

Kahuku Wind Power  
Habitat Conservation Plan  
Annual Report: FY 2017



Kahuku Wind Power, LLC  
56-1050 Kamehameha Hwy  
Kahuku, Hawai'i 96731  
August, 2017

ITL-10 BO# 2010-F-0190

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.

A handwritten signature in cursive script, reading "Mitchell Craig".

Hawai'i HCP Manager  
TerraForm Power, LLC

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## ***Executive Summary***

Kahuku Wind Power, LLC (KAH) has been implementing a Habitat Conservation Plan (HCP) since approval in May 2010. A federal Biological Opinion (BO 2010-F-0190) and a Hawaii Incidental Take License (ITL-10) were approved in May and June 2010, respectively. The project includes twelve 2.5 MW wind turbine generators and began commercial operations on March 23, 2011. This report summarizes work performed by KAH for the State of Hawaii fiscal year (FY) 2017, July 1, 2016 - June 30, 2017. Species covered under the HCP include the Hawaiian stilt, Hawaiian coot, Hawaiian duck, Hawaiian moorhen, Newell's shearwater, Hawaiian petrel, Hawaiian hoary bat and the Hawaiian short-eared owl.

Terraform Power, LLC now operates KAH. Because of this ownership change the federal loan guarantee with U. S. Department of Energy is paid and DOE no longer regulates activities under the BO; however, the U.S. Fish and Wildlife Service has determined that the BO Incidental Take Statement associated with the BO remains in effect with a letter dated November 19, 2014. The HCP and ITL remain unchanged and in the project's name, Kahuku Wind Power, LLC.

Fatality monitoring plots were reduced to 35-meter (m) radius plots searched once weekly beginning in April 2015. Deborah Wilson and her canine Murphy provided canine-assisted searching in FY 2017. No visual searching occurred in FY 2017. Mean and standard deviation (SD) of search interval in days is 6.98 and 0.46, respectively. The FY 2017 search area density weighted proportion (DWP) of the predicted total fall distribution for the bat is approximately 70% based on Hull and Muir (2010).

No HCP covered species were found in FY 2017. Two great frigatebirds (*Fregata minor*) were the Migratory Bird Treaty Act covered species found dead in FY 2017. No non-native introduced species were found in FY 2017. The total estimated direct take for four observed bats at 80% credibility level is eight and the indirect take is three adults (converted using the juvenile to adult survival rate). The total estimated take is 11 adult bats.

Forty-four searcher efficiency trials with six medium size birds and 38 small size rats and four 28-day carcass retention trials with four medium size birds and 21 small size rats were conducted in FY 2017. The results for searcher efficiency for small rats is 97.4 % and for medium birds is 100 %. The mean and SD for small rat carcass retention in days is 10.52 (SD = 9.40) and for medium birds is 21.75 (SD = 12.50).

Twelve Wildlife Acoustics SM2BAT+™ ultrasonic detectors with one SMX-U1™ microphone each located 50 meters from the project's 12 wind turbine generators and at 6.5 meters above the ground detected Hawaiian hoary bats on 0.5 % of total detector nights in FY 2017). Bats were detected at eight of 12 locations and in six of 12 months, peaking in July, August and September.

Baseline mitigation for Newell's shearwater and Hawaiian petrel was completed in FY 2017 quarter 2. Baseline mitigation for waterbirds, pueo and bat are complete. KAH provided abbreviated quarterly summary reports for FY 2017 quarters 1-3. The Endangered Species Recovery Committee reviewed the FY 2016 annual HCP report on November 1-2, 2016.

## ***Introduction***

This report summarizes work performed by Kahuku Wind Power, LLC (KAH) under the terms of the approved Habitat Conservation Plan (HCP) dated May 27, 2010 and pursuant to the project's Incidental Take License (ITL-10) and Biological Opinion (BO# 2010-F-0190) at the conclusion of the State of Hawaii FY 2017 (July 1, 2016 – June 30, 2017). KAH has previously submitted annual HCP progress reports for FY 2011 through FY 2016 to the U.S. Fish and Wildlife Service (USFWS) and the Department of Land and Natural Resources- Division of Forestry and Wildlife (DOFAW) (Kahuku Wind Power 2011, 2012, 2013, 2014, 2015 and 2016).

The BO and ITL were issued for the project in May and June, 2010, respectively, for 20-year periods. 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 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.

Terraform Power, LLC now operates KAH. Because of this ownership change the U.S. Department of Energy no longer regulates activities under the BO, however USFWS has determined in a letter dated November 19, 2014 that the BO Incidental Take Statement remains in effect. The HCP and ITL remain unchanged and in the project's name, Kahuku Wind Power, LLC.

## ***Downed Wildlife Monitoring***

KAH biologists have implemented 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 since operations began in January 2011 (commercial operations officially began on March 23, 2011). Fatality monitoring plots were reduced from initial intensive monitoring (twice weekly to 64-meter (m) radius circular plots centered on each wind turbine generator (WTG) and every two weeks to 96m radius) on September 15, 2014 to only 64m radius searched twice weekly. The KAH HCP indicates that after three years of intensive monitoring the search plot area could be reduced as an adaptive management action with agency agreement. Both USFWS and DOFAW agreed to this proposed reduction in an e-mail dated September 8, 2014.

In the December 16, 2014 meeting of the Endangered Species Recovery Committee (ESRC) members proposed KAH temporarily proceed with the "interim monitoring" plan until all monitoring data to date was compiled and presented at the next ESRC meeting. Interim monitoring had been proposed by KAH in keeping with the KAH HCP plan as monthly searches of all WTGs to 30m radius circular plots. From December 2014 through March 2015 plots were searched monthly to 35m radius. At the March 31, 2015 ESRC meeting, after review of monitoring data, members agreed to "encourage the applicant to work with the statistical experts and researchers to develop an alternative more efficient and focused monitoring strategy which still meets the committees expressed preference for continuation of annual monitoring". Interim monitoring was then discontinued and intensive monitoring within a reduced area commenced. Downed wildlife monitoring searches beginning in April 2015 have been conducted weekly, year-round, within 35m radius circular plots centered on each WTG (Figure 1).

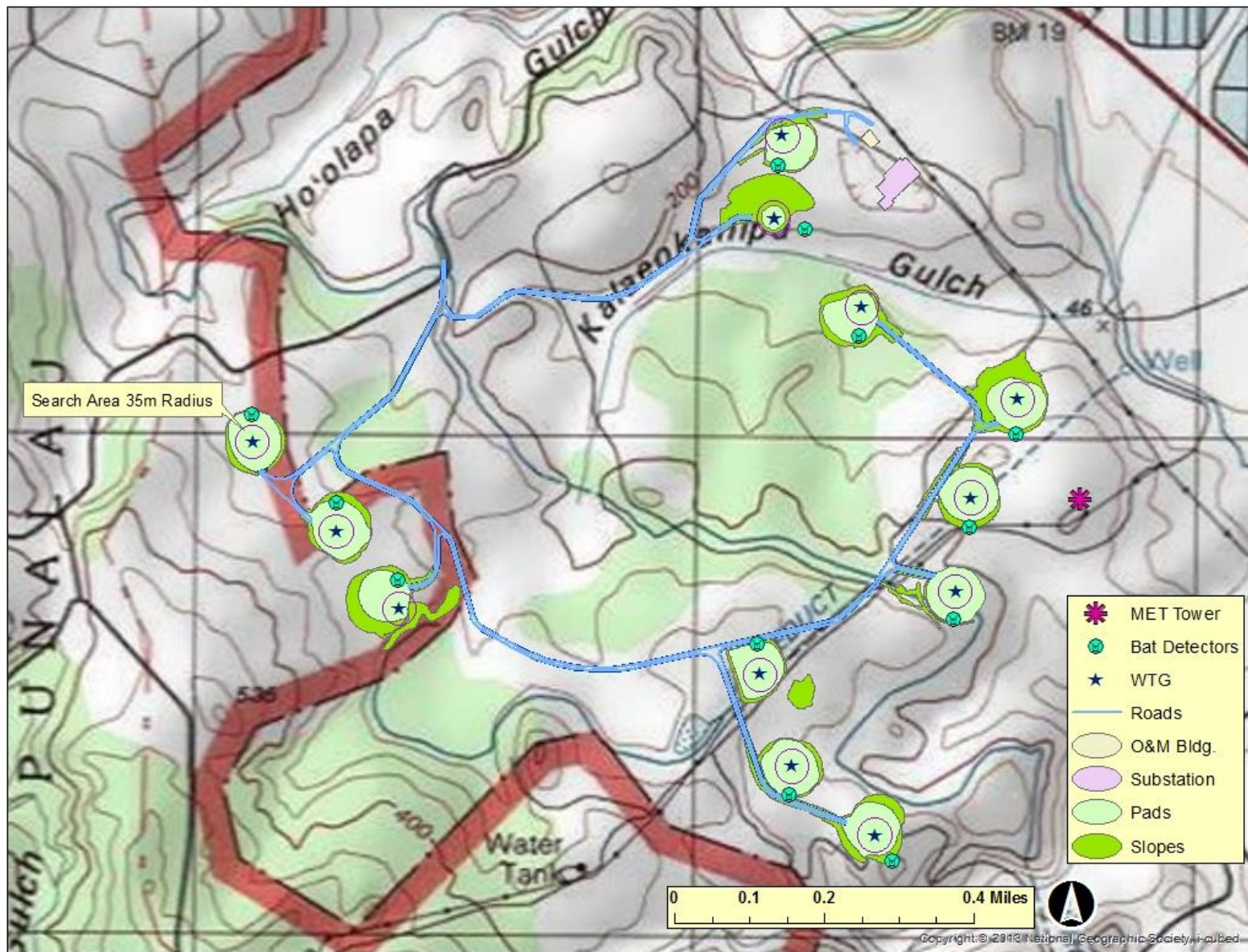


Figure 1. KAH roads, WTG's, MET tower, fatality monitoring plots and bat detector locations.

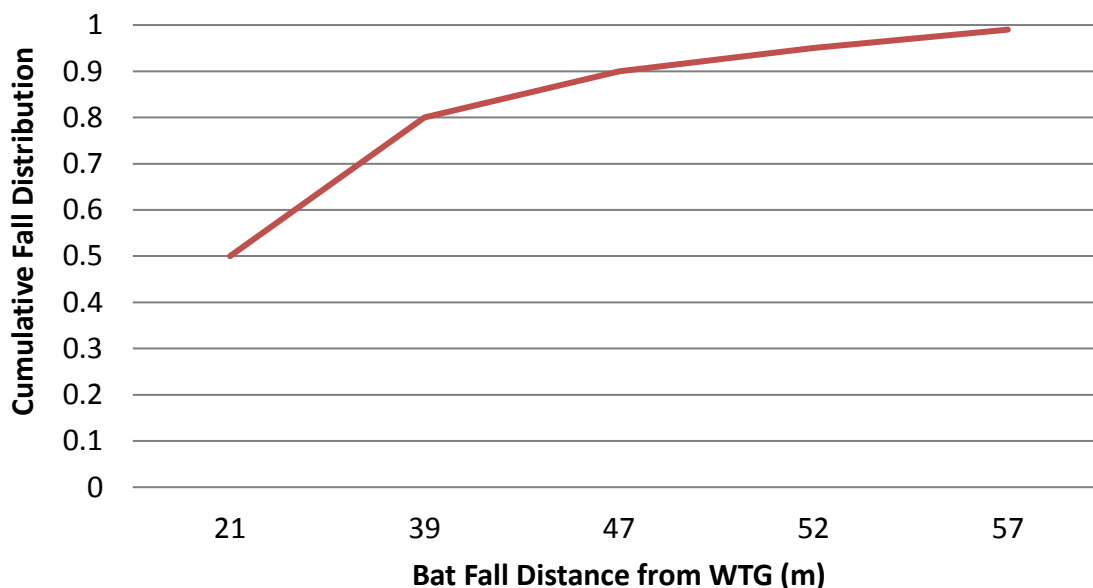


The density weighted proportion (DWP) of the predicted total fall distribution is one of the measured variables used to estimate the total take for each HCP listed species (see Estimated Adjusted Take). The DWP has also been called the density weighted area (DWA). No wind farms on O’ahu have WTGs with a nacelle height like KAH (80m) and the limited number of observed fatalities at KAH are insufficient to create a reliable fatality distribution. Therefore, we base the DWP for the 35m radius circular plots at KAH on the ballistics modelling of Hull and Muir (2010). Hull and Muir consider WTGs with an 80m nacelle height to be “medium” height WTGs. The DWP of the total predicted fall distribution for bats at a medium height WTG and in a search area of 35m radius circular plots would be approximately 70% (Figure 2, Table 5 in Hull and Muir (2010)). Hull and Muir (2010) models that 38m radius includes 80% of the total predicted fatality distribution.

All searches for a specific week occurred on the same day (Appendix 1). Search interval mean and standard deviation (SD) in days for KAH in FY 2017 is 6.98 and 0.46, respectively. Canine-assisted searching began at KAH in August 2012. Deborah Wilson and her canine Murphy were contracted to provide canine-assisted searching in FY 2017. Canine-assisted searching was the primary search method, with visual searching by HCP staff if canine-assisted searching was not available. No visual searches were required in FY 2017.

No HCP covered specie’s fatalities were found in FY 2017. The total observed take for HCP covered species at KAH is four bats, with the last bat take observed August 29, 2014. Two Migratory Bird Treaty Act protected birds, great frigatebirds (*Fregata minor*), were found dead in FY 2017, on August 23, 2016 and February 15, 2017. No non-native introduced species were found. All incidents were reported to DOFAW and USFWS within 24 hours. KAH submitted downed wildlife incident reports to DOFAW and USFWS within three days of each discovery.

As prescribed in the HCP, KAH had initiated adaptive management (see Adaptive Management below) measures to reduce bat fatalities at the site on April 27, 2012.



**Figure 2. The cumulative fall distribution of bats struck by distance from WTG (based on Hull and Muir (2010) for a medium height WTG).**



## ***Vegetation Management***

Fatality monitoring plots around the WTG's are mowed every 2-3 weeks only within the 35m reduced search radius. The vegetation within 35m is primarily bare ground and short grass that reaches 4-6 inches before management.

## ***Carcass Retention Trials***

Four 28-day carcass retention (CARE) trials with four medium size birds (wedge-tailed shearwaters) and 21 small size rats were conducted in FY 2017, one trial in each quarter (Appendix 2). The mean medium bird carcass retention in days is 21.75 (SD = 12.50) and for small rat is 10.52 (SD = 9.40).

## ***Searcher Efficiency Trials***

Six medium size bird and 38 small rat searcher efficiency (SEEF) trials were successfully proctored for the canine-assisted searcher by the KAH HCP manager (Appendix 3). The searcher efficiency results for medium birds and small rats in FY 2017 is 100% and 97.4%, respectively.

## ***Estimated Adjusted Take***

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

A stipulation of the estimator model is that only fatalities observed within the search area are included in the take estimation. Fatalities observed outside of the designated search area or incidental to searches are considered in the estimation calculation to have already been represented in the un-searched portion of the total expected fatality distribution. No HCP covered species were found outside of the designated search area.

The total estimated direct take at the 80% credibility level, is eight (Appendix 4). Observed direct take (ODT) is the only take that has been documented and confirmed at the site. However, for the purposes of estimating potential take for permitting and mitigation, the Evidence of Absence estimator calculates additional take that may have occurred but that was not observed. This unobserved direct take (UDT) attempts to account for fatalities that may have fallen outside of search plots, were missed by searchers within search plots, or were removed by scavengers or environmental factors such as high winds.

In addition to ODT and UDT, indirect take (IDT) is estimated separately for ODT and UDT and is the possible or known take of offspring that have been negatively affected by the direct take of their parents. For bats, only females care for their offspring and the bat breeding season designated by the USFWS and DOFAW is from April 1 – September 15. Any ODT of adult female or sex unknown (conservatively assumed to be female) bat fatalities found during the breeding season are assumed to have dependent young, and a loss of 1.8 juveniles is calculated per female or unknown sex observed take (2 pups X 0.9 survival rate to weaning per pup). All four ODT (1 female and 3 unknowns) were found during the breeding season. Thus, the IDT from the four ODT found during the breeding season would 7.2 juveniles (4 x 1.8 = 7.2) (Appendix 5). The sex of all bats found during the breeding period will be determined in FY 2018 and IDT recalculated.

IDT estimated from bat UDT is calculated assuming 50% of the unobserved take would be female and that for each female there is an average probability that she would be pregnant or lactating for three months in a year. Bats fly through the project area throughout the year and the probability of an individual female bat having dependent young during a 12-month period is assumed to be 25% (three out of 12 months). The average period of dependence is based on the information that Hawaiian hoary bats have one brood a year, and that hoary bats in North America have an average 56-day gestation period followed by parental care to weaning averaging 34 days or approximately three months for gestation and parental care (Hayssen *et al* 1993, Hayes and Wiles 2013, and NatureServe 2015 for *Lasiurus cinereus*). There is not enough information for hoary bats from Hawaii to determine the gestation and pre-weaning dependent period. Consequently, indirect take is assessed to bats lost through “unobserved direct take” at the rate of 0.225 juveniles/bat ( $0.5 \times 0.25 \times 1.8 = 0.225$ ). The IDT for the unobserved direct take considering the 80% credibility level is 1.35 juveniles ( $8 \text{ estimated} - 4 \text{ observed} = 4 \text{ unobserved} \times 0.225 = 0.9$ ).

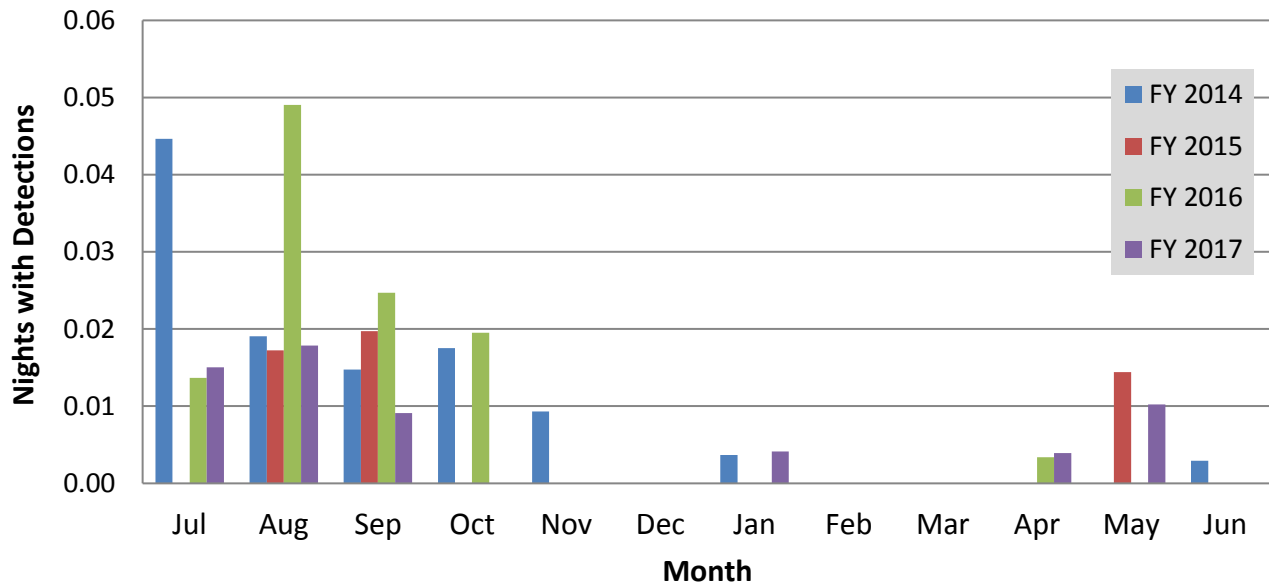
The estimated rate of survival of young to reproductive age assumed from available data is 0.30 (extrapolated from *Myotis lucifugus* and *Eptesicus fuscus*, little and big brown bats; Humphrey 1982, Humphrey and Cope 1976). Bat IDT of 8.78 ( $7.20 + 0.9 = 8.1$ ) converts to 2.43 or three adults rounded up ( $8.1 \times 0.3 = 2.43$ ). The total estimated bat take at 80% credibility is not more than 11 adults. Six and half years of the 20-year permit have been completed at the end of FY 2017 (although all WTGs were not operational from August 1, 2013 to September 1, 2014). The Tier 1 20-year take limit of 15 adults (12 adults and nine juveniles (converted to three adults)) has not been exceeded but has nearly reached 75% of the Tier 1 take limit ( $11/15 \times 100 = 73.3\%$ ). Mitigation planning, implementation, and funding for Tier 2 level take will occur in FY 2018. The total 20-year permitted take is 23 adults. Tier 2 mitigation will be for eight adult bats.

### ***Hawaiian Hoary Bat Monitoring***

Twelve Wildlife Acoustics SM2BAT+™ ultrasonic bat detectors with one SMX-U1™ microphone (mic) each located 50m from the project’s 12 WTG’s at 6.5m above the ground detected Hawaiian hoary bats on 0.5 % of detector nights (15 of 3143) in FY 2017 (Table 1). Bats were detected at eight of 12 locations and in six of 12 months peaking in July, August and September (Figure 2). Prior to October 2013 Titley Anabat™ detectors had been deployed around the site near WTGs beginning in 2011 (KAH 2013).

**Table 1. Hawaiian hoary bat nights with detections and total detection nights at KAH in FY 2017.**

Detector Location (WTG)	Total Detector Nights	Total Detector Nights with Activity	% Total Detector Nights with Activity
1	220	0	0.0
2	365	0	0.0
3	363	1	0.3
4	312	1	0.3
5	328	2	0.6
6	158	3	1.9
7	327	2	0.6
8	293	2	0.7
9	147	1	0.7
10	312	3	1.0
11	138	0	0.0
12	180	0	0.0
<b>Total</b>	<b>3143</b>	<b>15</b>	<b>0.5</b>



**Figure 3. Proportion of total nights with bat detections at KAH in FY 2014-2017.**

## ***Wildlife Education and Observation Program***

Three new personnel or longer term contractors required WEOP training orientation to be administered in FY 2017.

### ***Mitigation***

#### ***Newell's Shearwater and Hawaiian Petrel***

As part of KAH's seabird mitigation obligation KAH funded the Kaua'i Endangered Seabird Recovery Project (KESRP) to deploy and then analyze data from Wildlife Acoustics SM2™ Songmeters at multiple locations in Kaua'i's remote mountains to survey for Newell's shearwater and Hawaiian petrel nesting colonies. These were deployed in August 2013, April 2014, and April 2015 via helicopter and were retrieved in October 2013, August 2014, and August 2015, respectively. Songs were analyzed and results summarized by Conservation Metrics, Inc. (Kahuku Wind Power 2016).

Additional mitigation for Newell's shearwater and Hawaiian petrel on Kaua'i began in FY 2015 Q4 and was completed in FY 2017 Q2. KAH funded DOFAW to conduct a barn owl predator control project on Kaua'i and Lehua Island, Ni'ihau at the chosen seabird colonies (Appendix 6). Total funding for these projects has been \$349,000.

#### ***Waterbirds***

KAH has completed its obligation for Hawaiian stilts, moorhens, and coot with funding already provided to DOFAW for four years of waterbird mitigation at Hamakua Marsh. Quarterly and annual reports of progress and results were submitted by DOFAW (Kahuku Wind Power 2012, 2013, 2014, 2015, 2016). Waterbird mitigation included four years of predator and vegetation control and productivity assessment. Total Coot, Moorhen and Stilt fledgling production from FY2012 through FY2015 was 13, 141 and 24, respectively. The total funding for this project was \$457,000.

#### ***Pueo***

Total funding for pueo mitigation is complete and was \$75,000. \$25,000 funded the Hawaii Wildlife Center and \$50,000 has been provided to DOFAW for population research. Pueo population research began in FY 2017 investigates pueo population size, distribution, and habitat use on O'ahu (see <https://pueoproject.com>).

#### ***Hawaiian Hoary Bat***

KAH has paid the full obligation of \$150,000 for ongoing Tier 1 bat mitigation being conducted by DOFAW at Kahikinui Forest Reserve on Maui. These funds were used for 2,500m of ungulate fencing around a 280-acre enclosed restoration area.

### ***Adaptive Management***

The third of the four total Hawaiian hoary bat fatalities occurred April 23, 2012. According to fatality estimate calculations the Baseline annual take of four was exceeded then, triggering Adaptive Management.

In accordance with the HCP, low wind speed curtailment of all turbines up to a wind speed of five meters per second began April 27, 2012 and continues to be implemented between sunset and sunrise from April through November. Curtailment includes blades feathered to minimize rotation.

### ***Agency Site Visits and Reporting***

KAH provided abbreviated quarterly summary reports for FY 2017 quarters 1-3. The Endangered Species Recovery Committee reviewed the FY 2016 annual HCP report on November 1-2, 2016.

### ***Expenditures***

KAH total HCP related expenditures were \$110,310.

**Table 2. KAH total HCP related expenditures.**

<b>Category</b>	<b>Cost (\$)</b>
Permit Compliance	700
Seabird Management	64,359
Fatality Monitoring	15,385
Equipment and Supplies	200
Staff Labor	29,666
<b>Total Cost</b>	<b>110,310</b>

## ***Citations***

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

**Appendix 1. Fatality monitoring plot search dates for all WTGs at KAH in FY 2017.**

<b>Search Schedule</b>					
<b>July</b>	7/6/2016	7/14/2016	7/21/2016	7/28/2016	
<b>August</b>	8/4/2016	8/11/2016	8/18/2016	8/25/2016	
<b>September</b>	9/1/2016	9/8/2016	9/15/2016	9/22/2016	9/29/2016
<b>October</b>	10/5/2016	10/13/2016	10/20/2016	10/27/2016	
<b>November</b>	11/2/2016	11/9/2016	11/16/2016	11/23/2016	11/30/2016
<b>December</b>	12/7/2016	12/14/2016	12/21/2016	12/28/2016	
<b>January</b>	1/3/2017	1/11/2017	1/18/2017	1/25/2017	1/31/2017
<b>February</b>	2/8/2017	2/15/2017	2/22/2017		
<b>March</b>	3/1/2017	3/8/2017	3/15/2017	3/22/2017	3/29/2017
<b>April</b>	4/5/2017	4/12/2017	4/18/2017	4/26/2017	
<b>May</b>	5/3/2017	5/10/2017	5/17/2017	5/24/2017	5/31/2017
<b>June</b>	6/7/2017	6/14/2017	6/21/2017	6/28/2017	



## Appendix 2. CARE trial AB at KAH in FY 2017.

CARE AB FY2017		Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6	
Carcass Type		Rat		Rat		Rat		Rat		Rat		Medium Bird	
WTG		2		4		6		8		10		12	
Vegetation		Short Grass											
Distance (m)		25											
Day	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
0	16-Aug	P		P		P		P		P		P	
1	17-Aug	P		P		A		P		P		P	
2	18-Aug	P	A,H	P	A			P	A,C	P		P	
3	19-Aug	P		P				P		P		P	
5	21-Aug	A		P	D,S			P	C	P	H	P	
6	22-Aug			P				A		P	D	P	
7	23-Aug			P				A		P		P	D
8	24-Aug			P				P	S	P	S	P	
9	25-Aug			P				P		P		P	
10	26-Aug			P				P		P		P	
11	27-Aug			P				P		P		P	
12	28-Aug			P				P		P		P	
13	29-Aug			P				P		P		P	S
14	30-Aug			P				P		P		P	
21	8-Sep			P				P		P		P	
28	13-Sep			P	S			P	S	P	S	P	
Retention (days)		3		28		0		28		28		28	

A	ants	L	fly larvae
B	body feathers	M	moved
C	dirt covered	P	present
D	desiccated	A	absent
F	feathers	S	skeleton
H	hair loss	W	wing feathers
Scav	Scavenged		

CARE AC FY2017		Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		Trial 7	
Carcass Type		Rat		Medium Bird		Rat		Rat		Rat		Rat		Rat	
WTG		1		1		3		7		10		11		12	
Vegetation		Medium		Medium		Short		Short		Short		Short		Short	
Distance (m)		25		27		1		30		12		17		27	
Day	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
0	8-Nov	P		P		P		P		P		P		P	
1	9-Nov	P	D,S	P		P		P		P		P		P	
2	10-Nov	P	A	P		P	D	P		P	A	P		P	
3	11-Nov	P		P		P	S	P		P	D	P		P	
4	12-Nov	P		A		P		P		P	S	P	D,S	P	
5	13-Nov	A				P		P		P		P		P	D
6	14-Nov					P		P	D,S	P		P		P	
7	15-Nov					A		P		P		P		P	
8	16-Nov							P		P		P		P	
9	17-Nov							P		P		P		P	
10	18-Nov							P		P		P		P	
11	19-Nov							P		P		P		P	
12	20-Nov							P		P		P		P	
13	21-Nov							P		P		P		P	
14	22-Nov							A		P		P		A	
21	29-Nov									P		A			
28	6-Dec									A					
Retention (days)		4		3		6		13		21		14		13	

CARE AD FY2017		Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6	
Carcass Type		Rat		Rat		Bird		Rat		Rat		Rat	
WTG		1		3		5		7		9		11	
Vegetation		Short Grass and Dirt											
Distance (m)		21		27		29		25		26		21	
Day	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
0	23-Feb	P		P		P		P		P		P	
1	24-Feb	P		P		P		P		P		P	
2	25-Feb	P	A	P		P		P		P		A	H
3	26-Feb	P		P	D	P		A		A			
4	27-Feb	P		P		P							
5	28-Feb	P		P		P							
6	1-Mar	P		P		P							
7	2-Mar	P		A		P							
8	3-Mar	P	D			P	D						
9	4-Mar	P				P							
10	5-Mar	P				P							
11	6-Mar	P				P							
12	7-Mar	P				P							
13	8-Mar	P	Scav			P	S						
14	9-Mar	P	S			P							
21	16-Mar	P				P							
28	23-Mar	A				P							
Retention (days)		21		6		28		2		2		1	

CARE AE FY2017		Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6	
Carcass Type		Bird		Rat		Rat		Rat		Rat		Rat	
WTG		2		4		6		8		10		12	
Vegetation		Short Grass and Dirt											
Distance (m)		25		2		27		31		1		23	
Day	Date	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes	P/A	Notes
0	19-May	P		P		P		P		P		P	
1	20-May	P		P		P	A,C,H	P	M	P		P	
2	21-May	P		P	M, Scav	P	M	P		P		P	
3	22-May	P		P	M	P		P	A,C,S	P	A	P	D,S
4	23-May	P		A		P		P		P		P	H
5	24-May	P				P		P		P		P	
6	25-May	P				A		P		P		P	
7	26-May	P						P		P	M	A	
8	27-May	P						A		P			
9	28-May	P								P			
10	29-May	P								P	M		
11	30-May	P								A			
12	31-May	P											
13	1-Jun	P											
14	2-Jun	P	D										
21	9-Jun	P											
28	16-Jun	P											
Retention (days)		28		3		5		7		10		6	

### Appendix 3. SEEF trials at KAH in FY 2017.

Date	WTG	Vegetation Class	Carcass Type	Found	Searcher
8/11/2016	2	Short	Rat	1	K9
8/11/2016	6	Short	Rat	1	K9
8/11/2016	11	Short	Rat	1	K9
8/11/2016	11	Short	Medium Bird	1	K9
9/14/2016	1	Short	Rat	1	K9
9/14/2016	2	Short	Rat	1	K9
9/14/2016	3	Short	Rat	1	K9
9/14/2016	3	Short	Rat	1	K9
9/14/2016	7	Short	Rat	1	K9
9/14/2016	7	Short	Medium Bird	1	K9
11/9/2016	1	Short	Rat	1	K9
11/9/2016	1	Short	Medium Bird	1	K9
11/9/2016	3	Short	Rat	0	K9
11/9/2016	3	Short	Medium Bird	1	K9
11/9/2016	7	Short	Rat	1	K9
11/9/2016	10	Short	Rat	1	K9
11/9/2016	11	Short	Rat	1	K9
11/9/2016	12	Short	Rat	1	K9
12/28/2016	8	Short	Rat	1	K9
12/28/2016	8	Short	Rat	1	K9
12/28/2016	9	Short	Rat	1	K9
12/28/2016	9	Short	Rat	1	K9
12/28/2016	10	Short	Rat	1	K9
2/22/2017	12	Short	Rat	1	K9
2/22/2017	12	Short	Rat	1	K9
2/22/2017	11	Short	Rat	1	K9
2/22/2017	10	Short	Rat	1	K9
2/22/2017	9	Short	Rat	1	K9
3/29/2017	11	Short	Rat	1	K9
3/29/2017	11	Short	Rat	1	K9
3/29/2017	12	Short	Rat	1	K9
4/12/2017	6	Short	Rat	1	K9
4/12/2017	10	Short	Rat	1	K9
5/16/2017	1	Short	Rat	1	K9
5/16/2017	1	Short	Rat	1	K9
5/16/2017	5	Short	Medium Bird	1	K9
5/16/2017	6	Short	Rat	1	K9
5/16/2017	6	Short	Rat	1	K9
5/16/2017	7	Short	Rat	1	K9
5/16/2017	7	Short	Rat	1	K9
5/16/2017	11	Short	Rat	1	K9
6/7/2017	2	Short	Rat	1	K9
6/7/2017	3	Short	Rat	1	K9
6/7/2017	4	Short	Medium Bird	1	K9

#### Appendix 4. Hawaiian hoary bat fatality estimation at KAH in FY 2017.

													Estimation Results			
Period #	Year Portion	Portion Dates	Observed Mortality	Search Interval (Days)	SEEF	SEEF Trial Total Placed	CARE Mean <sup>1</sup>	CARE SD	CARE Trials Placed	$k^2$	$dwp^3$	$\rho^4$	$g^5$	$g_{lower}$	$g_{upper}$	M* Estimated Mortality, 80% Credibility
1	0.75	1/1/2011-10/1/2011	1	3.5	0.6	10	3.63	4.08	16	0.7	1	0.75	0.464	0.262	0.672	5
2	0.50	10/2/2011-3/31/2012	0	2.5	0.73	22	8.31	5.39	26			0.50	0.795	0.675	0.893	3
3	0.33	4/1/2012-8/1/2012	2	3.5	0.7	27	8.19	5.37	16			0.33	0.746	0.611	0.861	7
4	0.91	9/1/2013-7/31/2014	0		0.85	66	17.75	12.96	12			0.42	0.830	0.647	0.955	6
5	0.25	8/1/2014-10/31/2014	1		0.58	19	10.91	11.11	11			0.12	0.670	0.460	0.850	8
6	0.41	11/1/2014-3/31/2015	0	30	0.86	7						0.19	0.347	0.166	0.554	8
7	1.25	4/1/2015-6/30/2016	0	7	0.82	39	13.73	10.12	15	1	0.7	0.58	0.565	0.486	0.642	8
8	1.00	7/1/2016-6/30/2017	0		0.97	38	10.52	9.40	21	1		0.46	0.530	0.465	0.595	8
<sup>1</sup> CARE Trials in Periods 1-3 were for 14 days, in Periods 4-8 were for 28 days																
<sup>2</sup> $k$ represents the factor by which searcher efficiency decreases with each successive search (value of 1 indicates a carcass can be found on the second search as easily as for the first search)																
<sup>3</sup> $dwp$ is density weighted proportion: fraction of the total modeled or known carcasses that arrive in a searched area (value of 1 indicates the search area includes the area where all possible carcasses could fall)																
<sup>4</sup> $\rho$ is the relative mortality rate (the product of Year Portion and Low Wind Speed Curtailment predicted mortality rate reduction (0.46 for periods 4-8))																
<sup>5</sup> $g$ is overall detection probability, $g_{lower}$ and $g_{upper}$ are the 95% confidence intervals around $g$																

## Appendix 5. Hawaiian hoary bat Indirect take calculation KAH FY2017.

Component	Input/Description	Result/Value
A	Total Estimated Direct take	8
B	Observed direct take (ODT)	4
C	Unobserved direct take (UDT) ( <b>A - B</b> )	4
D	ODT female or unknown during Apr 1-Sep 15 (1 female, 3 unknown)	4
E	Proportion of UDT that could be female and probability a female is pregnant or lactating ( $0.5 \times 3/12$ )	0.125
F	Survival of twin pups to weaning ( $0.9 \times 2$ pups)	1.8
G	ODT IDT ( <b>D x F</b> )	7.2
H	UDT IDT ( <b>C x E x F</b> )	0.9
I	IDT total ( <b>G + H</b> )	8.1
J	Survival of juvenile to adult	0.3
	<b>IDT as adults (I x J)</b>	2.43
	<b>Total IDT rounded up</b>	<b>3</b>



## **Appendix 6. Nonnative Avian Predator Control Annual Activity Report.**



# Nonnative Avian Predator Control Annual Activity Report February 28, 2017



## Introduction

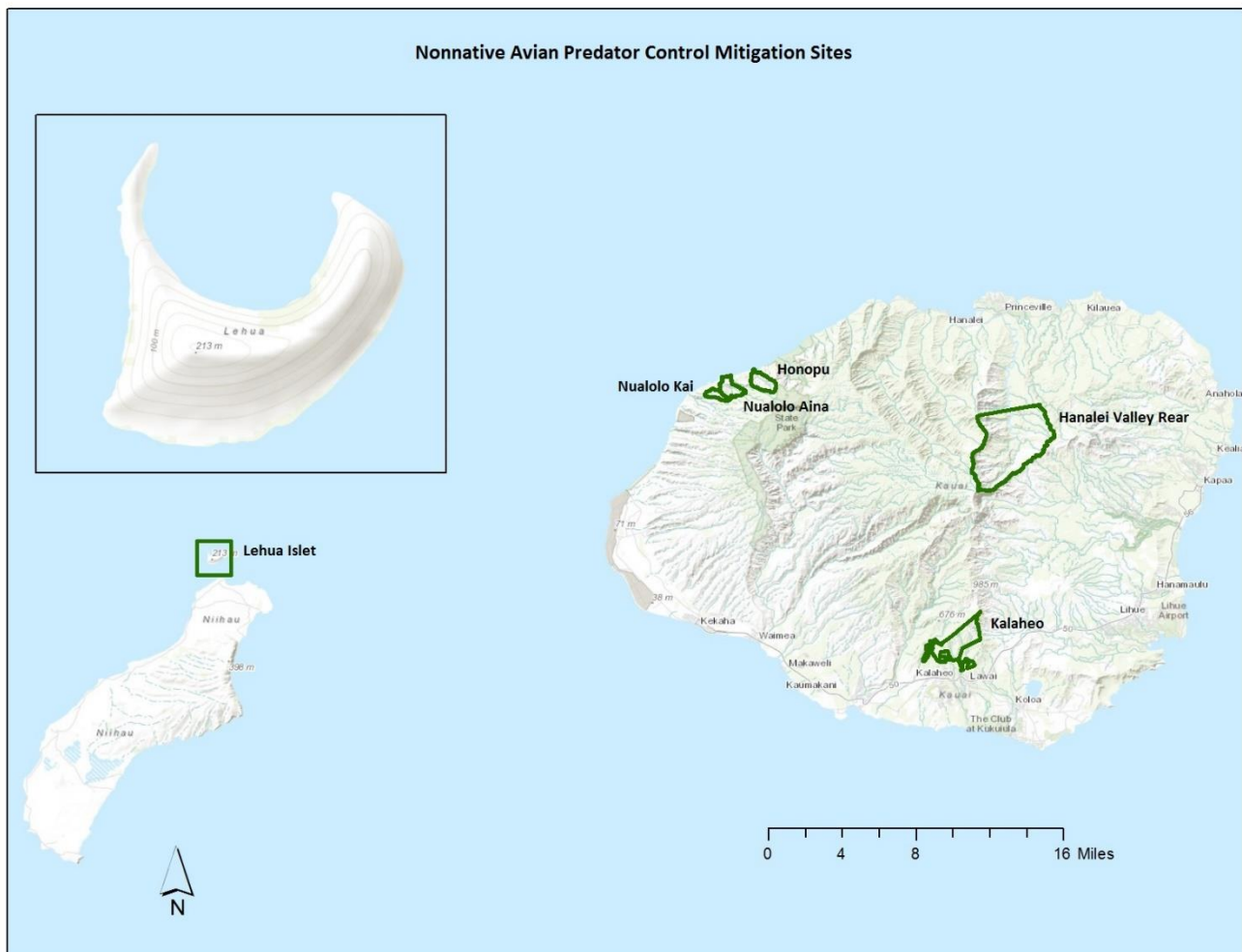
The Nonnative Avian Predator Control (NAPC) program was developed as a means to remove the invasive Barn Owl (*Tyto alba*) from the vicinities of important seabird breeding colonies, thereby mitigating for potential take of endangered seabirds at the Kahuku Wind Power Project on Oahu. The program specifically protects juvenile and adult Newell's Shearwater (*Puffinus auricularis newelli*), and Hawaiian Petrel (*Pterodroma sandwichensis*) from Barn Owl predation at select colonies. NAPC received funding for this project from December 2014 through December 2016 from SunEdison (formerly First Wind) in compliance with the Kahuku Wind Power Habitat Conservation Plan (HCP). The Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife provided oversight for program operations, with funds for personnel disbursed through the Pacific Cooperative Studies Unit at the University of Hawaii at Manoa (PCSU). The NAPC team has been in operation since March, 2015.

This report describes NAPC program logistics and operations including transportation, permits, training, site locations, Barn Owl activities and dispatch, trap development, and other predator observations/dispatches at select seabird colonies on the Island of Kauai and nearby Lehua Island. The period covered by this report includes 3/1/2016 through 12/31/2016. A previous report covers earlier project activities.

## Project Overview

During the final nine months of Sun Edison funding, the NAPC project continued to visit and protect Kauai's endangered seabirds. Twenty-four safe and successful expeditions to the six prescribed remote seabird colonies were made during this time. Additionally, the team developed and deployed new multi-predator traps. As the program is funded indirectly through PCSU and staff are employed by the Research Corporation for the University of Hawaii, steps were taken to practice hunting and trapping methods approved by the University's Institutional Animal Care and Use Committee (IACUC), as required of all US university-affiliated wildlife management programs. After the first year of operation, Barn Owl numbers at the colonies were noticeably reduced, with a few resilient individuals remaining which largely proved too difficult to remove by hunting. In order to maintain program effectiveness, NAPC switched much of its effort to feral cat (*Felis catus*) removal from colony sites.

Feral Cats are known seabird predators (Hess et. al. 2008) and represent a serious threat to native birds on all Hawaiian Islands. Cats were far more prevalent at the project's remote work sites than initially expected, and thus depletion of their numbers became a major program objective. It was found that thriving cat colonies existed on even the steepest terrain along the remote Na Pali coast. A breakdown of predator detections, removals, and site attributes for each colony is to follow.



## Field Methods

The NAPC staff is comprised of an Avian Predator Control Specialist and an Avian Predator Control Assistant, both experienced as avian biologists and hunters.

### Hunting

Technicians would play Barn Owl and prey sounds during night hunts and trapping sessions, listening for a response and scanning skies with Night Vision units to determine roost and nest locations. If a

roost or nest was spotted, technicians would relocate, terrain permitting, into close proximity of these suspected activity centers. Call playback, which often resulted in attracting owls towards the electronic caller, aided technicians in identifying owl species type, as either Pueo (Hawaiian Short-eared Owl – *Asio flammeus sandwichensis*) and Barn Owl. Technicians generally worked in a pair while hunting, with one person operating the spotlight, while the other operates a 12-ga shotgun. Barn Owls were removed only after being positively confirmed as Barn Owls and Not Pueo. Technicians purchased gun-mounted spotlights in mid-fall, allowing them to hunt separately, doubling chances for dispatch. This, in addition to an increased trapping effort, were necessary to attempt removal of the remaining wary Barn Owls at the six colony sites. Once dispatched, technicians made every effort to retrieve remains for identification of sex, age, nesting status (brood patch) and stomach contents. Also, liver and wing samples were collected to be later analyzed in a lab for inclusion of marine elements which would indicate predation on seabirds.

Feral cats, largely active at night, were also primary hunting targets. Technicians would work in pairs, spotlighting cliff edges and riparian zones, and dispatching felines with either a shotgun or .223 caliber AR rifle. This method has been proven effective for cat at remote seabird colonies all over the South Pacific (Rauzon 2015). Cat samples including whiskers, legs, and liver, were also taken for later stable isotope analysis. All samples are pending testing at an Akron University lab in Akron, OH.

### Baiting and Trapping

Attempts were made to capture Barn Owls with custom Swedish Goshawk-style traps, baited with live mice or rats (*Rattus* spp.). Earlier trapping efforts had been made using bal-chatri traps, but were discontinued due to ineffectiveness. Swedish Goshawk traps were found to be better suited for the



Barn Owl caught in a Swedish Goshawk trap at a BOR testing location.

Barn Owl hunting style, as they are known to hover over prey before dropping vertically with legs extended for capture. Trap doors would close upon an owl once it descended onto a break-away perch. Traps would be set with automated sensor setting off an alarm when triggered. Rodents were housed humanely within the trap which provided shelter, food, water and synthetic batting for insulation.

Following prior trapping efforts, NAPC technicians realized that Barn Owls were wary and often would not approach new traps or other manmade objects without becoming first acclimated to their presence. In order to address this, and to promote successful trapping efforts, the team began development of a new methods for luring Barn Owls repeatedly into trap vicinity. The first iteration of this project, aptly named Bucket-of-Rats (BOR), was a large box designed to humanely capture and hold invasive island rats,

both Polynesian (*R. exulans*) and Black (*R. rattus*). An automated door would then open at night, allowing access by Barn Owls, and successfully prohibiting entry by the diurnal Pueo. Rats were given food, shelter, water, batting for insulation, with the entire trap cleaned and sterilized regularly. The project also incorporated a self-automated game caller programmed to emit Barn Owl territorial calls as well as rodent prey noises for the purpose of attracting owls to the site. Once an owl visited the site and successfully captured a rodent from BOR, return visits were found to be frequent, occurring almost every night thereafter. This regular visitation worked to facilitate subsequent removal via trap or firearm. Game cameras were strategically placed to capture all activity at the site both on the



Barn Owl predate a *R. exulans* from BOR

ground and at perches placed nearby. Baiting, which is generally an effective but illegal hunting practice for game animals in the US, has also been shown to be a successful means of promoting return visits by birds of prey (U.S.D.O.I. 1980). A great example of this technique is written into the official Northern Spotted Owl Survey Protocol, where owls are repeatedly fed lab mice, to determine nest locations, facilitate capture and banding, and to quantify home ranges (U.S.F.W.S. 2012). BOR also has the ability to lure cats, promoting regular, often nightly, visits to the site.

Placement of tomahawk live traps has resulted in several successful cat removals from the project test site (located on private land away from seabird colonies). The BOR project was designed to be light and transportable by helicopter sling load or in a 5-foot wide truck bed. It was flown to the valley above Nualolo Kai in August 2016, where it was left in operation until through the end of December 2016. Despite initial success at the test site, only one confirmed Barn Owl visitation occurred at Nualolo Kai. This owl failed to detect the bait held within, and did not return until January 2017, when it was successfully captured. The project, was captured rats and attracted cats at the Nualolo Kai rim location. Additional modifications are currently being made to this prototype in order to facilitate increased prey detectability and accessibility to introduced predators.



Feral cat Visits BOR prior to capture



During visits to each remote colony location, grids of tomahawk traps were set for the purpose of cat removal. This effort resulted in several successful removals, two of which contained seabird remains inside stomachs. This effort was in addition to, and not in replacement of, nighttime Barn Owl hunts. Trap locations will be shown on the map for each colony description. *Rattus* spp. were often captured in lieu of cats, and were either euthanized on-site, or transported to BOR for use as bait.

## Training and Permitting

Taking into account the diverse legal and safety requirements associated with NAPC operations, the NAPC team ensured that each of the following were up-to-date prior to field deployments.

### Training

*Hawaii Hunter Education Course* – Department of Land and Natural Resources – Division of Conservation and Resources Enforcement

*National Rifle Association Firearm Safety Course Completion Certificates*



BOR on heads to Na Pali Coast

*A-100 Basic Aviation Safety Certifications* – Office of Aviation Services – U.S. Department of the Interior

*A-219 Helicopter Transport of External Cargo* – Office of Aviation Services – U.S. Department of the Interior

*Institutional Animal Care and Use Committee (IACUC) Investigators, Staff and Students Training* – Collaborative Institutional Training Initiative

*Institutional Animal Care and Use Committee (IACUC) Wildlife Research Training* – Collaborative Institutional Training

*Wilderness First Aid and CPR certification* – American Red Cross – Wilderness Medical Society

### Permitting

*Depredation Permit 50 CFR 21.41* – U.S. Fish and Wildlife Service – Migratory Bird Permit Office –

Renewed March 1, 2016. Allows for shooting or trap-euthanization of 180 Barn Owls on Kauai (including Lehua) state property; other property with landowner approval.

*Wildlife Control Permit WCP 15-25* – State of Hawaii Department of Land and Natural Resources – Division of Forestry and Wildlife – Renewed March 1, 2016. Allows for take of nonnative avian predators including Cattle Egret (*Bulbulcus ibis*) and Barn Owl by trapping and shooting firearms on Kauai State Lands.

*Alexander and Baldwin Right of Entry Permit* – A&B Properties, INC. – Allows for access to A&B properties for the purpose of transporting to state lands accessible by trails and roads on A&B properties.

## NAPC Work Sites

### Hanalei Valley Rear

At over twice the size of all other project mitigation sites combined, this important valley encompasses several localized seabird colonies as well as ample Barn Owl nesting habitat. Having worked in the valley since October, 2015 NAPC technicians became increasingly familiar with the challenging terrain. Four predator removal visits were made Between March 1<sup>st</sup> and December 31<sup>st</sup> 2016. This lush North-facing valley has a diverse ecology, split at the base by the Hanalei River at 400 ft., habitat ranges from mesic forest to wet forest near the height of Mt. Waialeale at over 5000 ft.



Adult male BANO with brood patch, removed on 3/10/2016.

Low-elevation groves of Hau (*Hibiscus tiliaceus*), Kukui (*Aleurites moluccana*), and African Tulip (*Spathodea campanulata*) give way to mid-elevation dominant Ohia Lehua (*Metrosideros polymorpha*), Hala Pepe (*Pleomele spp.*), Common Guava (*Psidium guajava*), and Australian Tree Fern (*Sphaeropteris cooperi*). High elevation vegetation coverage largely includes ohia tree and shrub forms interspersed with vast mats of Uluhe (*Dicranopteris linearis*). Navigation at mid-elevation hunt sites is complicated by mats of Uluhe and Glory Bush (*Tibouchina urvilleana*) often

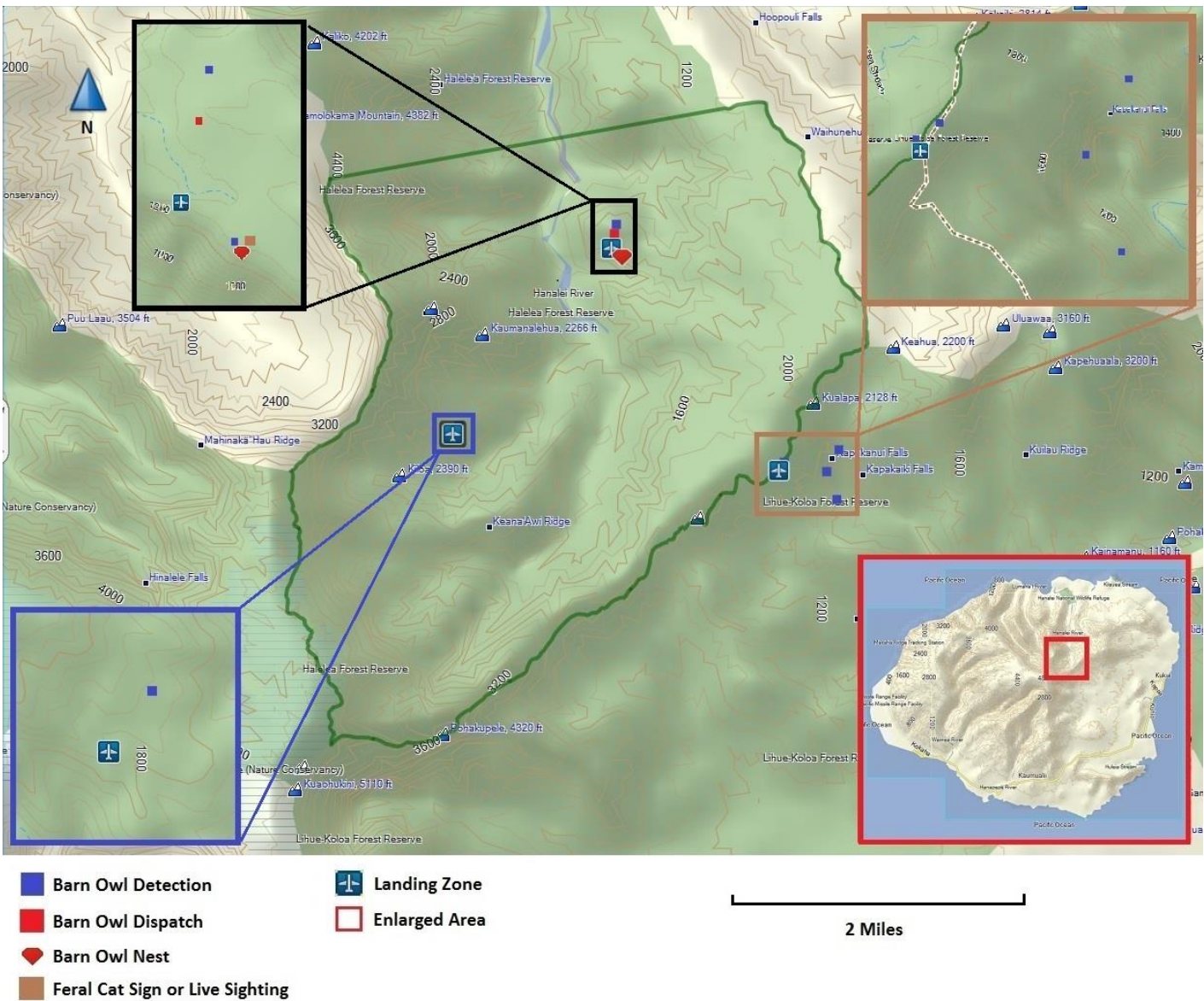
exceeding 8 ft. in height. In 1992, Hurricane Iniki was responsible for toppling vast stands of mature Ohia within the valley, leaving remnant snags covered with the now-dominant Uluhe. Foot travel at hunt areas is heavily impeded by this vegetation, often limiting movement to less than 600 feet /



hour. For this reason, NAPC staff have staged activities at prominent ridges within the valley, featuring optimal auditory broadcast potential and wide visibility.

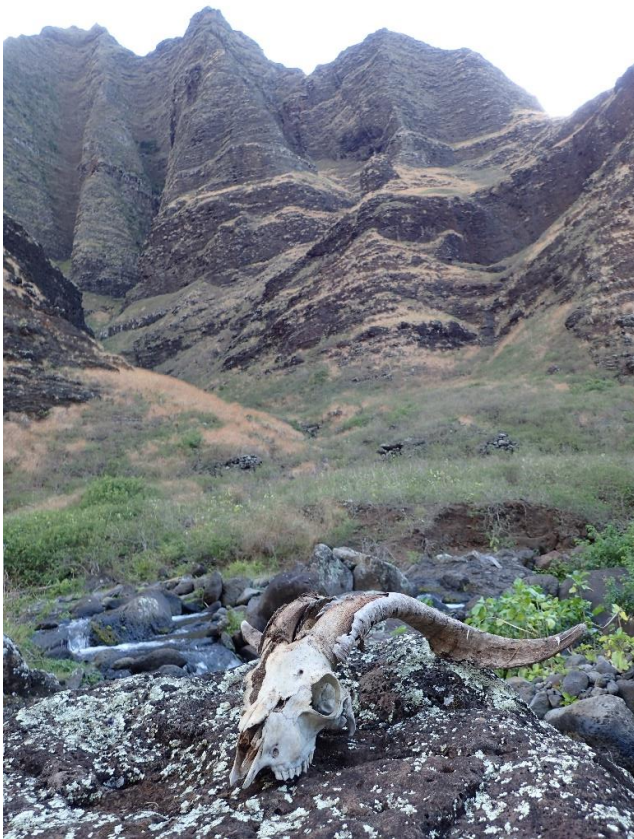
Transportation to and from most valley hunt locations is possible by only by helicopter. One prominent location with a large Barn Owl and cat population can be reached by hiking along the old power line trail, which transects the island. Technicians transported enough food and water to last for several days in the event of foul weather. Trips covered three prominent ridges in the valley rear. An estimated total of six individual Barn Owls were detected, and one removed from a mesa roost at the valley center, the same site where five had previously been removed.

### Hanalei Valley Rear Work Site



All predator sign and live detections are shown at the coordinates determined for their initial discovery. A new point was made each day for each live detection, regardless of whether technicians suspected it was the same individual previously recorded. Sign, such as scat, pellets, or tracks, were only recorded once per occurrence. Dispatches were detections that ended with removal. Thus, Barn Owl individuals might be dispatched far from the (mapped) location of initial detection and detections would sometimes be made at over a mile from observer location. The three hunt locations close to the valley rear featured regular flyover seabird detections, although one site (lower left on map) had at least 20 nesting Hawaiian Petrel and 30 Newell's Shearwater. One of the three sites visited featured cat sign, however no individuals had yet been removed as of late December.

### Honopu Valley



Feral Goat Remains at the Valley Floor

One of three sites along the precipitous Na Pali Coast, Honopu Valley, also known as the “Valley of the Lost Tribe” is featured as an important historic site in several Hawaiian legends. The valley floor is covered in ancient agricultural terraces which persist intact. The steep valley walls house a multitude of nesting Newell's Shearwater, and are a vital breeding colony for the species.

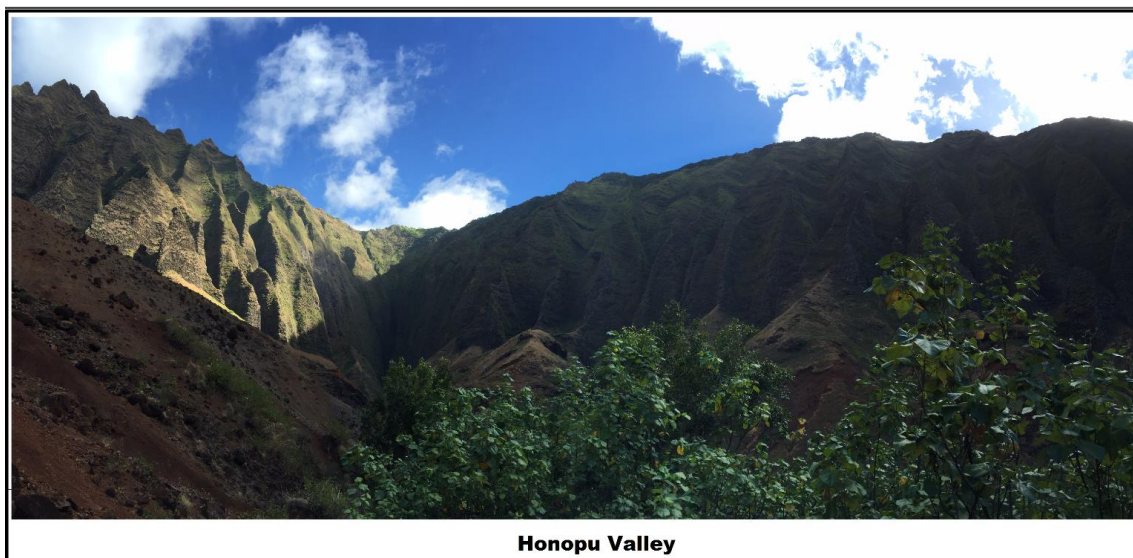
The only navigable terrain at Honopu is to be found near the valley floor, which contains groves of Kukui, Hau, Kiawe (*Prosopis pallida*), and Common Guava. The understory is largely comprised of dense Lantana (*Lantana camara*) thickets, a spiny allergenic invasive bush which hinders navigation. The valley floor features a perennial creek which swells greatly during storms. Visits to the valley are made by helicopter, as heavy surf and steep cliffs at the valley mouth make boat entry impossible. Three trips to Honopu Valley were made since between February and December 2016. A single Barn Owl was detected during the last two trips,

but stayed high up near the valley rim, flying over the valley rather than descending to the floor. At least one family of cats were detected. A total of six individuals were detected, and five removed, one of which was a large male with a stomach full of white-tailed tropicbird feathers. This species, similar to Newell's Shearwater and Hawaiian Petrel, nests in burrows on the steep cliffs of the valley. Removing cats that hunt in this terrain is a priority for the NAPC program. Honopu Valley will continue to remain an important target for future control efforts.



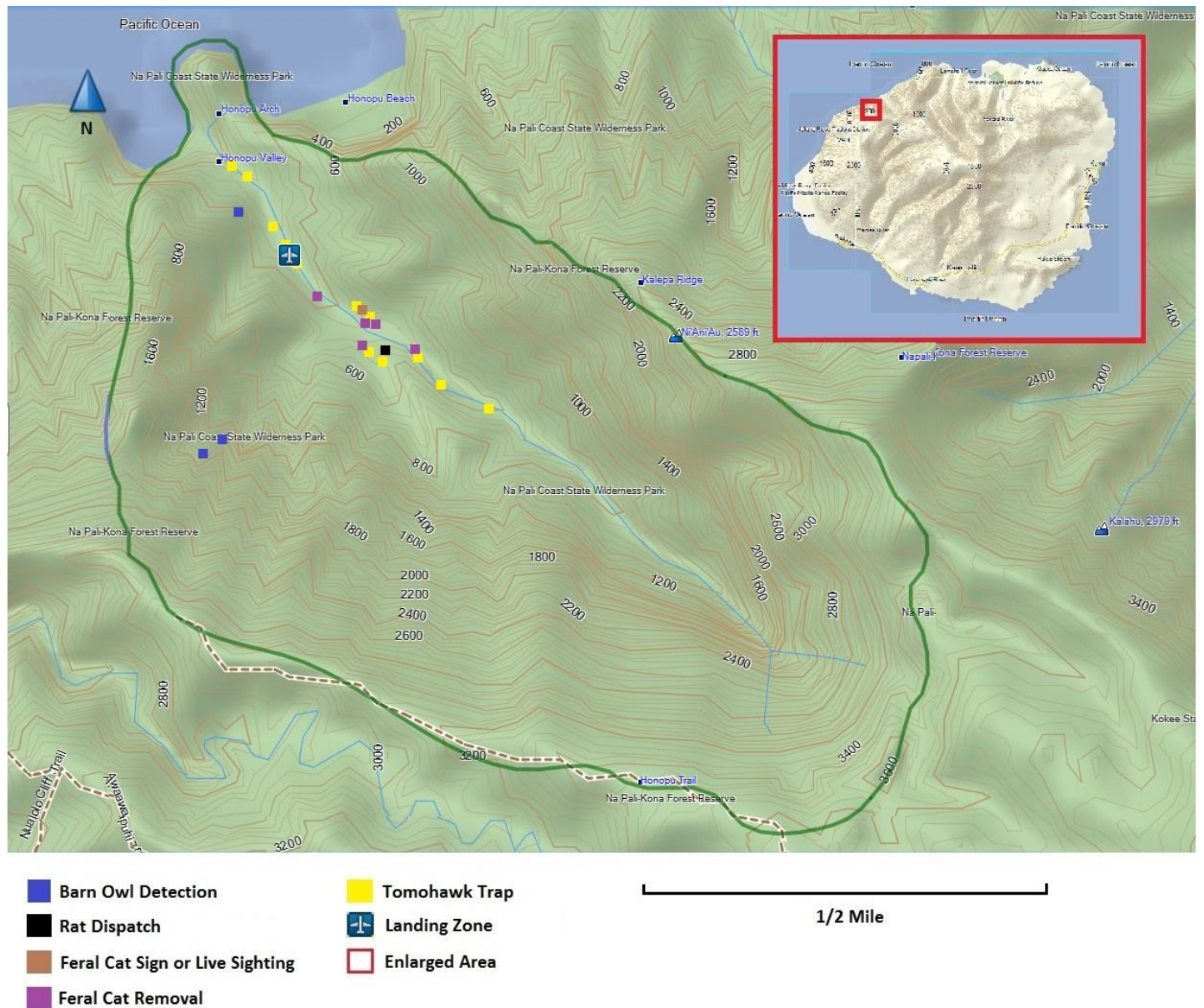


Feral Cats with Seabird Remains at Honopu Valley





## Honopu Valley Work Site



### Kahili and Lihue-Koloa Forest Reserve

Once a site of prime importance to breeding Hawaiian Petrels and Newell's Shearwater, this Southern management area has dwindled in the last decade due to predation by invasive predators such as feral cats, pigs (*Sus scrofa*) and rats (*Rattus spp.*), and powerline collisions. The latter issue compelled the Kauai Island Utility Cooperative (KIUC) to bury 0.5 miles of the powerline leading up to the radio tower at Kahili Peak. The management area encompasses the entire forest reserve which is composed of mid-elevation mesic forest leading to wet forest and marsh basins at higher elevation. Much of the surrounding hills have been managed for forest products, and are covered with thick groves of various *Eucalyptus spp.*, Cook Pine (*Araucaria columnaris*), and Albezia (*Paraserianthes*

*falcataria*). Stands of Java Plum (*Syzygium cumini*) can also be found at lower elevation. Strawberry Guava (*Psidium cattleianum*) occurs in ample thickets throughout the reserve, providing forage for roving ungulates. Higher-elevated reserve areas are also covered with thick Uluhe mats, interspersed with Koster's Curse (*Clidemia hirta*). Technicians access the colony by a combination of trail and road which winds along the ridge leading towards Kahili Peak, passing through Alexander and Baldwin (A & B) private lands. Landowners have granted permission for program access to the property. The Kahili site is divided by a West-facing ridge into an upper and lower colony. NAPC staff have detected nesting Hawaiian Petrel and Newell's Shearwater repeatedly at both colonies.



Black Rat caught in Tomahawk Trap



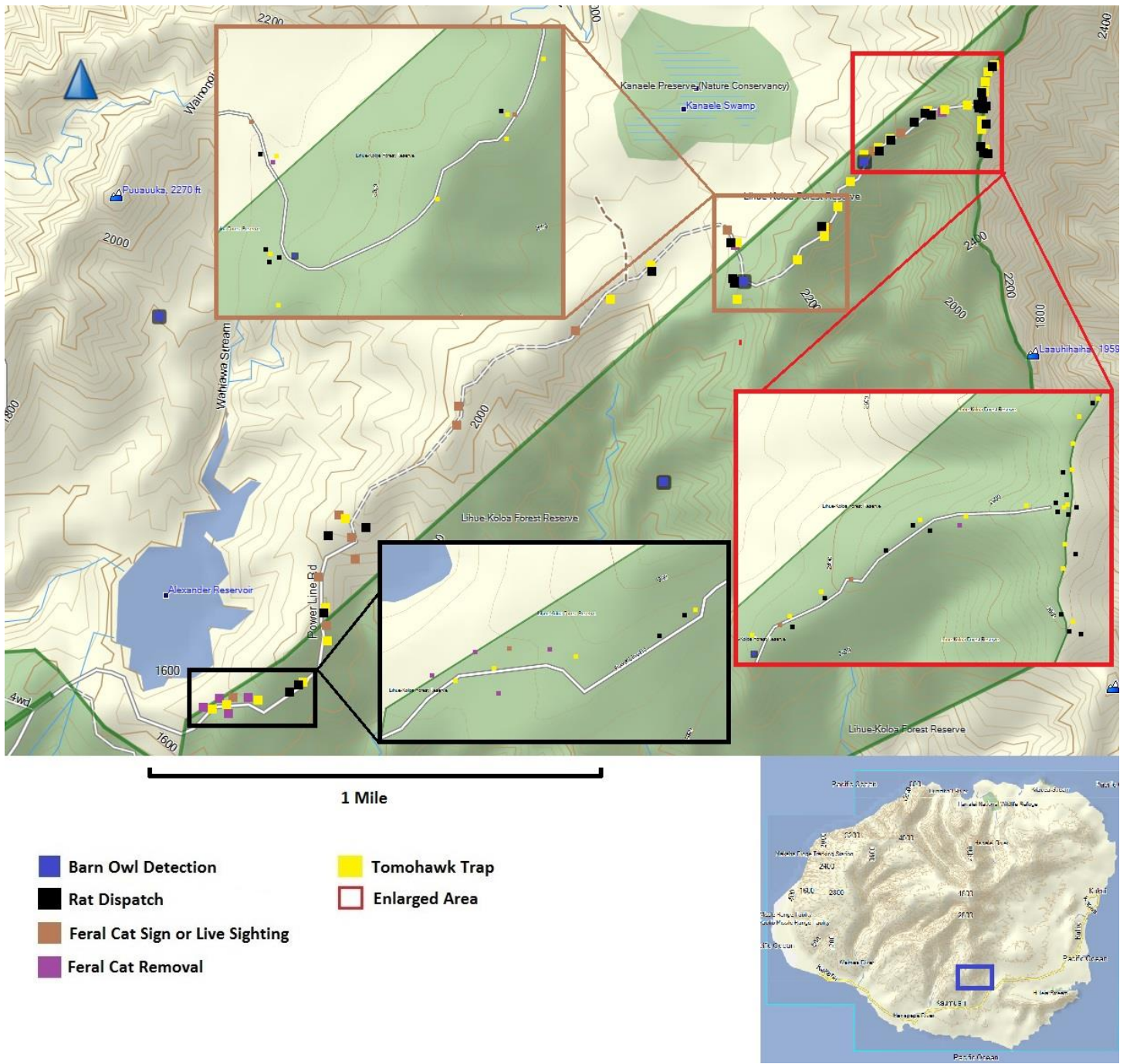
NAPC technician moving along a trapping grid near Kahili Peak

Due to the proximity of this colony to nearby town and suburbs of Kalaheo, feral cats are the main predator at this locations. Surveys for predator sign were conducted along the main access road, as well as side trails and swamps adjacent to the road. Most sign was found along the road, a major travel corridor for feral cats. Because of this, it was decided that the trapping effort should largely occur along the main access road, as well as along the ridgeline above the seabird colonies, both above and below a radio tower situated near Kahili peak. The trapping effort was successful, resulting in the removal of seven feral cats and twenty six rats (both *R. rattus* and *R. exulans*) from the colony region. Captured rats were often carried downhill to be used as subsequent bait at other sites. One of the cats captured was an adult male with a stomach stuffed with Newell's Shearwater fledgling remains. Only two observations of Barn Owls were made.

Possibly a combination of regular foul weather as well as numerous Pueo at the site are responsible for low Barn Owl numbers there.



## Kahili Work Site



## Lehua Island



NAPC technician hiking towards the summit of Lehua Island at sunset

This small, dry, crescent-shaped crater with an approximate surface of 0.75 square miles, ascends out of the Pacific Ocean to a height of over 600 feet at its peak. The rock provides precious natural habitat for thousands of breeding seabirds comprising many species from March through November, with Black-footed Albatross (*Phoebastria nigripes*) and Laysan Albatross (*Phoebastria immutabilis*) nesting atop the highest ridge and North-facing upper slope during winter months. Red-footed Boobies (*Sula sula rubripes*), Brown

Boobies (*Sula leucogaster plotus*), Great Frigatebirds (*Fregata minor palmerstoni*) and Black Noddies (*Anous minutus melanogenys*) maintain a year-round presence, while Wedge-tailed Shearwaters (*Puffinus pacificus*) congregate in massive numbers to breed from spring to late fall. Red-tailed Tropicbirds (*Phaethon rubricuada melanorhynchous*) also form a strong breeding presence.



Brown Booby (left) and Red-footed Booby (right) chicks waiting for a meal

Newell's Shearwater adults have been historically recorded at the islet, with chick remains found which indicated nesting activity (Vanderwerf et. al. 2007). The removal of invasive predators, including Barn Owls and Polynesian rats (*Rattus exulans*) from the islet is of critical concern to promote safe breeding habitat for endangered species. Vegetation is scarce at the islet, with nesting Red-tailed tropicbirds seeking out clumps of Sourbrush (*Pluchea indica*) and Camphorweed (*Pluchea carolinensis*) for nest sites. A single Kiawe Tree (*Prosopis pallida*) provides important nest habitat for Red-Footed Boobies,

although they must compete for space with invasive Cattle Egrets also nesting at the tree. NAPC staff actively remove egret nests, eggs, juveniles and often adults upon each visit to the islet. Although sixty



plant taxa have been described on the islet (Wood and Legrande 2005), the *Pluchea* along with highly invasive Buffelgrass (*Cenchrus ciliaris*) comprise the majority of readily-visible vegetation.

Barn Owls have been voracious predators at Lehua for at least a decade, as determined by the evaluation of hundreds of pellets, many containing seabird remains, found at an inactive nest site on the Northwest peninsula of the islet (Vanderwerf et. al. 2007). After several initial visits to the island in 2015, the resident Barn Owl population was highly reduced, commensurate with a noticeable reduction in



Female Barn Owl contained Wedge-tailed shearwater remains in March

barn owl predation evidence upon resident seabirds. Despite persistent removal efforts, there remains at least two Barn Owl's residing at or regularly visiting Lehua, both of which are wary of approaching hunters. An extensive trapping effort at the island, using Swedish Goshawk Traps, is planned for future visits. Weather and transportation issues inhibited island visitations during the late Fall 2016. It is likely that many Barn Owls visit the islet from nearby Ni'ihau, which lies less than a mile to the south of Lehua. A short flight presents the opportunity for a quick snack. Thus, removal of Barn Owl's from

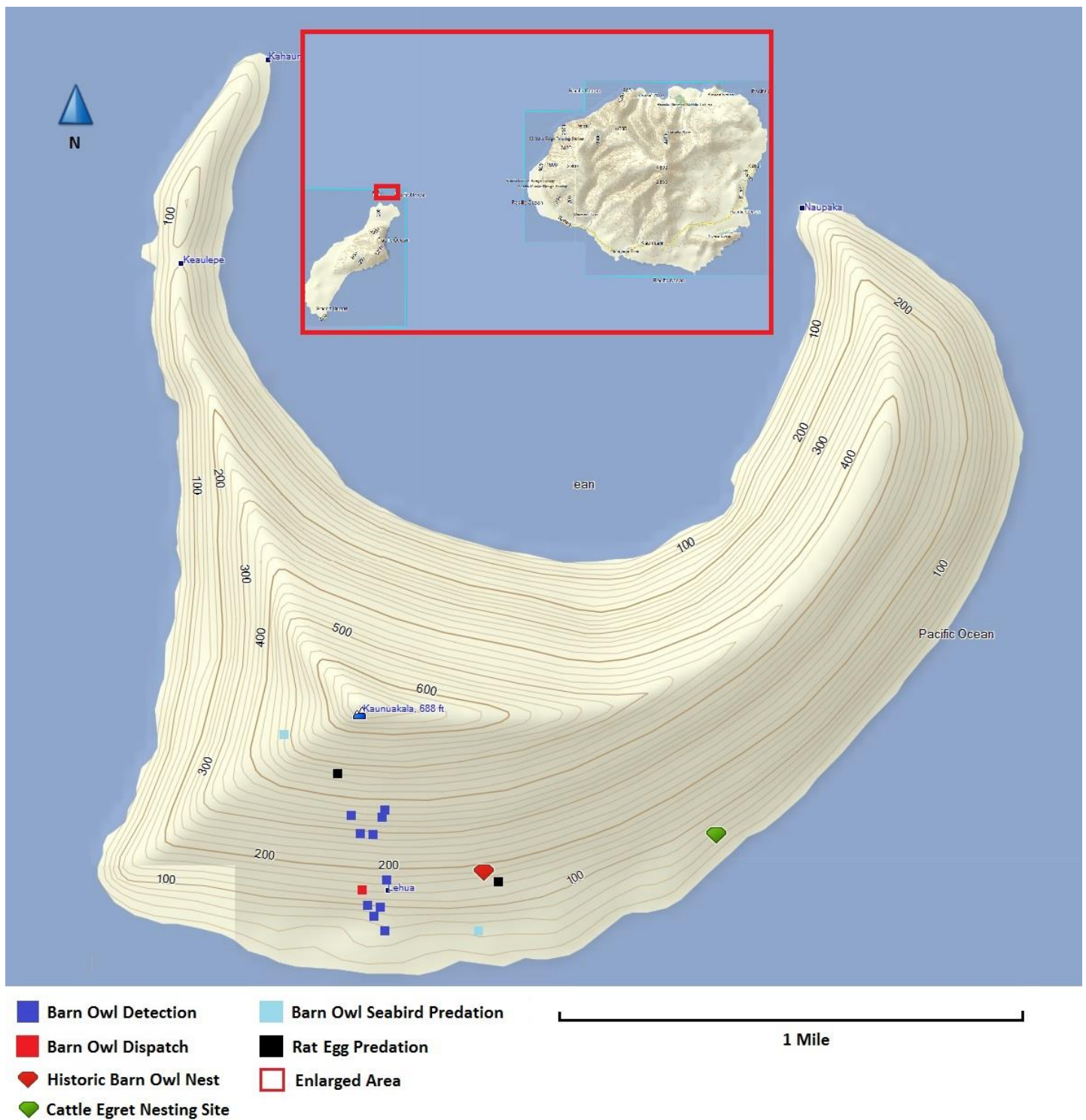
Lehua likely decreases numbers on Ni'ihau, an added benefit of continued removal efforts. A problem exists, however, due to the fact that recruitment at Lehua from Niihau will persist until all philopatric individuals and opportune hunters are removed. In addition to Barn Owl removals, 68 Adult and Juvenile Cattle Egret, along with 21 Eggs were removed during trips in May and again in July. These removals occurred at the Kiawe tree nest site shown on the map below. All Cattle Egret nests were destroyed during each visit. NAPC staff were transported to Lehua on-board a large catamaran which



NAPC Technician being observed by a first-year Red-footed Booby

provided regular service to the Island and nearby Ni'ihau for offshore snorkel tours. This service was largely dependent on weather as well as abundance of additional customer patronage. Transport to the Islet during late fall and winter months was often inhibited due to poor weather and ocean conditions.

## Lehua Work Site





## Nualolo Aina and Kai



Nualolo Valley from the rim

These two sites border one-another and are viewed as one from a predator control perspective. The rim, situated approximately 2000 feet above the valley floor, is visited separately from the valley floor. The rim can be accessed by foot, descending 2,500 from Kokee trailhead. Nualolo Aina consists of a dry sheer-walled valley similar to that of Honopu, but with a valley floor nearly twice the size. The valley is only accessible by helicopter or private-chartered boat (with the most ideal ocean conditions). NAPC staff

have observed Barn Owls repeatedly frequenting both Nualolo Kai and Aina regions in a single night. Vegetation at the valley floor consists of large groves of Kukui Trees, bordered with Hau and Common Guava along the perennial creek at the base. Lantana thickets cover the valley, but are slightly thinned by feral goat (*Capra aegagrus hircus*) trails, allowing for increased maneuverability. The south rim of the valley, at over two thousand feet above the valley floor, is effectively the Nualolo Kai work site. Hunting access to the beach of Nualolo Kai is not permitted by the landowner, State Parks,



NAPC technician setting tomahawk traps at the valley floor

however adequate coverage is achieved from the rim above. This rim is covered by barren eroded patches extending down precipitous slopes with occasional stands of Slash Pine (*Pinus elliotii*) and Loblolly Pine (*Pinus taeda*), planted for bank stabilization. Native Koa (*Acacia confusa*), Ohia, and invasive Eucalyptus, Ironwood (*Casuarina spp.*), Common and Strawberry Guava and Albezia are also interspersed in patches at the rim. The Nualolo region, as observed below, is highly-frequented by Barn Owls. Multiple detections, as shown on the map below, might indicate a single individual over several days or months of surveys in the region.

Despite several removals during 2015, and early 2016, Barn Owls have maintained a consistent presence in the region. NAPC staff believe this is due to the consistent updrafts, ease of transport and variety of hunting habitats available to birds of prey along the Na Pali



Cat scat at the valley floor containing White-tailed Tropicbird feathers

coastline. This increased mobility effectively leads to larger home ranges and high rates of colonization by young Barn Owls.

Due to the consistent Barn Owl presence in the region, the rim was selected as the first site for mobilization of Bucket of Rats, the NAPC baiting project. Once in place, the project succeeded in trapping rats, attracting cats, Barn Owls, and even feral pigs to the site. One Barn Owl was successfully removed, after becoming habituated to the site. This was likely due to increased rat activity outside the project and regular automated calls played by the attached sound anchor. No successful predations from the project itself were recorded at the Nualolo Rim site. No cats were successfully captured during this reporting period, although sign was detected in the area. A persistent, continued effort at Barn Owl and Cat removal will be necessary to ensure the quality of seabird nesting habitat in the region. Additional work sites along the coastline, both in valley and along rim will lead to better overall protection

of the region. Finding and removing predators at centers of population density will help stem the radiation out of these sites into adjacent valleys.

Seabirds observed frequenting the region include Newell's Shearwater, White-tailed Tropicbird and Band-rumped Storm Petrel. NAPC workers identified Newell's Shearwater nightly both activity zones during the nesting season.

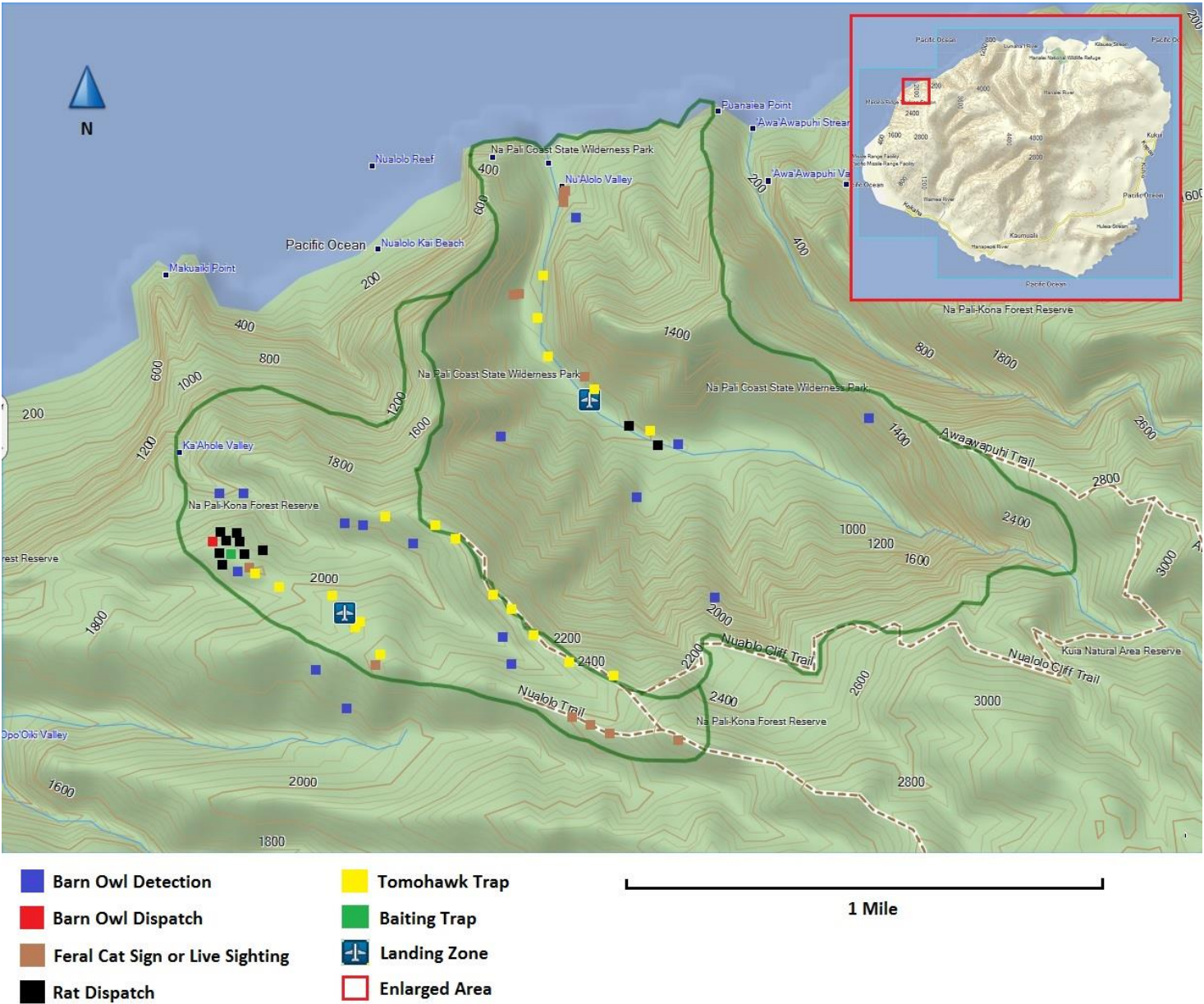


Female Barn Owl removed adjacent to the baiting project

in



Nualolo Aina and Kai Work Sites



## NAPC March 1<sup>st</sup> to December 31<sup>st</sup> 2016 Predator Detections and Dispatches

DATE	SITE	SPECIES	NUMBER IN GROUP	OBSERVATIONS
3/9/2016	HANAIEI	Barn Owl - Observed	1	HEARD CALLING TO NORTH 1/4 MILE
3/9/2016	HANAIEI	Pig - Sign	1	FRESH PIG TRACKS NEAR LZ
3/10/2016	HANAIEI	Barn Owl - Dispatched	1	MALE ADULT WITH BROOD PATCH AND RAT IN STOMACH
3/11/2016	HANAIEI	Barn Owl - Observed	1	CALLED ONCE FROM NEST SITE VICINITY
5/12/2016	HANAIEI	Barn Owl - Observed	1	ONE CALL HEARD JUST AFTER SUNSET. TWO PUEO IN AREA.
8/8/2016	HANAIEI	Cat - Sign	1	THREE SCATS W/IN 5 FT OF EACH OTHER, RODENT REMAINS, COLLECTED SAMPLES
10/13/2016	HANAIEI	Barn Owl - Observed	1	LIKELY MALE PAIRED W/BANO 101316 CALLED FROM VARIOUS SPOTS UNTIL 2015
10/13/2016	HANAIEI	Barn Owl - Observed	1	LIKELY FEMALE VOCAL DETECTION. CONTINUED CALLING UNTIL 2015, LIKELY PAIRED
10/14/2016	HANAIEI	Barn Owl - Observed	1	LIKELY MALE. AT LEAST TWO BARN OWL PAIRS WITHIN 1MILE RADIUS
10/14/2016	HANAIEI	Barn Owl - Observed	1	LARGE ADULT FEMALE, PAIRED, CIRCLED AND HUNTED STAYING OUR OF GUN RANGE
10/14/2016	HANAIEI	Barn Owl - Observed	1	PAIRED MALE. CALLED AND CIRCLED FOR OVER 1 HOUR, STAYED OUT OF GUN RANGE
12/13/2016	HANAIEI	Barn Owl - Observed	1	PELLET FOUND ON EDGE OF "RED HILL" CONTAINED RODENT HAIR AND BONES
12/13/2016	HANAIEI	Barn Owl - Observed	1	PELLET FOUND ON EDGE OF "RED HILL" CONTAINED RODENT HAIR AND BONES
10/17/2016	HONOPU	Barn Owl - Observed	1	CALLED A RESPONSE FROM SW WALL ~1/2 WAY UP. MALE POSSIBLY
10/17/2016	HONOPU	Cat - Dispatched	1	FEMALE TABBY KITTEN, STOMACH CONTAINED ~40 COCKROACHES
10/18/2016	HONOPU	Barn Owl - Observed	1	LIKELY SAME INDIVIDUAL HEARD ON 10/17. ROOST OR NEST SITE IN VICINITY
10/18/2016	HONOPU	Cat - Dispatched	1	YOUNG BLACK MALE, PASSERINE FEATHERS, RAT REMAINS, PRAWN IN STOMACH
10/19/2016	HONOPU	Cat - Observed	1	CAT EYE SHINE SEEN FROM 100 YARDS AWAY. RETREATED QUICKLY
11/17/2016	HONOPU	Barn Owl - Observed	1	BANO HEARD NEAR OPENING OF VALLEY. PROBABLY A FLYBY.
11/17/2016	HONOPU	Cat - Dispatched	1	YOUNG TABBY FEMALE. CONTAINED TAPEWORMS. SAMPLES COLLECTED
11/17/2016	HONOPU	Cat - Dispatched	1	YOUNG BLK/WHT MALE. CONTAINED RODENT HAIR AND BONES. SAMPLES COLLECTED
11/17/2016	HONOPU	Cat - Dispatched	1	LARGE MALE, SEABIRD LEG AND FEATHERS IN STOMACH. 9 LBS. SAMPLES COLLECTED
11/17/2016	HONOPU	Rat - Dispatched	1	MATURE MALE R. RATTUS
3/2/2016	KAHILI	Cat - Sign	1	FRESH TRACKS ALONG ROAD
3/2/2016	KAHILI	Cat - Sign	1	CAT SCAT WITH RAT BONES AND HAIR
3/3/2016	KAHILI	Barn Owl - Observed	1	ADULT FEMALE FROM PRIOR VISIT, SHOT AND HIT BUT FLEW AWAY
3/3/2016	KAHILI	Cat - Dispatched	1	FEMALE TABBY, ENLARGED MAMMARIES
3/3/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Barn Owl - Observed	1	HEARD CALLING FROM DISTANCE ACROSS VALLEY FROM HUNTERS
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
3/4/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
4/26/2016	KAHILI	Cat - Sign	1	PARTIALLY PREDATED RAT IN ROAD
4/26/2016	KAHILI	Pig - Sign	1	PIG TRACKS ALONG ROAD
4/28/2016	KAHILI	Barn Owl - Observed	1	OBSERVED FLYING UP ROAD. CALLED IN VICINITY UNTIL 2200. PUEO IN AREA
4/28/2016	KAHILI	Cat - Observed	1	TRAPPED CAT ESCAPED BEFORE DISPATCH
4/28/2016	KAHILI	Cat - Sign	1	CAT SCAT CONTAINING RAT HAIR AND BONES
4/28/2016	KAHILI	Cat - Sign	1	CAT SCAT WITH HAIR AND BONES OF RAT
4/28/2016	KAHILI	Pig - Live	2	TWO ADULT PIGS FLUSHED FROM ROADSIDE AS TECHS PASSED
4/28/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
4/29/2016	KAHILI	Barn Owl - Observed	1	HEARD CALLING FROM ACROSS VALLEY, DID NOT APPROACH HUNT LOCATION
4/29/2016	KAHILI	Cat - Sign	1	CAT SCAT WITH HAIR AND BONES OF RAT

DATE	SITE	SPECIES	NUMBER IN GROUP	OBSERVATIONS
4/29/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
4/29/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
4/29/2016	KAHILI	Rat - Dispatched	1	ADULT R. EXULANS IN TRAP, HALF IN HALF OUT, OUTSIDE HALF PREDATED
4/29/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
4/29/2016	KAHILI	Rat - Observed	1	TRAPPED RATTUS EXULANS EATEN BY ANOTHER RAT
6/8/2016	KAHILI	Cat - Sign	1	LARGE CAT SCAT WITH BONE DEPOSITS
6/8/2016	KAHILI	Pig - Sign	1	FRESH PIG SCAT NEAR TRAP #15
6/10/2016	KAHILI	Cat - Dispatched	1	LARGE FAT MALE TABBY, SEABIRD FEATHERS IN STOMACH, TOOK SAMPLE
6/10/2016	KAHILI	Cat - Dispatched	1	ADULT MALE CAUGHT IN TRAP
6/10/2016	KAHILI	Cat - Sign	1	LARGE SCAT ON ROAD
6/10/2016	KAHILI	Cat - Sign	1	LARGE SCAT ON ROAD
6/10/2016	KAHILI	Pig - Sign	1	FRESH ENORMOUS SCAT ON ROAD
6/10/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
6/10/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
6/10/2016	KAHILI	Rat - Observed	1	ESCAPED TRAP UPON ARRIVAL
8/12/2016	KAHILI	Cat - Dispatched	1	BLACK/WHITE MALE- SAMPLES COLLECTED. STOMACH EMPTY
8/12/2016	KAHILI	Pig - Live	1	ADULT PIG ROLLIN IN GRASS ALONGSIDE ROAD, LEFT ONCE IT NOTICED ME
8/12/2016	KAHILI	Pig - Sign	1	PIG TRACKS ALONG ROAD
8/12/2016	KAHILI	Pig - Sign	1	PIG TRACKS ALONG ROAD
8/12/2016	KAHILI	Rat - Dispatched	1	ADULT MALE R. RATTUS IN TRAP
8/12/2016	KAHILI	Rat - Dispatched	1	ADULT MALE R. RATTUS IN TRAP COLLECTED
8/12/2016	KAHILI	Rat - Dispatched	1	ADULT FEMALE R. EXULANS (TAIL CLIPPED-COLLECTED)
8/12/2016	KAHILI	Rat - Dispatched	1	R. RATTUS MALE REAR L FOOT CLIPPED, COLLECTED
8/12/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP
8/12/2016	KAHILI	Rat - Dispatched	1	R. EXULANS CAUGHT IN TRAP MALE
8/12/2016	KAHILI	Rat - Dispatched	1	ADULT MALE R. RATTUS (REAR L FOOT CLIPPED - COLLECTED)
9/28/2016	KAHILI	Cat - Sign	1	A SMALL SCAT, OLD AND CONTAINING REPTILE BONES
9/28/2016	KAHILI	Pig - Sign	1	MEDIUM SIZED PIG TRACKS ON ROAD
9/29/2016	KAHILI	Cat - Sign	1	LARGE FRESH CAT SCAT ALONG ROAD, CONTAINED RAT HAIRS
9/29/2016	KAHILI	Pig - Sign	1	LARGE PIG SCAT IN ROAD, FULL OF STRAWBERRY GUAVA
9/30/2016	KAHILI	Cat - Dispatched	1	ADULT MALE CAUGHT IN TRAP. STOMACH WITH RAT REMAINS. SAMPLE COLLECTED
9/30/2016	KAHILI	Rat - Dispatched	1	ADULT MALE R. RATTUS IN TRAP
9/30/2016	KAHILI	Rat - Dispatched	1	ADULT FEMALE R. RATTUS IN TRAP- DEAD ON ARRIVAL
9/30/2016	KAHILI	Rat - Dispatched	1	ADULT FEMALE R. RATTUS IN TRAP - PREGNANT
9/30/2016	KAHILI	Rat - Observed	1	EVIDENCE OF ESCAPED RAT FROM TOMOHAWK CAGE
12/5/2016	KAHILI	Pig - Sign	1	PIG TRACKS ALONG ROAD
12/5/2016	KAHILI	Pig - Sign	1	PIG TRACKS ALONG ROAD
12/7/2016	KAHILI	Cat - Dispatched	1	LARGE BRN TABBY MALE. STOMACH EMPTY. COLLECTED SAMPLES
12/7/2016	KAHILI	Cat - Dispatched	1	PETITE MATURE MALE BROWN TABBY. STOMACH EMPTY. COLLECTED SAMPLES
12/7/2016	KAHILI	Pig - Sign	1	PIG TRACKS ALONG ROAD
12/7/2016	KAHILI	Pig - Sign	1	PIG TRACKS AND 5M SQUARE AREA OF ROOTING
12/7/2016	KAHILI	Rat - Dispatched	1	R. RATTUS COLLECTED FOR SI
12/7/2016	KAHILI	Rat - Dispatched	1	R. RATTUS COLLECTED
3/21/2016	LEHUA	Barn Owl - Observed	1	SHOT AT BUT MISSED, REMAINED IN AREA FLYING BACK AND FORTH OUT OF RANGE
3/21/2016	LEHUA	Egret - Observed	25	EGRETS FLEW FROM NIGHT ROOST NEAR MOORING AS SHOTS WERE FIRED AT BANO
3/22/2016	LEHUA	Barn Owl - Dispatched	1	ADULT FEMALE W/ BROOD PATCH, STOMACH W/ WTSH REMAINS
3/22/2016	LEHUA	Barn Owl - Observed	1	TOOK SHOT AT BANO AND POSSIBLE HIT BUT FLEW OFF
3/23/2016	LEHUA	Barn Owl - Observed	1	CALL MADE FROM POTENTIAL ROOST SITE OR NEST UP HILL FROM HUNT AREA

DATE	SITE	SPECIES	NUMBER IN GROUP	OBSERVATIONS
5/3/2016	LEHUA	Barn Owl - Observed	1	ONE CHIRRP CALL HEARD FROM POSSIBLE ROOST SITE UPHILL FROM TECHS
5/3/2016	LEHUA	Barn Owl - Observed	1	INDIVIDUAL PASSED TECHS BRIEFLY, UNABLE TO DISPATCH
5/3/2016	LEHUA	Egret - Observed	94	CAEG FLYING TO NEST SITE FROM NIIHAU AT SUNSET
5/4/2016	LEHUA	Barn Owl - Observed	1	BREAST FEATHERS REMOVED, ORGANS REMOVED, TYPICAL BANO SIGN
5/4/2016	LEHUA	Cattle Egret - Nest	11	REMOVED NESTS, MAINLY LOCATED UNDER RBBO NESTS. OVER 20 BROKEN EGGS
5/4/2016	LEHUA	Egret - Dispatched	15	REMOVED ONE ADULT AND 14 EGGS
5/4/2016	LEHUA	Egret - Dispatched	2	2 ADULTS SHOT AFTER BEING FLUSHED BY TECHS
5/4/2016	LEHUA	Egret - Observed	130	INDIVIDUALS FLUSHED FROM NEST SITE UPON TECHNICIAN ARRIVAL
5/4/2016	LEHUA	Egret - Observed	4	VIEWED FOUR OF LIKLEY 200 CAEG WHICH FLUSHED AFTER HARASSMENT SHOT FIRED
5/4/2016	LEHUA	Egret - Observed	60	CAEG ROOSTING AT WESTERN SITE. JOINED LARGER FLOCK IN AIR ONCE FLUSHED
7/19/2016	LEHUA	Cattle Egret - Nest	93	NESTS WERE MOSTLY EMPTY, 3 CONTAINED EGGS. APPR 30 WITH JUV EGRETS
7/19/2016	LEHUA	Egret - Dispatched	57	INCLUDED 19 ADULT, 20 JUV, 18 UNFLEDGED
7/19/2016	LEHUA	Egret - Dispatched	7	ND
7/19/2016	LEHUA	Egret - Observed	123	FLUSHED UPON ARRIVAL
7/19/2016	LEHUA	Rat - Observed	1	TWO WTSH EGGS PREDATED BY RATS
7/20/2016	LEHUA	Egret - Dispatched	7	INDIVIDUALS WHICH HAD FLUSHED ON 7/19 WERE FOUND BACK AT NEST SITE
7/20/2016	LEHUA	Egret - Observed	106	INDIVIDUALS FLUSHED FROM NEST SITE UPON RETURN ON 7/20. SOME RAN UP HILL
9/21/2016	LEHUA	Barn Owl - Observed	1	ADULT SEEN/HEARD FLYING IN RAVINE BELOW HUNT LOCATION. LIKELY MALE
9/21/2016	LEHUA	Barn Owl - Observed	1	LIKELY FEMALE HEARD CALLING TO MALE FROM ROOST ABOVE HUNT LOCATION
9/22/2016	LEHUA	Barn Owl - Nest	1	EXPLORED AN HISTORIC BANO NEST SITE, LIKELY STILL AN ACTIVE ROOST SITE
9/22/2016	LEHUA	Barn Owl - Observed	1	BANO \ FLYING OVER GULLY WEST OF WEATHERPORT DURING MORNING HUNT
9/22/2016	LEHUA	Barn Owl - Observed	1	HEARD FROM ROOST UPHIL (N) OF HUNT LOCATION. DID NOT APPROACH HUNTERS
9/22/2016	LEHUA	Barn Owl - Observed	2	TWO PREDATED RTTR CHICKS 5 FT APART, DRAGGED FROM NEST SITE AND EATEN
9/22/2016	LEHUA	Rat - Observed	1	RAT-EATEN WTSH AT BURROW. ORIGINAL CAUSE OF DEATH UNKNOWN
9/23/2016	LEHUA	Barn Owl - Observed	1	ONCE AGAIN OBSERVED FLYING/HUNTING OVER RAVINE TO W OF WEATHERPORT
4/13/2016	Nualolo	Barn Owl - Observed	1	SOARED AND CALLED INNERMITTANTLY ABOVE TECHS UNTIL 2200. PUEO IN AREA
4/13/2016	Nualolo	Barn Owl - Observed	1	ALSO DETECTED FAR ABOVE TECHS, CALLED OCCASSIONALLY, PUEO IN AREA
4/14/2016	Nualolo	Barn Owl - Observed	1	CALLED THREE TIMES WHILE PASSING OVER HUNT LOCATION TO THE NORTH
4/14/2016	Nualolo	Cat - Observed	1	VIEWED VIA EYE REFLECTION BRIEFLY BEFORE CLIMBING OUT OF SIGHT
6/5/2016	Nualolo	Pig - Sign	1	FRESH PIG SCAT ALONG NUALOLO AINA TRAIL NEAR CLIFF TRAIL JUNCTION
6/14/2016	Nualolo	Barn Owl - Observed	1	CALL HEARD ONCE IN DISTANCE, SEX UNKNOWN
6/14/2016	Nualolo	Barn Owl - Observed	1	ONE CALL HEARD, SEX UNKNOWN
6/14/2016	Nualolo	Pig - Sign	1	LARGE FRESH PIG SCAT IN TRAIL
6/15/2016	Nualolo	Barn Owl - Observed	1	LIKELY FEMALE, CALLED, APPROACHED HUNT LOCATION, UNABLE TO DISPATCH
6/15/2016	Nualolo	Barn Owl - Observed	1	CALLED, APPROACHED HUNT LOCATION, ATTEMPTED DISPATCH. LIKELY PAIRED
6/15/2016	Nualolo	Barn Owl - Observed	1	CALLED AND APPROACHED HUNT LOCATION IN TANDEM. FAILED TO DISPATCH.
6/15/2016	Nualolo	Cat - Sign	1	LARGE SCAT ON TRAILSIDE
6/15/2016	Nualolo	Cat - Sign	1	MYNA FEATHERS COLLECTED LYING ALONG TRAIL
7/15/2016	Nualolo	Pig - Sign	1	LIKELY PREDATED SEABIRD - SAMPLE COLLECTED
7/26/2016	Nualolo	Cat - Sign	1	CAT SCAT WITH WTTR FEATHER
7/26/2016	Nualolo	Pig - Sign	1	EXCESSIVE PIG DIGGINGS
8/18/2016	Nualolo	Barn Owl - Observed	1	PHOTOGRAPHED BY INTERNAL BOR CAMERA FLYING INTO CAT FENCING
9/13/2016	Nualolo	Barn Owl - Observed	1	FLYING OVER "KNOLL" BELOW NUALOLO LOOKOUT
9/13/2016	Nualolo	Barn Owl - Observed	1	FLYING ABOVE "KNOLL" BELOW HUNT LOCATION, CALLED
9/13/2016	Nualolo	Cat - Sign	1	SCAT FOUND ON TRAIL 30M SOUTH OF BOR; PLACED TRAP IN AREA
9/13/2016	Nualolo	Cat - Sign	1	SCAT FOUND ON TRAIL S OF HIGHEST PINE/VEG PATCH
9/13/2016	Nualolo	Pig - Sign	1	PIG TRACKS 100M ON RIDGE ALONG TRAIL NEAR BOR AND LZ
9/13/2016	Nualolo	Pig - Sign	3	PIG AND PIGLET TRACKS, 4 INDIVIDUALS, ALONG TRAIL AT HIGHEST PINE/VEG PATCH



DATE	SITE	SPECIES	NUMBER IN GROUP	OBSERVATIONS
9/14/2016	Nualolo	Barn Owl - Observed	1	ONE INDIVIDUAL OBSERVED 3 TIMES, FLYING AROUND KNOLL TO THE NORTH
9/14/2016	Nualolo	Cat - Sign	1	LARGE CAT SCAT ALONG KAAHOLE RIM TRAIL
9/14/2016	Nualolo	Pig - Sign	5	FIVE PIG TRAILS/TRACKS ALONG KAAHOLE RIM TRAIL
9/20/2016	Nualolo	Cat - Sign	1	LARGE SCAT WITH RAT HAIRS ON TRAIL
9/20/2016	Nualolo	Cat - Sign	1	CAT SCAT ALONG TRAIL- RAT HAIR ONLY
9/20/2016	Nualolo	Pig - Sign	1	PIG SCAT W/GUAVA SEEDS ALONG TRAIL, VERY FRESH
9/29/2016	Nualolo	Rat - Observed	1	UNKNOWN RATTUS SPP OUTSIDE BOR
9/29/2016	Nualolo	Rat - Observed	2	# OF RAT OBSERVATION OUTSIDE BOR 09/29-10/08/2016
10/4/2016	Nualolo	Cat - Sign	1	CONTAINED WTTR FEATHERS
10/4/2016	Nualolo	Cat - Sign	1	CONTAINED PRAWN AND RAT REMAINS
10/4/2016	Nualolo	Cat - Sign	1	CONTAINED RAT/CAT HAIR AND PRAWN REMAINS
10/4/2016	Nualolo	Cat - Sign	1	CONTAINED PRAWN AND RAT REMAINS
10/4/2016	Nualolo	Cat - Sign	1	THREE SCATS W/RAT HAIR SPACED APPROX 2 FT APART
10/5/2016	Nualolo	Barn Owl - Observed	1	LIKELY FEMALE CALLED FROM HIGH ELEVATION (~400') ABOVE HUNT LOCATION
10/5/2016	Nualolo	Rat - Dispatched	1	ADULT MALE R RATTUS
10/6/2016	Nualolo	Barn Owl - Observed	1	LIKELY SAME FEMALE AS DETECTED 10/05 EVENING
10/7/2016	Nualolo	Rat - Dispatched	1	ADULT MALE R RATTUS
10/25/2016	Nualolo	Barn Owl - Dispatched	1	CAME FROM UP VALLEY; VERY LIGHT AND ON SMALLER SIDE, BODY UNRECOVERABLE
10/25/2016	Nualolo	Barn Owl - Observed	1	BANO OBSERVED FLYING AROUND NUALOLO "KNOB"; MAKAI SIDE
10/25/2016	Nualolo	Barn Owl - Observed	1	BANO CALLED ONCE FROM ~600M UP KAAHOLE VALLEY
10/25/2016	Nualolo	Pig - Sign	1	PIG TRACKS AND SCAT W/GUAVA 75M PAST END OF NUALOLO TRAIL MARKER.
10/25/2016	Nualolo	Pig - Sign	3	3 SETS OF PIG TRACKS OBSERVED FOR ~ 50m ALONG NUALOLO RIDGE
10/26/2016	Nualolo	Cat - Sign	1	SOME SMALL FEATHERS IN SCAT (NOT SEABIRD)
10/26/2016	Nualolo	Pig - Sign	1	PIG TRACKS AND SCAT W/GUAVA ALONG KAAHOLE RIDGE
10/26/2016	Nualolo	Pig - Sign	1	TRACKS AND SCAT ALONG RIDGE
10/29/2016	Nualolo	Rat - Observed	61	# OF RAT OBSERVATION OUTSIDE BOR 10/29-11/7/2016
11/6/2016	Nualolo	Cat - Observed	1	1 BROWN TABBY LURKING AROUND OUTSIDE BOR
11/8/2016	Nualolo	Rat - Observed	89	# OF RAT OBSERVATION OUTSIDE BOR 11/08-11/17/2016
11/10/2016	Nualolo	Pig - Live	1	CLOSE-UP BODY SHOTS. CAN BARELY TELL IT'S A PIG
11/15/2016	Nualolo	Cat - Observed	1	SCAT FOUND ALONG NUALOLO TRAIL. CONTAINED RODENT HAIR AND BONES
11/15/2016	Nualolo	Cat - Observed	1	SCATBETWEEN NUALOLO AND KAAHOLE RIDGES. CONTAINED ONLY RODENT REMAINS
11/15/2016	Nualolo	Cat - Observed	1	SCAT FOUND. ONLY RODENT HAIR AND BONES IN SCAT.
11/15/2016	Nualolo	Pig - Sign	1	FRESH GUAVA SCAT ALONG NUALOLO TRAIL
11/18/2016	Nualolo	Rat - Observed	125	# OF RAT OBSERVATION OUTSIDE BOR 11/18-11/27/2016
11/28/2016	Nualolo	Rat - Observed	42	# OF RAT OBSERVATION OUTSIDE BOR 11/28-12/7/2016
12/2/2016	Nualolo	Cat - Sign	1	MOSTLY GREEN W/ALGAE, ONLY HAIR OBSERVED. COLLECTED
12/8/2016	Nualolo	Rat - Observed	31	# OF RAT OBSERVATION OUTSIDE BOR 12/8-12/17/2016
12/17/2016	Nualolo	Cat - Observed	1	ADULT MALE BLACK CAT (TABBY UNDERCOAT; LIGHT PATCH ON CHEST) OUTSIDE BOR
12/18/2016	Nualolo	Rat - Observed	89	# OF RAT OBSERVATION OUTSIDE BOR 12/18-12/27/2016
12/20/2016	Nualolo	Cat - Observed	1	MALE BLACK CAT OUTSIDE BOR. SAME CAT FROM 12/17/2016
12/20/2016	Nualolo	Rat - Observed	10	10 DIFFERENT RAT SIGHTINGS OUTSIDE BOR 12/10-12/20
12/28/2016	Nualolo	Rat - Observed	142	# OF RAT OBSERVATION OUTSIDE BOR 12/28-01/06/2017
12/30/2016	Nualolo	Pig - Live	1	LARGE PIG PASSING BY BOR

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