WTSH | | WTSH | | WTSH | |
| WTG | | 5 | | 7 | | 8 | |
| Vegetation type On-Pad | | Present /Absent | Medium | Present /Absent | Short | Present /Absent | Short |
| day 0 | 2/12 | | Notes | | Notes | | Notes |
| day 1 | 2/13 | P | | P | | P | |
| day 2 | 2/14 | P | | P | | P | |
| day 3 | 2/15 | P | | P | | P | |
| day 4 | 2/16 | P | | P | | P | |
| day 5 | 2/17 | P | | P | | P | |
| day 6 | 2/18 | P | | P | | P | |
| day 7 | 2/19 | P | | P | | P | |
| day 8 | 2/20 | P | SCAV, F | P | SCAV, F | P | |
| day 9 | 2/21 | P | | P | | P | |
| day 10 | 2/22 | P | | P | | P | |
| day 11 | 2/23 | P | | P | | P | |
| day 12 | 2/24 | P | | P | | P | |
| day 13 | 2/25 | P | | P | | P | |
| day 14 | 2/26 | P | | P | | P | |
| Retention (days) | | ***14*** | | ***14*** | | ***14*** | |

**Appendix 9.** SEEF trials at KAH in FY 2013.

| Date | WTG | Searcher | Vegetation | Carcass | Found On-pad | Found Off-pad |
|---|---|---|---|---|---|---|
| 7/2/2012 | 6 | AL | On-Pad | Rat | 0 | |
| 7/2/2012 | 8 | AL | On-Pad | Rat | 0 | |
| 7/2/2012 | 2 | MW | On-Pad | Rat | 0 | |
| 7/2/2012 | 11 | SL | On-Pad | Rat | 1 | |
| 7/2/2012 | 12 | SL | On-Pad | Rat | 1 | |
| 7/19/2012 | 5 | AL | On-Pad | Rat | 1 | |
| 7/19/2012 | 8 | AL | Off-Pad | Rat | | 0 |
| 7/19/2012 | 11 | SL | Off-Pad | WTSH | | 1 |
| 7/19/2012 | 3 | MW | Off-Pad | Rat | Scavenged | |
| 7/30/2012 | 2 | MW | On-Pad | Rat | 1 | |
| 7/30/2012 | 7 | AL | Off-Pad | Rat | | 1 |
| 7/30/2012 | 5 | AL | On-Pad | WTSH | 1 | |
| 7/30/2012 | 10 | AL | Off-Pad | WTSH | | 1 |
| 8/17/2012 | 10 | AL | On-Pad | Rat | 0 | |
| 8/17/2012 | 12 | MC | On-Pad | Duck | 1 | |
| 8/17/2012 | 8 | MW | Off-Pad | Duck | | 1 |
| 8/20/2012 | 10 | AL | On-Pad | Rat | 1 | |
| 8/20/2012 | 4 | SL | On-Pad | Rat | 1 | |
| 8/20/2012 | 12 | AL | On-Pad | Duck | 1 | |
| 8/27/2012 | 8 | AL | On-pad | Rat | 0 | |
| 8/27/2012 | 1 | SL | On-Pad | Rat | 0 | |
| 8/27/2012 | 6 | SL | Off-pad | Rat | | 0 |
| 9/17/2012 | 3 | MW | On-Pad | WTSH | 1 | |
| 9/26/2012 | 8 | MW | On-Pad | WTSH | 1 | |
| 9/26/2012 | 9 | MW | On-Pad | Duck | 1 | |
| 9/27/2012 | 11 | MW | On-Pad | WTSH | 0 | |
| 10/10/2012 | 5 | MW | On-pad | WTSH | 1 | |
| 10/10/2012 | 5 | MW | On-Pad | Duck | 1 | |
| 10/15/2012 | 1 | Mw | On-pad | Duck | 1 | |
| 10/15/2012 | 1 | MW | On-pad | WTSH | 1 | |
| 10/22/2012 | 1 | MW | On-pad | WTSH | 1 | |
| 10/22/2012 | 1 | MW | On-pad | Duck | 1 | |
| 10/31/2012 | 4 | MW | On-pad | Duck | 1 | |
| 11/7/2012 | 7 | MW | On-pad | WTSH | 1 | |
| 12/18/2012 | 6 | MW | On-pad | Rat | 1 | |
| 12/18/2012 | 6 | MW | On-pad | Rat | 1 | |

**Appendix 9.** (cont).

| Date | WTG | Searcher | Vegetation | Carcass | Found On-pad | Found Off-pad |
|---|---|---|---|---|---|---|
| 10/10/2012 | 6 | K9 | Off pad | WTSH | | 1 |
| 10/15/2012 | 3 | K9 | Off pad | Duck | | 1 |
| 10/22/2012 | 3 | K9 | Off pad | Duck | | 1 |
| 10/31/2012 | 5 | K9 | On-pad | Duck | 1 | |
| 11/7/2012 | 9 | K9 | On-pad | WTSH | 1 | |
| 12/10/2012 | 2 | K9 | On-pad | WTSH | 1 | |
| 12/12/2012 | 8 | K9 | On pad | Rat | 1 | |
| 12/12/2012 | 8 | K9 | On pad | Rat | 0 | |
| 12/12/2012 | 9 | K9 | On pad | Rat | 1 | |
| 12/12/2012 | 7 | K9 | On-pad | WTSH | 1 | |
| 12/12/2012 | 9 | K9 | On-pad | WTSH | 1 | |
| 12/12/2012 | 9 | K9 | Off pad | WTSH | | 1 |
| 12/18/2012 | 4 | K9 | Off-pad | Rat | | 1 |
| 12/18/2012 | 5 | K9 | Off pad | WTSH | | 1 |
| 12/20/2012 | 11 | K9 | On pad | Rat | 1 | |
| 12/20/2012 | 11 | K9 | On pad | Rat | 1 | |
| 12/20/2012 | 10 | K9 | Off-pad | Rat | | 1 |
| 12/20/2012 | 12 | K9 | Off pad | WTSH | | 1 |
| 2/7/2013 | 11 | K9 | On pad | Rat | 1 | |
| 2/7/2013 | 12 | K9 | Off-pad | Rat | | 1 |
| 2/11/2013 | 3 | K9 | On pad | Rat | 1 | |
| 2/11/2013 | 2 | K9 | Off-pad | Rat | | 1 |
| 2/11/2013 | 3 | K9 | Off-pad | Rat | | 0 |
| 2/12/2013 | 7 | K9 | On-pad | WTSH | 1 | |
| 2/12/2013 | 8 | K9 | On-pad | WTSH | 1 | |
| 2/12/2013 | 5 | K9 | Off pad | WTSH | | 1 |
| 3/1/2013 | 12 | K9 | On pad | Rat | 1 | |
| 3/1/2013 | 11 | K9 | On pad | Rat | 1 | |
| 3/1/2013 | 11 | K9 | On pad | Rat | 1 | |
| 3/5/2013 | 5 | K9 | On pad | Rat | 1 | |
| 3/5/2013 | 7 | K9 | On pad | Rat | 1 | |
| 3/5/2013 | 8 | K9 | Off-pad | Rat | | 0 |
| 3/11/2013 | 1 | K9 | On pad | Rat | 1 | |
| 3/11/2013 | 4 | K9 | On pad | Rat | 0 | |
| 3/11/2013 | 1 | K9 | On-pad | WTSH | 1 | |
| 3/11/2013 | 4 | K9 | On-pad | WTSH | 1 | |

**Appendix 9.** (cont).

| Date | WTG | Searcher | Vegetation | Carcass | Found On-pad | Found Off-pad |
|---|---|---|---|---|---|---|
| 5/23/2013 | 9 | K9 | On pad | Rat | 0 | |
| 5/23/2013 | 9 | K9 | On-pad | WTSH | 0 | |
| 5/24/2013 | 10 | K9 | Off pad | WTSH | | 1 |
| 5/27/2013 | 5 | K9 | On pad | Rat | 1 | |
| 5/27/2013 | 6 | K9 | Off-pad | Rat | | 0 |
| 5/27/2013 | 6 | K9 | Off pad | WTSH | | 0 |
| 5/29/2013 | 5 | K9 | On pad | Rat | 1 | |
| 5/30/2013 | 9 | K9 | On pad | Rat | 1 | |
| 6/3/2013 | 2 | K9 | On pad | Rat | 0 | |
| 6/3/2013 | 1 | K9 | On pad | Rat | 0 | |

**Appendix 10.** Hawaiian Hoary bat passes at Kahuku 2011-2013.

| **Anabat Location (WTG)** | **Date Range** | | **Detector Nights w Passes** | **Detector Nights** | **Passes per Detector Night** |
|---|---|---|---|---|---|
| 1 | 1/24/11 | 06/30/13 | 1 | 810 | 0.001 |
| 2 | 1/23/11 | 06/30/13 | 0 | 694 | 0.000 |
| 3 | 3/6/11 | 06/30/13 | 2 | 809 | 0.002 |
| 4 | 1/26/11 | 06/30/13 | 3 | 642 | 0.005 |
| 5 | 2/20/11 | 06/30/13 | 3 | 524 | 0.006 |
| 6 | 2/18/11 | 06/30/13 | 0 | 797 | 0.000 |
| 7 | 2/20/11 | 06/30/13 | 1 | 745 | 0.001 |
| 8 | 2/18/11 | 06/30/13 | 3 | 545 | 0.006 |
| 9 | 2/20/11 | 06/30/13 | 0 | 734 | 0.000 |
| 10 | 3/8/11 | 06/30/13 | 1 | 741 | 0.001 |
| 11 | 1/26/11 | 06/30/13 | 1 | 802 | 0.001 |
| 12 | 1/26/11 | 06/30/13 | 1 | 686 | 0.001 |
| Met 40 | 8/10/11 | 06/30/13 | 3 | 443 | 0.007 |
| Met 80 | 8/10/11 | 06/30/13 | 1 | 482 | 0.002 |
| NAC 2 | 3/27/2012 | 06/30/13 | 0 | 146 | 0.000 |
| NAC 5 | 3/27/2012 | 06/30/13 | 1 | 140 | 0.007 |
| NAC 8 | 3/5/2012 | 06/30/13 | 0 | 215 | 0.000 |
| NAC 11 | 3/27/2012 | 06/30/13 | 2 | 237 | 0.008 |
| | | **Total** | **23** | **10192** | **0.002** |

**Appendix 11.** Expenditures at KAH in FY 2013.

| Category | Item | Amount | Notes |
|---|---|---|---|
| Equipment | Bat detector | 48600 | Replace Anabats with Wildlife Acoustics, detector supplies |
| | | | |
| Contracts | SEEF Trials | 4200 | SWCA |
| | Canine assist | 3800 | Country Canine |
| | Kennel | 15000 | Hawaii Metal |
| | Veterinarian | 1400 | Waikele Vet. |
| Supplies | Fuel | 4000 | Vegetation Maintenance and Truck |
| | General Supplies | 27000 | Mower parts/repair, traps, bait, detector supplies/repair, signs, PPE, veg man. Supplies, rats, dog food, etc. |
| Labor | First Wind Labor | 93000 (salary plus 35% overhead) | 20 person months (permanent and temporary)for : Fatality Monitoring, Vegetation Management, Scavenger Trapping, Bat Detector Analysis, , Data Management/Reporting, CARE Trials, Machine Maintenance, dog care and training, Overhead |
| Mitigation | Waterbird, Pueo | 179500 | Paid to DOFAW for Hamakua Marsh State Sanctuary, labor charge, HWRC |
| | 2 Letters of Credit | 45000 | 4.5% of $1,000,000 |
| Travel | | 3000 | Conference, workshop, interisland |

# Scope of Work for Feral Cat and Barn Owl control in Newell's Shearwater colonies: Year One

Four areas have been identified for potential introduced predator control work – North Fork Wailua, Kalaheo, Sleeping Giant and Moalepe.

Auditory surveys by the Kauai Endangered Seabird Recovery Project (KESRP) in 2011 to 2013 have confirmed that these sites all currently contain Newell's Shearwater *Puffinus newelli* colonies. North Fork Wailua and Kalaheo are also all known as historical breeding sites for Newell's Shearwater. The Kalaheo colony in particular was intensively studied in 1993 and 1994, with 57 burrows located on two main ridge lines identified (Ainley et al, 1995). Currently, there is no management in any of these areas for seabird conservation.

Predation of endangered seabirds by non-native mammals and owls exist through-out these areas. Feral cats *Felis cattus*, rats (likely both Black *Rattus rattus* and Polynesian *Rattus exulans*), Barn owls *Tyto alba* and feral pigs *Sus scrofa* are all non-native predators that are potentially limiting the breeding success of birds within these colonies. Predation by all of the above predators has been documented on Newell's Shearwater and Hawaiian Petrel in Kaua'i. Arguably one of the most serious introduced predators on threatened seabirds in Kaua'i is the feral cat. Feral cat predation at the Kalaheo colony in particular has been identified as one of the main reasons why this colony is now reduced to a handful of breeding pairs.

This SOW addresses the need to reduce overall predation rates within these identified seabird colonies, specifically related to feral cats and Barn Owl. Management for these species at known colonies is expected to increase the survival rates of both adult birds and fledglings. In the longer term, this work could expand to include other introduced predators (through additional funding sources) and management of the areas to reduce other forms of mortality (such as power lines and invasive plant species).

The activities that DOFAW (through KESRP) will conduct during 2013 will entail the creation of a baseline activity level of Newell's Shearwater at four potential control sites using song meters. Song meters are proving to be an important component of colony level monitoring on Kauai, with work currently focusing on relating the change in calling rates to actual colony-level change over time. Song meters are currently being used for this purpose in Upper Limahuli Preserve and Hono o Na Pali NARS. Song meters are deployed and run by KESRP. Song meter analysis is currently being conducted by Conservation Metrics Inc.

**Annual Reporting Requirements**

By December 20th a report (via Conservation Metrics) will be produced. This will outline the results of the song meter analysis for all song meters deployed during the latter part of the 2013 breeding season.

By January 1st 2014, KESRP will produce a work plan and associated budget for predator control and seabird monitoring to be undertaken within one or more of the colonies outlined above during the 2014 breeding season.

## Budget

*The budget presented below is for two months of song meter work carried out at four colonies in August and September 2013. Analysis of data will be conducted by Conservation Metrics Inc, who have been analysing song meter data for KESRP for several years and have been proven to be reliable and efficient.*

| Item | Unit | Cost | Total Cost |
|---|---|---|---|
| | | | |
| **WAGES** | | | |
| ***Seabird monitoring*** | | | |
| Biological co-ordinator (co-ordination and report writing) | | | $2,125 |
| GIS support (mapping and planning) | | | $1,650 |
| 2 x field tech (2 week each, field work) | | | $2,153 |
| Fringe Benefits for above staff time | | | $1,991 |
| Per diems ($20/day when in field, 2 weeks, 4 days a week) | | | $320 |
| | | | |
| **HELICOPTER** | | | |
| Helicopter flights to deploy and recover song meters | 8 | $1,000 | $8,000 |
| | | | |
| **SEABIRD MONITORING EQUIPMENT** | | | |
| Garmin Rino Lithium-Ion Battery | 2 | $69.99 | $140 |
| Garmin Rino 650 | 2 | $449.99 | $900 |
| Go Pro Camera (HERO3:Black Edition) | 1 | $399.99 | $400 |
| HERO3 Rechargeable battery | 1 | $19.99 | $20 |
| | | | |
| Song meters - SM2 (3 per site,2 for Sleeping Giant) | 11 | 490 | $5,390 |
| Microphone for SM2 (2 per unit) | 22 | 70 | $1,540 |
| 32GB SD cards for SM2 (2 per unit) | 22 | 20.69 | $455 |
| Song Meter - D batteries (4 per unit*2 months) | 88 | 0.92 | $81 |
| Analysis of song meter data by Conservation Metrics (NESH & HAPE) | | | $12,371 |
| | | | |
| **SUB-TOTAL** | | | **$37,536** |
| Contingency (10%) | | | $3,754 |
| PCSU Overhead (16%) | | | $6,606 |
| | | | |
| **GRAND TOTAL** | | | **$47,896** |

(Note budget cost would be reduced significantly if First Wind purchases the equipment and pays for helicopter directly as this will negate the 16% PCSU overhead. If that was the case, total would come to **$42,608.** Also note that helicopter costs are an estimate based on previous work with roving units.)

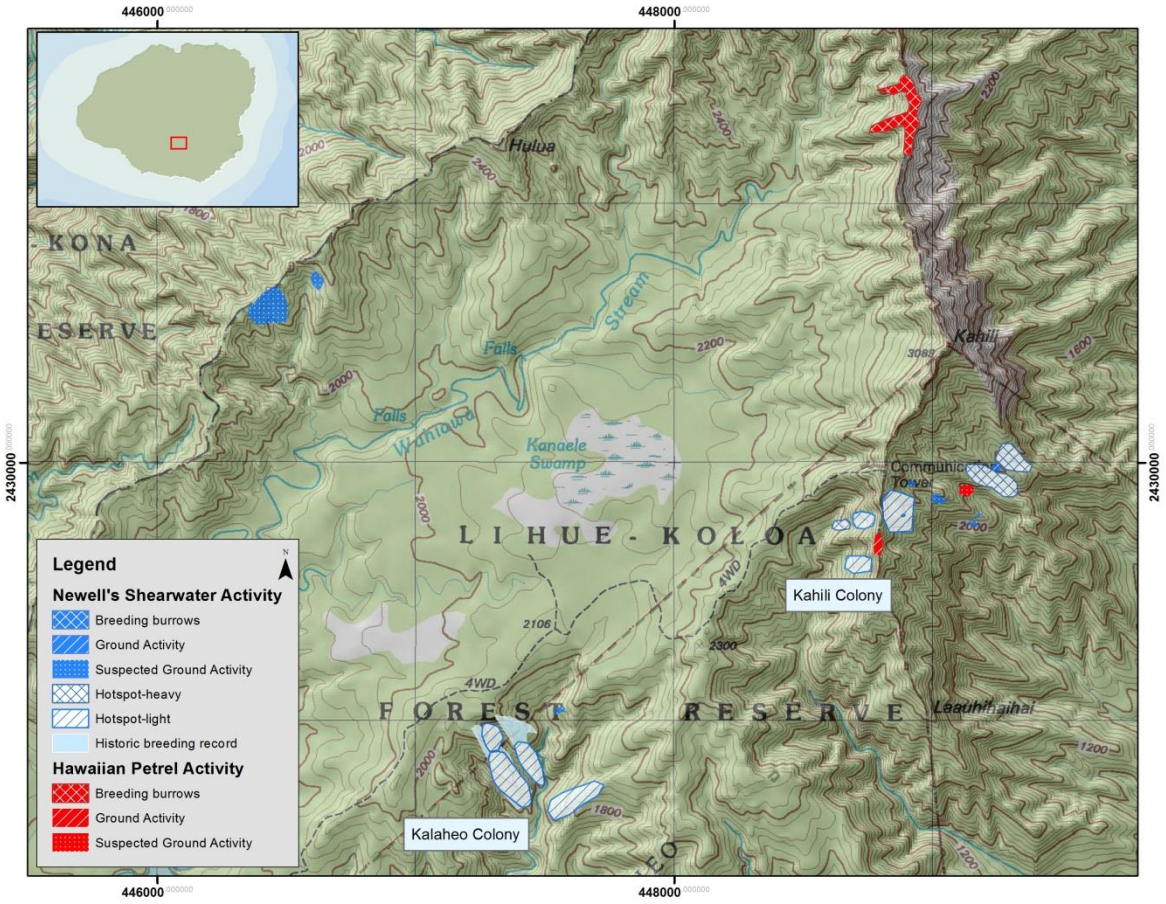



**Figure 1**. Distribution of known seabird colonies within the Kalaheo area.

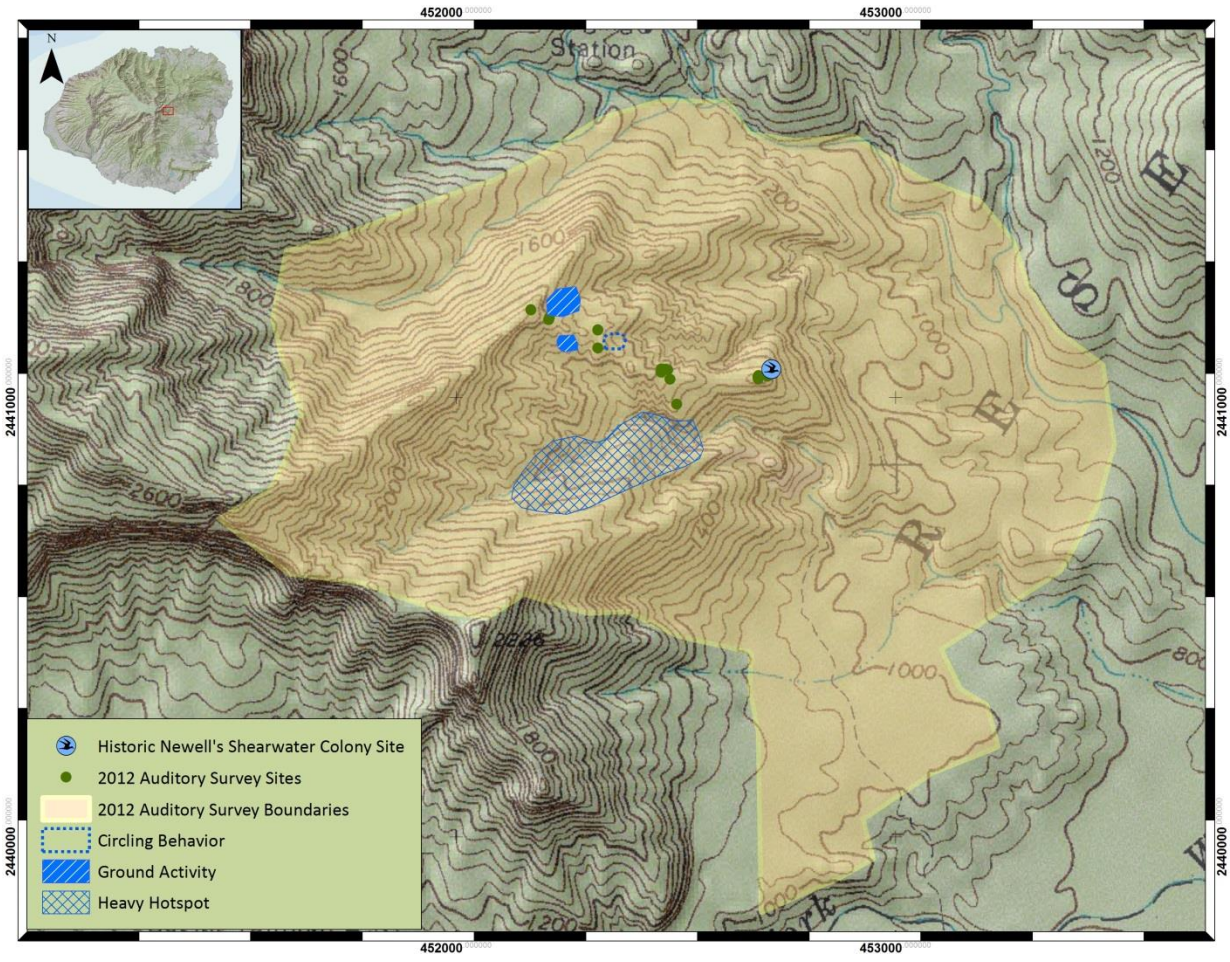



**Figure 2.** Distribution of known seabird colonies within the North Fork Wailua area.

Appendix 13.

JULY 2013 WATERBIRD NESTING ACTIVITY HAMAKUA MARSH

ISLAND OF OAHU

Prepared by: Katherine Doyle, Wildlife Biologist

Oahu Division of Forestry and Wildlife

## INTRODUCTION

Since July 2011, the Division of Forestry and Wildlife (DOFAW), funded by the Kahuku Wind Power's Hawaii Conservation Plan (HCP), has been actively managing Hamakua Marsh. Predator control and vegetation maintenance have been identified as key needs for maintaining and increasing waterbird productivity. Waterbird productivity is: nesting success, fledgling success, overall habitat utilization, and predator control success. Predator control has been contracted through the United States Department of Agriculture, Wildlife Services (USDA-WS). Predator control is conducted year-round to ensure enhanced waterbird nesting success. Vegetation maintenance is done by DOFAW personnel using herbicide, machinery, and hand tools. The Hawaiian Stilt (*Himantopus mexicanus knudseni*), Hawaiian Gallinule (*Gallinula chloropus sandvicensis*), and Hawaiian Coot (*Fulica alai*) are endemic and endangered Hawaiian waterbirds that utilize Hamakua Marsh for nesting, feeding, and loafing. There are also Black-crested night herons (*Nycticorax nycticorax)*, Mallard ducks (*Anas platyrhynchos*) and Mallard/Hawaiian Duck (*Anas platyrhynchos/Anas wyvilliana*) hybrids at Hamakua. A number of shorebirds also utilize this wetland as a loafing area. The Pacific golden plover (*Pluvialis fulva*), Ruddy turnstone (*Arenaria interpres*), Wandering tattler (*Tringa incana*), and Cattle Egret (*Bubulcus ibis*) are commonly seen and recorded. The main water source at Hamakua is the rainfall. There is a canal that runs adjacent to the marsh, but it plays a minor role for water in the interior mudflats, except when large amounts of water enter the system. Because the wetland's water supply is from the rain, flooding usually only occurs in the winter. This means the wetland dries out in the late summer, and after the nesting season is over, machinery and herbicides can be used for management. This quarter, there was 119% of the average precipitation for Hamakua Marsh (appendix 1). Because of this rain, the nesting season was extended and the marsh still has nests.

## METHODS

Survey Start Date: April 1, 2013
Survey End Date: June 28, 2013

Surveys are conducted following DOFAW protocol and have been repeated the same for every survey. Observers walked along the bank of the stream, on the shop side, away from the nesting areas, to avoid contact with birds, and survey the entire 22.7-acre wetland. This distance allows for observation of natural activity; most of the waterbirds in Hamakua are tame and expect to be fed when approached, so distance is needed to observe natural habits. The survey starts at the northwest corner of Kailua Road and Hamakua Drive, then continued southeast along the canal and marsh fence line. On each visit, the number of waterbirds and shorebirds in each of the four Basins were counted, native or non-native. Gallinule, Coot and Stilt numbers, habitat usage, nesting activity, banding information, predator control success, and overall wetland condition were the main focus in each of the surveys. Individuals were counted and mapped. Habitat usage was identified as: stream, stream bank, mudflat, mudflat/vegetated, 0"-3" water, 3"-6" water and >6" water (appendix 2a.-c.). Nesting activities of each species were also observed. Pairings, establishment of territory, and nesting activity was observed and recorded on maps. Survival rates of chicks and brood sized were also recorded. 21 bird surveys were performed at Hamakua Marsh from April 2013 until June 2013.

**NEST ACTIVITY AND REPRODUCTIVE SUCCESS**

Hamakua Marsh was surveyed from April 1st until June 28th (appendix 3-5). During this time, a total of 50 hours total was spent on monitoring the Stilts, Moorhens, and Coots. Also during this time, a total of 160 hours was spent on vegetation maintenance. The following table shows the time allocation.

| 2013 | Hours Surveying | Hours Vegetation |
|---|---|---|
| April | 10 | 64 |
| May | 20 | 56 |
| June | 20 | 40 |

**WATERBIRD SUCCESS**

The surveys found a range of numbers for all native and non- native birds. The ducks seen were Mallards and possibly a few Koloa hybrids. The ducks were seen on the banks and in the parking lots behind the shops on Hamakua Drive, where they are feed by the public. There was an average of 28 Mallard/Koloa hybrids seen during surveys. Also seen along the shop banks were the Black Crested Night Heron, or Aku'u. There were about 38 adult Aku'u seen. Inside the marsh along the grasslands, Cattle Egrets were seen. On average there were 10 egrets within the wetland. The wetland also supports Pacific Golden Plovers (16 avg. before they migrated north), Ruddy Turnstones (6 avg.), and Wandering Tattler's (6 avg.), which are usually found loafing on the grassy canals. The following is a breakdown of the annual fledging results. Every quarterly report, I will update these numbers.

| Fledgling Results | Coot | Moorhen | Stilt | Vegetation Maintenance | Predator Control |
|---|---|---|---|---|---|
| 2005 | 1 | 13 | 1 | Grass, limited tilling | During nesting season |
| 2006 | 0 | 51 | 15 | Tilling post breed 2005 | During nesting season |
| 2007 | 1 | 36 | 13 | No tilling | Year round |
| 2008 | 5 | 33 | 10 | No tilling | Year round |
| 2009 | 5 | 52 | 16 | Tilling post breed | Year round |
| 2011 | 8 | 30 | 2 | No tilling, grass | Year round |
| **2012** | **1** | **10** | **4** | **Tilling post breed 2011, grass** | **Year round** |
| **2013** | **2** | **19** | **11** | **No tilling, grass** | **Year round** |
| **2013** | | | | | |

*bold denotes HCP activity years

**'Alae Ke'oke'o**

Since the fall of 2011, a University of Hawaii graduate student, Randi Rhodes, has been catching coots to study them. She takes vital information, collars them, and releases where she catches them. There are three resident collard coots in Hamakua: AAD, ABT, and AAA.

Generally in this quarter, coot numbers ranged from 10 – 12. While we had nest in March, we only had 1 of the 6 chicks born fledge. What I notice is the chicks disappear in one night. I'm not sure what is causing the sudden loss, but I feel it is most likely the proximity to the Kailua town. The coots nest on the stream bank, and are the closest to humans and predators. The first nest had 4 chicks hatch in the B basin across from Down to Earth in the middle of April. Between May 7 and 8, I noticed 3 chicks disappear. The final chick fledged by the beginning of June, and was last seen flying away on the 14th. At the second nest, located in the C basin across from Foodland, I noticed 2 chicks the 24th of May. The next week, there was only 1, and the next day, none. Two nests were seen the last week of June, and we will have more chicks born in late July pending nothing predates them before.

During this quarter, coots were primarily seen within the stream in the A, B and C Basin (appendix 3, 4). Coots prefer to nest in locations that have robust emergent plants interspersed with open, fresh water which is usually less than 3 feet deep. They look for an area with room for takeoff and landing, but still protected from the wind. Salinity levels were taken periodically throughout the quarter.

| | Basin A | Basin B | Basin C | Basin D | Total |
|---|---|---|---|---|---|
| Stream | 0 | 6 | 4 | 2 | 12 |
| Stream Bank | 0 | 0 | 0 | 0 | 0 |
| Mudflat | 0 | 0 | 0 | 0 | 0 |
| Mudflat/Veg | 0 | 0 | 0 | 0 | 0 |
| 0" - 3" | 0 | 0 | 0 | 0 | 0 |
| 3" - 6" | 0 | 0 | 0 | 0 | 0 |
| > 6" | 0 | 0 | 0 | 0 | 0 |

**'Alae 'Ula**

Gallinule had the largest population among the endemic waterbirds within the marsh. Surveys found population counts ranged from 14 to 40. While only 2 nests have been seen this quarter, 32 chicks were seen. They are very secretive birds, and it is common that they are not been seen until the chicks have hatched. Of these, 16 chicks fledged, and judging from the increase in overall numbers, most stayed in Hamakua. With the abundance of water, emerging vegetation, and resources, it seems Hamakua has not reached its carrying capacity. In the end of June, we still have 2 nests with eggs. These are both in the A basin in the middle of the batis (appendix 3, 4). It seems we have had nesting almost continuously since October of 2012.

| | Basin A | Basin B | Basin C | Basin D | Total |
|---|---|---|---|---|---|
| Stream | 0 | 4 | 1 | 3 | 8 |
| Stream Bank | 0 | 2 | 6 | 2 | 10 |
| Mudflat | 0 | 0 | 0 | 0 | 0 |
| Mudflat/Veg | 4 | 2 | 4 | 2 | 12 |
| 0" - 3" | 4 | 0 | 0 | 0 | 4 |
| 3" - 6" | 0 | 0 | 0 | 0 | 0 |
| > 6" | 0 | 0 | 0 | 0 | 0 |

Most often, birds were seen along the stream bank, popping their heads out of the *Batis*, or on the grassy knoll abutting parking lot or within parking lot. Gallinules generally prefer to nest in locations above open water less than 3 feet, but may choose to nest in dry areas, which leave chicks more easily accessible to predation. Survivorship of gallinule chicks is difficult to ascertain because of their secretive nature.

**'Ae'o**

Stilt numbers were between 20 and 35 this quarter. The stilts started nesting at the end of April this year, coinciding with a large rain. Nests were seen in all four basins, from the road up to the stream. By the end of May, we had almost 25 stilt chicks. Unfortunately, a dog got into the marsh and killed 3 chicks and 1 adult on the berm diving C and D basin. The dog was later snared and euthanized. All but 1 adult stilt from the D basin were killed in this incident. I was able to band 8 stilts before they fledged. So far this year, we have had 11 stilts fledge, and we have 3 nests with eggs that have not hatched yet (appendix 3, 4). It is because of the vegetation management, predator control and rain that Hamakua is able to support this large amount of endangered birds.

| | Basin A | Basin B | Basin C | Basin D | Total |
|---|---|---|---|---|---|
| Stream | 0 | 0 | 1 | 0 | 1 |
| Stream Bank | 0 | 4 | 2 | 0 | 6 |
| Mudflat | 0 | 0 | 0 | 0 | 0 |
| Mudflat/Veg | 4 | 10 | 10 | 2 | 26 |
| 0" - 3" | 0 | 0 | 0 | 0 | 6 |
| 3" - 6" | 0 | 0 | 0 | 0 | 0 |
| > 6" | 0 | 0 | 0 | 0 | 0 |

**TRACKING TUNNELS RESULTS**

Tracking tunnels are used by conservationists to check for the presence of pest species in a target area. Because predators are often nocturnal, and are not readily seen during daylight, tracking tunnels give an indication of the presence of predators in the area. Tracking tunnels were deployed once per month, from July to present, to monitor trapping success. The construction was compliant with commonly used tunnels, 4" x 5" x 21". This rectangular box had peanut butter bait in the middle, ink pads surrounding the bait, and tracking cards placed on the inside of the tunnel. The tunnels were placed in a variety of areas to get a better understanding of rat activity (appendix 6). At each different spot, the tunnels were deployed overnight to monitor animal activity. The following table shows the results.

| | 4/4/2013 | 5/14/2013 | 6/13/2013 |
|---|---|---|---|
| Rat signs | 4 | 5 | 2 |
| No signs | 6 | 5 | 8 |
| # tunnels | 10 | 10 | 10 |
| Rat tracks % | 40% | 50% | 20% |
| Days elapsed | 1 | 1 | 1 |

**TRAPPING RESULTS**

Live trapping, hunting and firearms were used throughout the quarter by the USDA-WS, to control predators in the Sanctuary. 20 traps are placed along the inner fenceline about 180 feet apart (appendix 5). The traps are baited and checked every 48 hours, except over holidays. A total of 1 dog, 19 duck species, 47 mongooses, and 87 rats were euthanized this quarter. A total of 45 days were spent visiting the site, with 98 hours of field work completed.

| | Killed Euthanized | Transfer Custody |
|---|---|---|
| Dogs | 1 | |
| Feral Ducks | 5 | |
| Mallard Ducks | 14 | |
| Mongooses | 47 | |
| Rats | 87 | |

No snap-traps were set in this quarter.

**VEGETATION**

Since the winter rains have started, invasive species Indian fleabane (Pluchea indica) and koa haole (Leucaena leucocephala) were targeted and removed. Non-native Guinea grass (Urochloa maxima) and California grass (Urochloa mutica) are also targeted for removal, so as to reduce biomass and encourage growth of native plants and

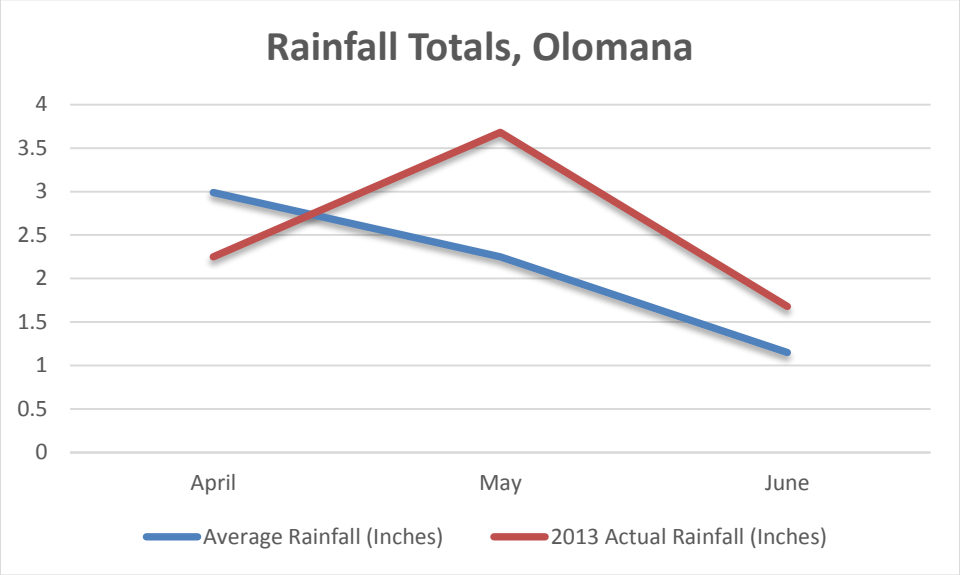
non-native Bermuda grass (Cynodon spp.). Bermuda grass populations are encouraged on access roads, outplanting sites, and slopes, to reduce erosion.

Mowing along grassy roads and surrounding marsh land continued. This provides extra foraging grounds for stilts, moorhens, kolea and other birds. By keeping the grass cut low, 2.5", this keeps California grass from growing and spreading. The inside of the marsh where the California grass was able to establish and grow during the nesting season, was sprayed, and cut. Weed-whacking the surrounding burms and roadways, has continued.

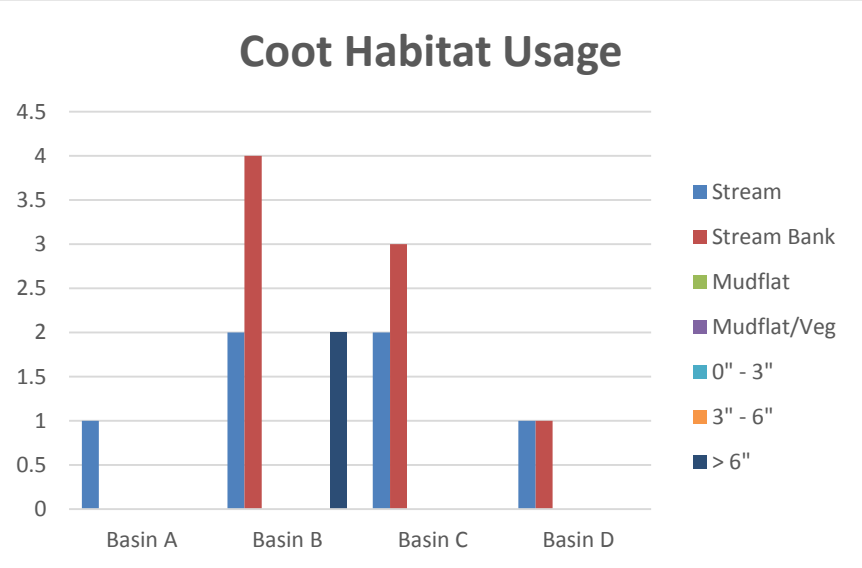
Only 440 gallons of herbicide has been sprayed around the marsh on batis, and California grass this quarter. The marsh itself has been wet, and had too much water to spray. It was also too wet to till this year. Continued removal of Pluchea and Koa Haole, Kiawe, and Acacia mearnsii (black wattle) has opened up more of the marsh in the "B" basin along the rock wall. Removal of these invasives, has made the area flat and open, and able to be mowed.

The back fenceline of the "A" basin clearing started in May. Upon the removal of kiawe, pluchea and christmas berry, an additional 200 sq. feet of marsh was discovered. This area was covered in batis, and I believe removing of this material will bring desired nesting area. It was also during this time that a large amount of rats were trapped and removed.

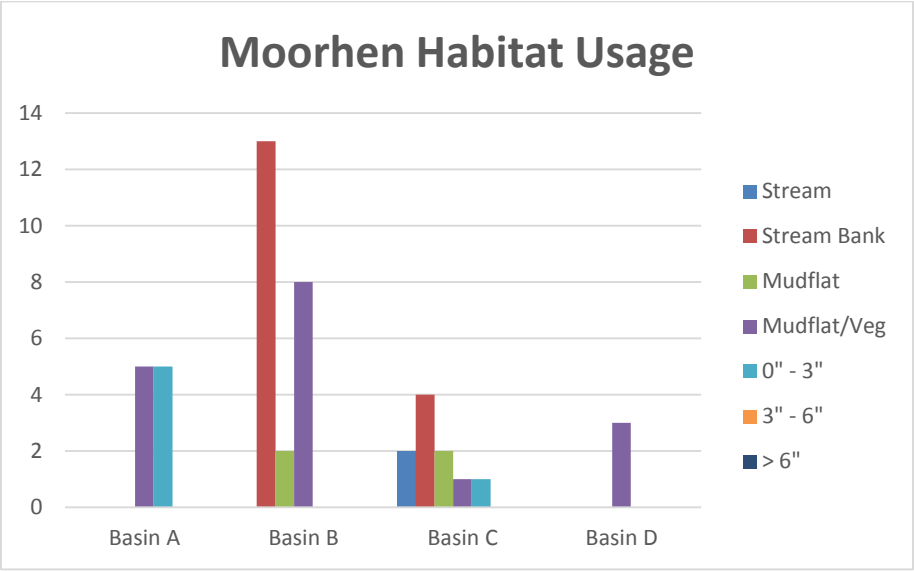
Appendix 1.



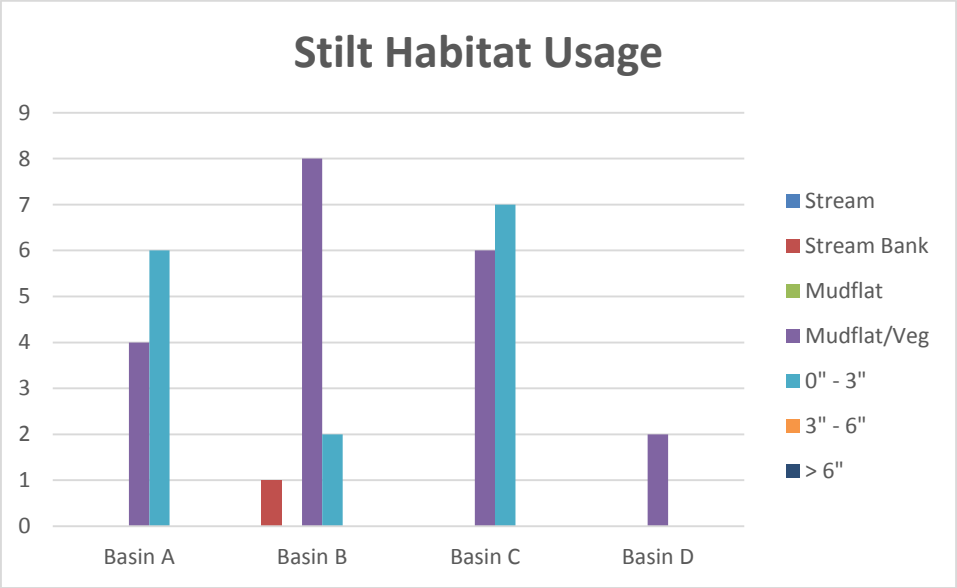

Appendix 2.a.



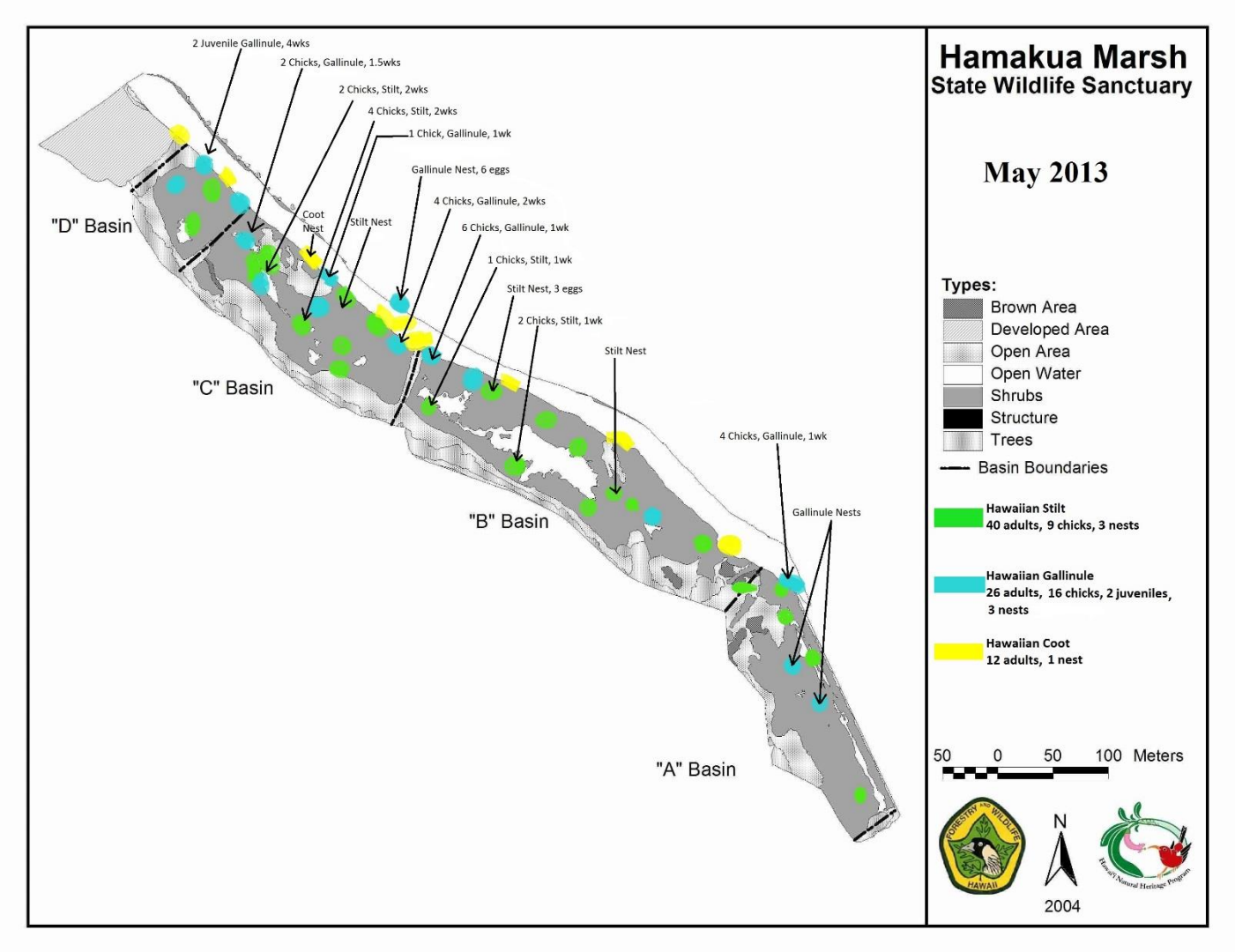
Appendix 2.b.



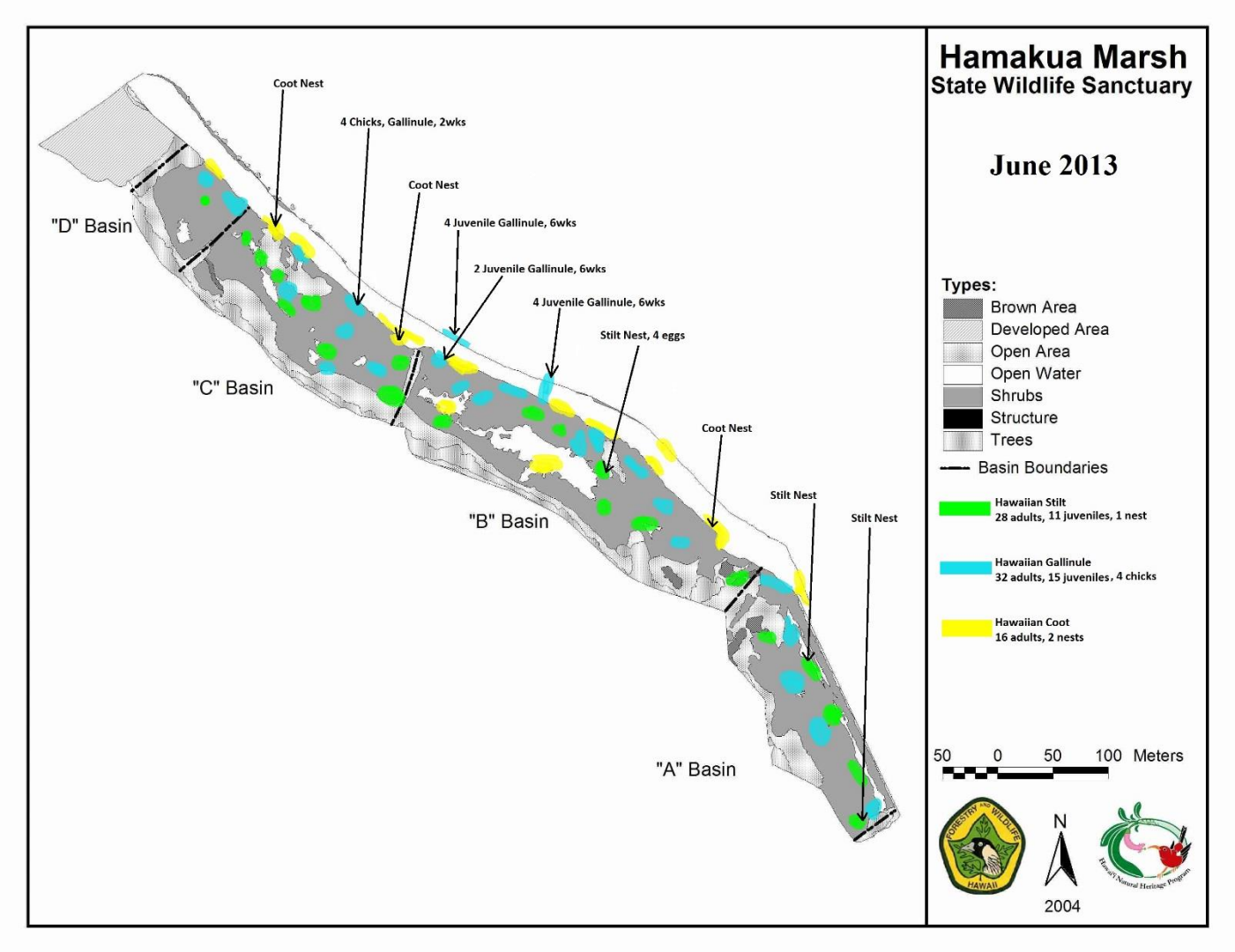

Appendix 2.c.



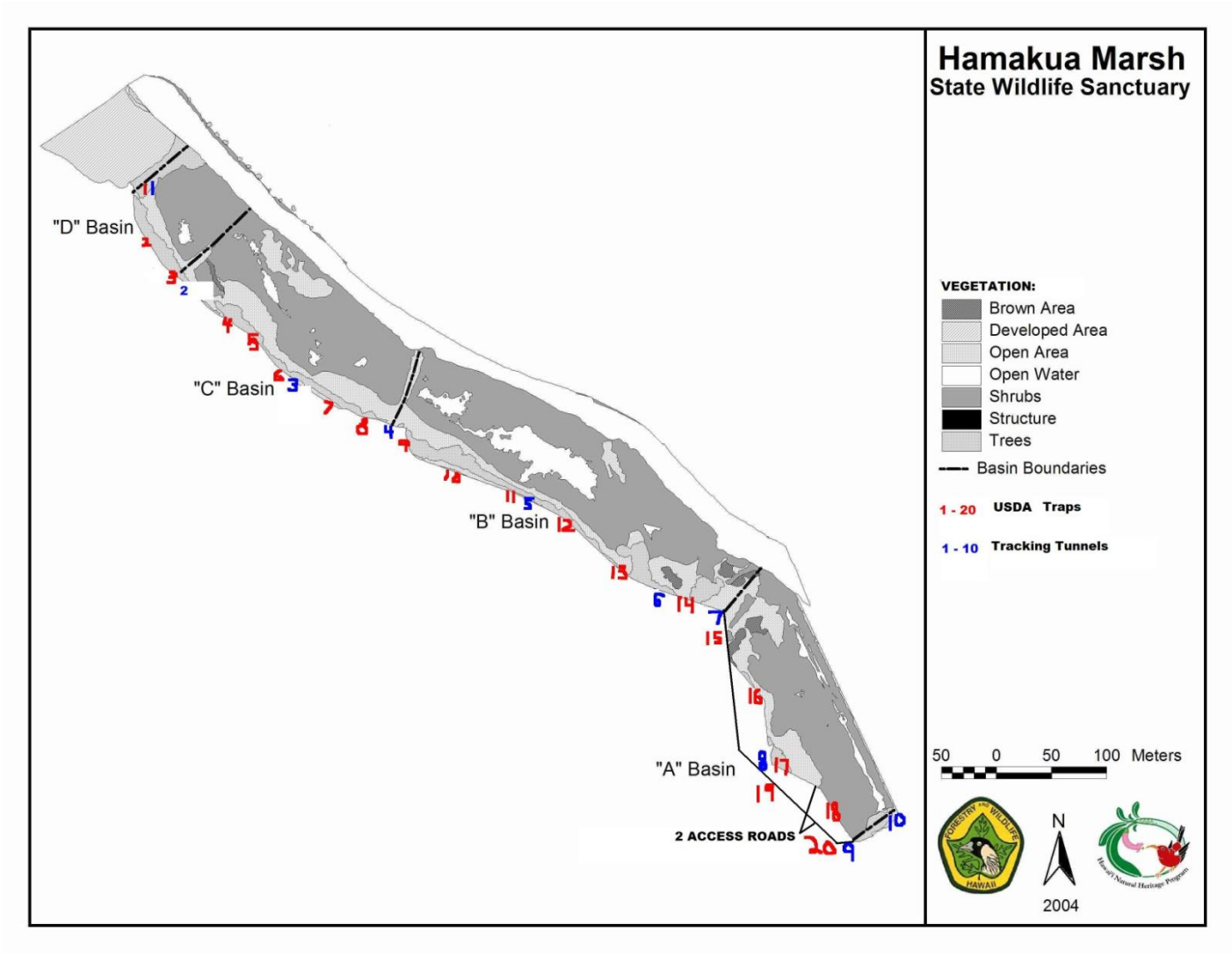
Appendix 3.


2 Juvenile Gallinule, 4wks
2 Chicks, Gallinule, 1.5wks
2 Chicks, Stilt, 2wks
4 Chicks, Stilt, 2wks
1 Chick, Gallinule, 1wk
Gallinule Nest, 6 eggs
4 Chicks, Gallinule, 2wks
6 Chicks, Gallinule, 1wk
1 Chicks, Stilt, 1wk
Stilt Nest, 3 eggs
2 Chicks, Stilt, 1wk
Stilt Nest
4 Chicks, Gallinule, 1wk
Gallinule Nests
Coot Nest
Stilt Nest
"D" Basin
"C" Basin
"B" Basin
"A" Basin
Hamakua Marsh
State Wildlife Sanctuary
May 2013
Types:
Brown Area
Developed Area
Open Area
Open Water
Shrubs
Structure
Trees
Basin Boundaries
Hawaiian Stilt
40 adults, 9 chicks, 3 nests
Hawaiian Gallinule
26 adults, 16 chicks, 2 juveniles, 3 nests
Hawaiian Coot
12 adults, 1 nest
50 0 50 100 Meters
N
2004

Appendix 4.


Hamakua Marsh
State Wildlife Sanctuary
June 2013
Coot Nest
4 Chicks, Gallinule, 2wks
Coot Nest
4 Juvenile Gallinule, 6wks
2 Juvenile Gallinule, 6wks
4 Juvenile Gallinule, 6wks
Stilt Nest, 4 eggs
Coot Nest
Stilt Nest
Stilt Nest
"D" Basin
"C" Basin
"B" Basin
"A" Basin
Types:
Brown Area
Developed Area
Open Area
Open Water
Shrubs
Structure
Trees
Basin Boundaries
Hawaiian Stilt
28 adults, 11 juveniles, 1 nest
Hawaiian Gallinule
32 adults, 15 juveniles, 4 chicks
Hawaiian Coot
16 adults, 2 nests
50 0 50 100 Meters
N
2004

Appendix 5.




Appendix 6.

**2013 Tracking Tunnel Station**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/22/2013 | 0 | 0 | 0 | 0 | R | 0 | 0 | 0 | 0 | 0 |
| 2/19/2013 | 0 | 0 | 0 | 0 | 0 | 0 | R | 0 | 0 | 0 |
| 3/19/2013 | 0 | 0 | 0 | 0 | 0 | 0 | R | 0 | 0 | 0 |
| 4/4/2013 | R | R | R | R | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/14/2013 | 0 | 0 | R | R | 0 | R | R | R | 0 | 0 |
| 6/13/2014 | 0 | 0 | 0 | R | 0 | 0 | 0 | R | 0 | 0 |
| | | | | | | | | | | |

R = mammal tracks present
0 = no tracks present