Kawailoa Wind Project Habitat Conservation Plan
FY 2024 Annual Report

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Incidental Take License ITL-14 Amended/Incidental Take Permit TE59861A-1

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EXECUTIVE SUMMARY

This report summarizes work performed by Kawailoa Wind, LLC (Kawailoa Wind), owner of Kawailoa Wind Project (Project) during the State of Hawai'i fiscal year 2024 (FY 2024; July 1, 2023 to June 30, 2024) under the terms of the approved Habitat Conservation Plan (HCP) dated October 2011 and the approved HCP Amendment dated September 2019, and pursuant to the obligations in the Project's state Incidental Take License (ITL; ITL-14 Amended) and federal Incidental Take Permit (ITP; TE-59861A-1). The Project was constructed in 2011 and 2012 and commissioned to begin operating on November 2, 2012. Species covered under the HCP and HCP Amendment include seven state and federally listed threatened or endangered species, as well as one state listed endangered species.

Fatality monitoring at the Project continued throughout FY 2024 at all wind turbine generators (WTG). In FY 2024, search areas consisted of 55-meter-radius circles centered on each turbine and roads out to 75 meters from each turbine. For the two unguyed meteorological towers, the search area consisted of a 50-meter-radius circle centered on each tower. The mean search interval for both turbines and the meteorological towers in FY 2024 was 7.0 days.

Four 28-day carcass persistence trials were conducted in FY 2024 using 60 bat surrogates and 12 medium-sized bird carcasses. For FY 2024, the probability and 95 percent confidence interval that a bat surrogate carcass persisted until the next search was 0.74 (0.66 to 0.81). The probability that a medium-size bird carcass persisted until the next search was 0.90 (0.27 to 1.00).

Searcher efficiency trials were conducted over 24 trial days with 81 trial carcasses in FY 2024. The overall searcher efficiency in FY 2024 for bat surrogates (N = 70) was 0.93 (0.85 to 0.97). For medium-sized birds (N = 11) searcher efficiency was 1.00 (0.80 to 1.00).

One HCP Covered Species fatality was observed in FY 2024; one Hawaiian hoary bat/'ōpe'ape'a (*Lasiurus semotus*) was found on May 7, 2024 at WTG 9. The Project's total observed Hawaiian hoary bat take from operations through FY 2024 is 43 bats. The fatality estimate for non-incidental observed bats using the Evidence of Absence estimator (Dalthorp et al. 2017) at the upper 80 percent credibility level is 88 bats, and the total indirect take for this estimate is 9 adult bat equivalents. Combining these values, there is an approximately 80 percent chance that actual take of Hawaiian hoary bats at the Project is less than or equal to 97 adult bats. In June 2024, USFWS approved the use of an adjusted rho value incorporating the benefits of deterrents. The current estimate falls within the Tier 4 bat take request (which is up to 115 bats). Mitigation for Tier 4 take was completed in 2018.

Twenty-one fatalities representing 10 non-listed species were found at the Project in FY 2024. This includes the following birds that are protected by the Migratory Bird Treaty Act: one Pacific golden plover/kolea (*Pluvialis fulva*) and one barn owl (*Tyto alba*).

Tier 1 mitigation for the Hawaiian hoary bat continued in FY 2024. Four permanent ground-based ultrasonic bat detectors were managed at the Project at WTGs 1, 10, 21, and 25. Hawaiian hoary bats were detected on 325 of 1,285 (25.3 percent) detector-nights sampled throughout the 2024

Bat Sampling Period. The ʻUkoʻa Wetland mitigation program for Tier 1 mitigation continued for waterbirds and bats through FY 2024 including invasive vegetation control, predator control and monitoring, fence monitoring and maintenance, bat acoustic monitoring, and bat lane maintenance. During the 2024 Bat Sampling Period, Hawaiian hoary bats were detected at ʻUkoʻa Wetland on 595 of 2,227 detector-nights sampled (26.7 percent).

Bat mitigation for Tiers 2 through 4 is complete. Kawailoa Wind continues to plan for Tier 5 bat mitigation, should it be needed.

Mitigation for waterbirds continued at ʻUkoʻa Wetland, despite no observed take of these species at the facility. In total, 17 Hawaiian common gallinule/ʻalae ʻula (*Gallinula galeata sandvicensis*) fledglings have been recorded at ʻUkoʻa Wetland since monitoring began following management until the end of FY 2024. No evidence of Hawaiian stilt/aeʻo (*Himantopus mexicanus knudseni*) or Hawaiian coot/ʻalae keʻokeʻo (*Fulica alai*) breeding has been observed at ʻUkoʻa Wetland despite years of ongoing management.

No Hawaiian petrel/ʻuaʻu (*Pterodroma sandwichensis*) fatalities were observed in FY 2024. The estimated cumulative Project take is below the authorized take limit. Mitigation for the take of Hawaiian petrel was completed in FY 2021. Pacific Rim Conservation's research related to Hawaiian petrels on Oʻahu continued in FY 2024 using funds provided by Kawailoa Wind.

Mitigation for Newell's shearwater/aʻo (*Puffinus newelli*) was completed in FY 2015. Hawaiian short-eared owl/pueo (*Asio flammeus sandwichensis*) mitigation was completed in FY 2017.

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Acronyms and Abbreviations

ANOVA	analysis of variance
CPT	carcass persistence trials
DOFAW	Division of Forestry and Wildlife
DU	deterrent unit
DUC	deterrent unit controllers
EoA	Evidence of Absence
ESRC	Endangered Species Recovery Committee
FY	fiscal year
HAGA	Hawaiian common gallinule
HCP	Habitat Conservation Plan
HWA	Helemano Wilderness Area
IQR	Interquartile Range
ITL	Incidental Take License
ITP	Incidental Take Permit
LWSC	low wind speed curtailment
MBTA	Migratory Bird Treaty Act
met	meteorological
ODT	observed direct take
ORQ	ordered quantile normalization transformation
PC	point-count
SD	standard deviation
SEEF	searcher efficiency
TPL	Trust for Public Lands
UAD	ultrasonic acoustic deterrents
UCL	upper credible limit
UDT	unobserved direct take
USFWS	United States Fish and Wildlife Service
WEOP	Wildlife Education and Observation Program
WEST	Western EcoSystems Technology, Incorporated
WTG	Wind Turbine Generator

1.0 Introduction

The Habitat Conservation Plan (HCP) for the Kawailoa Wind Project (Project) was approved by the Hawai‘i Division of Forestry and Wildlife (DOFAW) in 2012 (SWCA 2011; the 2011 HCP). On December 8, 2011, the U.S. Fish and Wildlife Service (USFWS) issued Kawailoa Wind, LLC (Kawailoa Wind) a federal incidental take permit (ITP) for the Project, and DOFAW issued a state incidental take license (ITL) on January 6, 2012. The original ITP and ITL cover the incidental take of six state and federally listed threatened or endangered species, as well as one state listed endangered species (collectively referred to as the Covered Species) over a 20-year permit term.

In September 2019, Kawailoa Wind submitted a final HCP Amendment to USFWS and DOFAW to request an increase in the amount of Hawaiian hoary bat/‘ōpe‘ape‘a (*Lasiurus semotus*) take and to add the state and federally listed endangered Hawaiian petrel/‘ua‘u (*Pterodroma sandwichensis*) as a Covered Species (Tetra Tech 2019). Kawailoa Wind received an amended ITP from USFWS on September 4, 2019. An amended ITL was issued by DOFAW on February 26, 2021, and signed by Kawailoa Wind on March 30, 2021. The Project’s Covered Species are listed in Table 1.

Table 1. Covered Species

Common Names	Hawaiian Names	Scientific Names	Listing Status[1]
Hawaiian coot	‘alae ke‘oke‘o	*Fulica alai*	FE/SE
Hawaiian duck	koloa maoli	*Anas wyvilliana*	FE/SE
Hawaiian common gallinule	‘alae ‘ula	*Gallinula galeata sandvicensis*	FE/SE
Hawaiian stilt	ae‘o	*Himantopus mexicanus knudseni*	FE/SE
Hawaiian petrel	‘ua‘u	*Pterodroma sandwichensis*	FE/SE
Newell’s shearwater	‘a‘o	*Puffinus newelli*	FT/ST
Hawaiian hoary bat	‘ōpe‘ape‘a	*Lasiurus semotus*	FE/SE
Hawaiian short-eared owl	pueo	*Asio flammeus sandwichensis*	SE
1. FE = Federally endangered; SE = State endangered; FT = Federally threatened; ST = State threatened.			

The Project was constructed in 2011 and 2012 and was commissioned to begin operating in November 2012. The Project is owned and operated by Kawailoa Wind, a wholly owned subsidiary of DESRI IV, LLC, which is an investment fund managed by D.E. Shaw Renewable Investments, LLC.

This report summarizes work performed for the Project during the State of Hawai‘i 2024 fiscal year (FY 2024; July 1, 2023 to June 30, 2024) pursuant to the terms and obligations of the 2011 HCP (SWCA 2011), HCP Amendment (Tetra Tech 2019), and amended ITL and ITP.

2.0 Fatality Monitoring

All 30 wind turbine generators (WTGs) and the two meteorological (met) towers were searched for fatalities once per week throughout FY 2024. Search plots for each WTG in FY 2024 consisted of a 55-meter-radius circle centered on the WTG and roads surrounding the WTG out to 75 meters. Search plots for each unguyed met tower were 50-meter-radius circles centered on the met towers. The FY 2024 mean search interval for WTGs was 7.0 days (standard deviation [SD] = 0.1 days). The mean search interval for unguyed met towers in FY 2024 was 7.0 days (SD = 1.9 days).

Due to safety issues or physical constraints, small portions of the 55-meter-radius search plots at 13 of the turbines have unsearchable areas. Combined, the inability to search these areas reduces the propoportion of the carcass distribution searched by 0.012 for birds and 0.035 for bats compared to 55-meter-radius search plots without these constraints. There were no unsearchable areas within the unguyed met tower search plots.

In FY 2024, the search areas were searched by trained dogs accompanied by their handlers. In previous years when conditions limited the use of dogs (e.g., weather, injury, availability of canine search teams), search plots were visually surveyed by Project staff; however, canine teams conducted 100 percent of the WTG searches in FY 2024. Vegetation within the search areas is managed to maximize searcher efficiency (SEEF) (see Section 4.0).

3.0 Bias Correction

3.1 Carcass Persistence Trials

Four 28-day carcass persistence trials (CPT) were conducted in FY 2024 using black rat (*Rattus rattus*) carcasses as bat surrogates and wedge-tailed shearwater (*Ardenna pacifica*) carcasses as surrogates for the Covered bird species. Trial results for FY 2024 are provided in Table 2, including results by vegetation class.

3.2 Searcher Efficiency Trials

Tetra Tech personnel (non-searchers) administered 81 searcher efficiency trials on 24 trial days during FY 2024. Similar to the carcass persistence trials, wedge-tailed shearwaters were used as surrogates for the Covered bird species, and black rats were used as surrogates for the Hawaiian hoary bat. SEEF trials occurred throughout FY 2024. Vegetation class (short vs. medium height) within each search plot was documented at the time the carcasses were placed. Results for the FY 2024 SEEF trials are provided in Table 2, including results by vegetation class.

Table 2. Carcass Persistence and Searcher Efficiency Trial Results in FY 2024

Size	Vegetation Class	Total Trials		Mean (95% Confidence Interval)	
		SEEF[1]	CPT[1]	SEEF (Proportion Detected)[2]	Probability of Persistence to the Next Search (r)[2, 3]
Rat Surrogate	Short	55	46	0.91 (0.81 – 0.96)	0.77 (0.70 – 0.84)
	Medium	15	14	1.00 (0.85 – 1.00)	0.66 (0.47 – 0.82)
	Combined	70	60	0.93 (0.85 – 0.97)	0.74 (0.66 – 0.81)
Medium Bird	Short	8	11	1.00 (0.74 – 1.00)	0.89 (0.26 – 1.00)
	Medium	3	1	1.00 (0.46 – 1.00)	0.99 (0.79 – 1.00)
	Combined	11	12	1.00 (0.80 – 1.00)	0.90 (0.27 – 1.00)

1. SEEF = Searcher efficiency; CPT = Carcass Persistence Trials.

2. Estimates and confidence interval calculated using Dalthorp et al. (2017) single-year module.

3. The estimate of r is reported in lieu of carcass persistence time, as r provides a more informative portrayal of the effect of carcass persistence on fatality estimates than carcass persistence time, incorporating information from the carcass persistence distribution and the search interval in a single variable. Estimates and confidence interval for r were calculated using Dalthorp et al. (2017) single-year module.

4.0 Vegetation Management

Vegetation in the search plots consists mainly of Guinea grass (*Megathyrsus maximus*), Bermuda grass (*Cynodon dactylon*), and a mixture of common, low-growing weedy plants. All search plots around the WTGs and unguyed met towers are mowed regularly to increase visibility during fatality searches. Plots are mowed to a height of 3 to 4 inches, depending on the type of mower used. Plots are mowed roughly every 2 to 4 weeks. Herbicides were also used in FY 2024 to control vegetation in some portions of the search areas. The frequency of vegetation management varies depending on rainfall, time of year, type of vegetation cover, and cattle presence.

The landowner, Kamehameha Schools, has managed cattle on their property since before the Project was constructed. Domestic cattle are rotated periodically throughout portions of the Project and graze vegetation under several of the turbines. Cattle periodically graze at WTGs 1 – 3 and WTGs 16 – 26. The specific locations and number of cows present throughout the year depends on several factors including forage and water availability, and landowner operations. No cattle are present at WTGs 4 – 15 and 27 – 30. Because Kawailoa Wind is not the landowner, the Project does not have control over cattle use in the area.

5.0 Scavenger Trapping

Scavenger trapping is a management action designed to limit removal of carcasses and thus support carcass retention at the Project. Scavenger trapping is responsive to Project needs, and carcass persistence and detection probability are monitored quarterly throughout the fiscal year. No scavenger trapping occurred in FY 2024. Despite no trapping efforts occurring in FY 2024, the

carcass persistence and detection probability increased slightly for bats compared to FY 2023 (Tetra Tech 2023). Scavenger trapping is planned to resume in Q1 of FY 2025.

6.0 Documented Fatalities and Take Estimates

One Hawaiian hoary bat fatality was observed in FY 2024 (Table 3). This is the third Hawaiian hoary bat fatality observed at the Project since deterrents were installed in May and June 2019 (see Section 10). According to NRG Systems, the ultrasonic acoustic deterrents (UAD) were functional when the fatality is expected to have occurred. The bat carcass was transferred to the Bishop Museum for genetic testing in August 2024.

Table 3. Observed Hawaiian Hoary Bat Fatalities at the Project in FY 2024

Age	Sex	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)
Adult	Unknown[1]	May 7, 2024	9	48	283
1. Genetic sexing of carcasses is not currently being conducted by USGS.					

No other listed species fatalities were observed in FY 2024. All observed, downed wildlife were handled and reported in accordance with the most recent Downed Wildlife Protocol. All non-listed fatalities observed at the Project during FY 2024 are listed in Appendix 1.

6.1 Hawaiian Hoary Bat

As mentioned above, a single Hawaiian hoary bat fatality was documented during FY 2024 (Table 3; Appendix 1). The total take estimate for the Hawaiian hoary bat is based on fatality monitoring data and bias correction data from the start of Project operation (November 2012) through the end of FY 2024 (June 2024). An upper credible limit (UCL) of take is estimated from three components: (1) observed direct take (ODT) during protocol (standardized) surveys, (2) unobserved direct take (UDT), and (3) indirect take. The Evidence of Absence software program (EoA; Dalthorp et al. 2017), which is the agency-approved analysis tool for analyzing direct take, uses results from bias correction trials and ODT to generate UCL of direct take (i.e., ODT + UDT). The USFWS and DOFAW have requested that these calculations be reported at the 80 percent UCL. Values from this analysis can be interpreted as meaning there is an 80 percent probability that actual direct take at the Project over the analysis period was less than or equal to the 80 percent UCL. Associated indirect take is estimated based on observations of the temporal distribution of Covered Species fatalities at the Project and agency guidance regarding life history characteristics of the associated Covered Species.

A total of 43 Hawaiian hoary bat fatalities have been observed at the Project since operations began on November 2, 2012. The highest number of annual bat fatalities (nine) was observed in FY 2014 and FY 2015 (Table 4). Two of the total 43 observed bats were found outside of fatality search plots

and classified as incidental observations. Table 4 presents the cumulative take estimates (direct take + indirect take) by FY since operations began. Direct take is estimated using the EoA estimator at the 80 percent UCL (Dalthorp et al. 2017). Indirect take is calculated using USFWS (2016) guidance.

Table 4. Hawaiian Hoary Bat Fatalities by Fiscal Year and Cumulative Take Estimates

Fiscal Year	Number of Observed Fatalities[1]	Cumulative Take Estimate[2]
2013	4	11
2014	9	26
2015	9	38
2016	4	49
2017	2	60
2018	5	73
2019	5	89
2020	0	89[3]
2021	0	91[3]
2022	2	95[3]
2023	0	95[3]
2024	1	97[3]
Total	**41**	97[3]

1. Does not include bat fatalities found outside of the search areas (i.e., two incidental observations).

2. Cumulative take represents the 80 percent UCL of cumulative direct take estimated from the Evidence of Absence estimator (Dalthorp et al. 2017) plus the associated indirect take calculated using USFWS (USFWS 2016) guidance.

3. The installation of acoustic deterrents represents an inflection point in the bat fatality rate, reducing the risk to bats at the Project. Based on results from 5 years of monitoring, USFWS approved the use of an unbiased estimate of deterrent effectiveness in June 2024. Monitoring data through FY 2024 suggests that the unbiased estimate of deterrent effectiveness at the Project reduces the risk to bats by 87.3 percent (rho = 0.127). Therefore, these values have been updated for these years in this annual report using a modified rho value in the EoA model.

Based on the June 2024 USFWS approval of a modified rho value to account for the benefit of deterrents, estimated take now incorporates this estimate for years of deterrent operation (FY 2020 – FY 2024); as a result, reported results for those years differ from values reported in the FY 2023 annual report. The estimated direct take (ODT + UDT) for the 43 Hawaiian hoary bat fatalities found between the start of operation (November 2, 2012) and end of FY 2024 is less than or equal to 88 bats (80 percent UCL; Appendix 2). Because two of the 43 observed bat fatalities were found outside of the search areas (i.e., were incidental observations), 41 fatalities were used in the direct take analysis, and the two incidental observations are accounted for in the estimated value of UDT. The two incidental observations were found in FY 2013 and FY 2016. UDT is estimated at 45 fatalities (88 bats; 80 percent UCL, 43 bats ODT).

Indirect take is estimated to account for the potential loss of individuals that may occur indirectly as the result of the loss of an adult female through direct take during the period that females may be

pregnant or supporting dependent young. Indirect take for the Project is calculated using the October 2016 USFWS guidance as follows:

- The average number of pups attributed to a female that survives to weaning is assumed to be 1.8.
- The sex ratio of bats taken through UDT is assumed to be 45 percent female based on the 42 bats assessed by USGS from the Project.
- The assessment of indirect take to a modeled UDT accounts for the fact that it is not known when the unobserved fatality may have occurred. The period of time from pregnancy to end of pup dependency for any individual bat is estimated to be 3 months. Thus, the probability of taking a female bat that is pregnant or has dependent young is 25 percent.
- The conversion of juveniles to adults is one juvenile to 0.3 adults.

Based on the USFWS methodology (USFWS 2016), the estimate of cumulative indirect take in FY 2024 is calculated as:

- **Total juvenile take calculated from observed female take (April 1 to September 15)**
    - 10 (observed females) * 1.8 (pups per female) = 18 juveniles
- **Total juvenile take calculated from observed unknown sex take (April 1 to September 15)**
    - 1 (observed unknown sex) * 0.45 (sex ratio observed at Kawailoa Wind) * 1.8 (pups per female) = 0.8 juveniles
- **Total juvenile take calculated from unobserved take**
    - 45 (unobserved direct take) * 0.45 (sex ratio observed at Kawailoa Wind) * 0.25 (proportion of calendar year females could be pregnant or have dependent pups) * 1.8 (pups per female) = 9.2 juveniles
- **Total Calculated Juvenile Indirect Take** = 28 (18 + 0.8 + 9.2)
- **Total Adult Equivalent Indirect Take =** 0.3 (juvenile to adult conversion factor) * 28 = 8.4

Therefore, the estimated indirect take based on the UCL of Hawaiian hoary bat direct take at the Project is nine adult bats (rounded up from 8.4).

The UCL for Project take of the Hawaiian hoary bat at the 80 percent credibility level is 97 adult bats (88 estimated direct take + 9 estimated indirect take)[1]. That is, there is an approximately 80 percent probability that actual take at the end of FY 2024 is less than or equal to 97 bats. This estimate falls within the Tier 4 bat take authorization detailed in the HCP Amendment (Tetra Tech 2019), which has a total take request of 115 bats.

[1] This total is estimated using a rho value of 0.127 for years when deterrents were operational.

Kawailoa Wind described methods for determining an estimate of a conservative rho value in the annual reports for FY 2020 to 2023 (Tetra Tech 2020, Tetra Tech 2021, Tetra Tech 2022, Tetra Tech 2023) and continued discussions with the agencies in FY 2024 to incorporate a modified rho into the take analyses. The minimization measures associated with the HCP Amendment demonstrate a statistically significant reduction in the fatality rate. This reduction warrants the application of an appropriate rho value in the EoA model. A comparison of the fatality rates before and after the application of minimization measures associated with the HCP Amendment shows the fatality rate is reduced from an average of 11.14 bats per year from FY 2013 to 2019, estimated by EoA, to an average of 1.55 bats per year in FY 2020 to 2024 (Figure 1). This demonstration of deterrent effectiveness was measurable in the first year of deployment (Tetra Tech 2020), has been sustained over 5 years, and is robust enough to demonstrate benefits despite the observation of two bat fatalities in FY 2022 and a single bat fatality in FY 2024. Based on the strength and resilience of these measured benefits, the use of an adjusted rho is appropriate. Kawailoa Wind has been working with USFWS and DOFAW to ensure that the measurable benefits from deployment of these minimization measures are appropriately accounted for in the take analyses. In June 2024, USFWS agreed that the proposed methodology could be applied to estimate the effectiveness of the deterrents at reducing risk to the Hawaiian hoary bat (Deena Gary/USFWS, pers. comm, June 2024). The details of the rho analysis estimating the effectiveness of deterrents with data through FY 2024 are provided in Appendix 3.

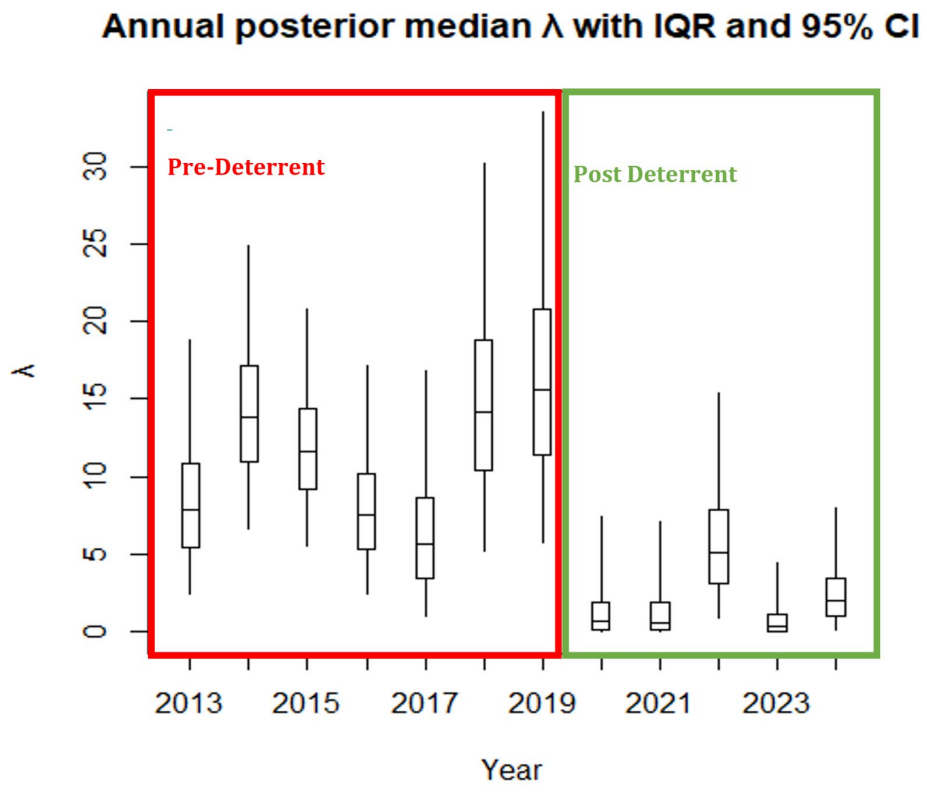

Figure 1. EoA Estimated Hawaiian Hoary Bat Fatality Rates by Year at the Project

In FY 2023, Kawailoa Wind worked with DAPPER Stats to develop a statistical analysis to produce an unbiased estimate of the benefit of the deterrents (DAPPER Stats 2023). Updated results through FY 2024 are shown in Appendix 3; these results indicate the unbiased estimate of rho to account for deterrent effectiveness from FY 2020 to 2024 is 0.127 (0.032 – 0.338), a 87.3 percent reduction of risk. Ultimately, the assessment of rho in the post-UAD installation period is expected to incorporate ongoing fatality monitoring results in the post-UAD period and an unbiased estimate of the deterrent benefit. The inclusion of additional years will continue to increase statistical rigor to accurately assess changes in rho. The rho value applied for periods with the current minimization measures will be re-evaluated annually to incorporate new data (i.e., the rho value will likely change annually based on new data).

A take projection can be generated with EoA and with methods outlined in the HCP Amendment to estimate the likelihood of staying within the permitted take. Given the use of an unbiased estimate of the rho value of 0.127 post-UAD for FY 2020 – 2024, the median take projection at the end of the ITP term (December 2031) is 98 bats (Interquartile Range [IQR]: 94, 102). Alternatively, using EoA with a selected estimate of relative risk of post-UAD versus pre-UAD periods, the HCP Amendment specifies a comparison of the current take estimate and the current take rate to total authorized take over the permit term to determine if adaptive management is warranted. This method can also be used to evaluate take rates on an ongoing basis. EoA estimated the take rate at the Project between FYs 2020 and 2024 as 1.55 bats per year; extrapolating from the current direct take estimate (using a rho of 0.127) and the current take rate, the Project estimates a direct take total of 99.6 bats at the end of the ITP term (88 bats estimated by EoA as direct take through FY 2024 + 1.55 bats per year * 7.5 years remaining in the permit term). This value falls within the IQR generated by EoA that was previously described.

The Project's current ratio of indirect take to direct take indicates the estimated indirect take is 9.5 percent of the direct take estimate (8.39 adult bat equivalents estimated through FY 2024/88 bats estimated from direct take). When an estimate of indirect take of 9.5 adult bat equivalents (9.5 percent * 99.6 bats estimated from direct take) is added to the direct take estimate, the estimated take is 109.1 adult bat equivalents (99.6 bats estimated through direct take + 9.5 bats estimated through indirect take) in December 2031. This indicates that while the Project is likely to stay below the Tier 4 maximum of 115 bats through the permit term, it is also possible that it could surpass this value. However, EoA indicates that there currently is an 88.8 percent chance that the project will remain within Tier 4 given the current rate of take. Nevertheless, both the EoA and HCP methods of generating take projections indicate the Project will stay below the total HCP Amendment take estimates (up to Tier 6) through the permit term.

6.2 Hawaiian Petrel

Although no Hawaiian petrel fatalities were observed in FY 2024, this is the only other HCP Covered Species previously observed as a fatality at the Project; thus, a take estimate is calculated. The Hawaiian petrel was added as an HCP Covered Species through an amendment to the HCP and

issuance of amended permits in 2019 (ITP in September 2019 and ITL in February 2021).[2] Therefore, there is a distinction between the Project estimated take and the level of take occurring under the authorized permits and the amended HCP. To address this issue, estimated take over the period of Project operations was analyzed first. Following this analysis, a ratio was applied of the portion of the Project's operations under which the Hawaiian petrel was an HCP Covered Species to identify the estimated take for the purposes of tracking take with respect to the applicable regulatory permits.

Table 5 summarizes the total estimated Hawaiian petrel take through FY 2024. Input values for the multi-year analysis are provided in Table 6. Inputs and output from EoA are provided in Appendix 4.

Table 5. Eighty Percent Upper Credible Limit (UCL) Estimate of Cumulative Hawaiian Petrel Take through FY 2024

A: Observed Direct Take[1]	B: Incidental Observed Take[2]	C: 80% UCL of Estimated Direct Take[3]	D: UDT (C –A – B)	E: Estimated Indirect Take (Chicks/Eggs)[4]
0	2	1	NA	2

1. Observed direct take used in Evidence of Absence analysis based on FY 2013 to FY 2024 data.

2. Fatalities occurred outside of the defined search area and were not used in Evidence of Absence analysis.

3. Multi-year Evidence of Absence analysis (Dalthorp et al. 2017) based on FY 2013 to FY 2024 data.

4. Overall indirect take for the Project is calculated based on parameters described in Appendix 16 of the HCP Amendment and rounded up to the nearest integer (Tetra Tech 2019).

Table 6. Input Values for Multi-Year Analysis of Hawaiian Petrel Take through FY 2024

Year[1]	Weight	Search Fatalities[2]	Ba	Bb	$\hat{g}$	$\hat{g}$ 95% Confidence Interval
FY 2013	0.67	0	347.5	34.45	0.910	0.879 – 0.936
FY 2014	1	0	126.3	23.51	0.843	0.781 – 0.897
FY 2015	1	0	398.7	221.4	0.643	0.605 – 0.680
FY 2016a	0.33	0	393.4	209.6	0.652	0.614 – 0.690
FY 2016b	0.67	0	1437	4968	0.224	0.214 – 0.235
FY 2017	1	0	496.6	1734	0.223	0.206 – 0.240
FY 2018	1	0	5.721	22.19	0.205	0.080 – 0.370
FY 2019	1	0	140.0	426.5	0.247	0.213 – 0.283
FY 2020	1	0	978.7	3056	0.243	0.229 – 0.256
FY 2021	1	0	1698	5298	0.243	0.233 – 0.253

[2] Based on input from the agencies and species experts, take of the Hawaiian petrel was not anticipated during the development of the original HCP.

Year[1]	Weight	Search Fatalities[2]	Ba	Bb	$\hat{g}$	$\hat{g}$ 95% Confidence Interval
FY 2022	1	0	201.2	448.2	0.310	0.275 – 0.346
FY 2023	1	0	775.1	1029	0.430	0.407 – 0.453
FY 2024	1	0	4.322	8.056	0.349	0.122 – 0.622

1. Year data for FY 2013 to 2017 are taken from Appendix 16 in the HCP Amendment (Tetra Tech 2019).

2. Two Hawaiian petrel fatalities have been found at the Project (July 21, 2017, and August 20, 2018), both occurred outside of the systematic search areas and therefore were not included in the Evidence of Absence analysis.

Based on biological parameters presented in Appendix 16 of the HCP Amendment (Tetra Tech 2019), the estimate of cumulative indirect take through FY 2024 is calculated as follows:

- **Estimate of direct adult take:**
    - Greater of observed adult direct take (2) and estimated direct take using Evidence of Absence (1) = **2 adults**
- **Proportion of adults that breed:**
    - Both observed fatalities occurred from May to August. The estimate of the percent of adults breeding in the colony = **0.89**
- **Parental contribution:**
    - Breeding adults produce 1 chick/pair and are dependent on both adults during May through August = **100 percent**
- **Reproductive success:**
    - Average reproductive success = **0.63**
- **Total chick/egg indirect take**
    - Calculated as (2 * 0.89 * 1.00 * 0.63) **= 1.12**

Therefore, the estimated indirect take based on the estimate of Hawaiian petrel direct take at the Project is **2 chicks/eggs** (rounded up from 1.12). The UCL for cumulative Project take of the Hawaiian petrel over the period of Project operations is **2 adults and 2 chicks/eggs**.

As noted above, from a regulatory perspective, take of the Hawaiian petrel has only been permitted for a portion of the Project's operations. To measure take against the authorized take limit, a proportion of the time the Project has operated with permits authorizing incidental take of the Hawaiian petrel is applied to the estimate for the entire period of Project operation. For FY 2024, the Project has operated from November 2012 through June 2024 (11.67 years) and the Project has authorized incidental take of the Hawaiian petrel from September 2019 to June 2024 (4.83 years).

- **Estimated adult Hawaiian petrel take** under permit = (4.83/11.67) * 2 = **0.83**
- **Estimated chick/fledging Hawaiian petrel take** under permit = (4.83/11.67) * 1.12 = **0.46**

Rounding up, the cumulative Project take of Hawaiian petrels as measured against the authorized take limit is **1 adult and 1 chick/egg**. This estimate is below the authorized take limit of 19 adults and 5 chicks/eggs.

6.3 Non-listed Species

Twenty-one bird fatalities representing 10 different non-listed species were documented at WTGs at the Project in FY 2024 (see Table 7). No fatalities have been observed at either of the two met towers. Two of the bird species observed in FY 2024 are protected by the Migratory Bird Treaty Act. Appendix 1 provides a complete list of fatalities for FY 2024.

Table 7. Non-listed Bird Fatalities Documented at the Project in FY 2024

Species	Common/ Hawaiian Names	No. of Observed Fatalities in FY 2024
Acridotheres tristis	Common myna	3
Estrilda astrild	Common waxbill	4
Euodice cantans	African silverbill	2
Francolinus francolinus	Black francolin	1
Ortygornis pondicerianus	Gray francolin	1
Geopelia striata	Zebra dove	6
Pluvialis fulva[1]	Pacific golden-plover; kōlea	1
Pycnonotus cafer	Red-vented bulbul	1
Spilopelia chinensis	Spotted dove	1
Tyto alba[1]	Barn owl	1
1. Species protected by the Migratory Bird Treaty Act.		

7.0 Wildlife Education and Observation Program

Wildlife Education and Observation Program (WEOP) trainings continue to be conducted on an as-needed basis to provide on-site personnel and visitors with the information they need to be able to respond appropriately in the event they observe a listed species or encounter a fatality while on site. Twenty-eight WEOP trainings were conducted in FY 2024.

8.0 Mitigation

The Project's current mitigation requirements are described in Section 7.6 of the 2011 HCP (SWCA 2011) and Section 7 of the HCP Amendment (Tetra Tech 2019).

8.1 Hawaiian Hoary Bats

For the Hawaiian hoary bat, mitigation is required based on where the estimated Project take falls with respect to tiers identified in the HCP and HCP Amendment. As stated above, the Project is currently in the Tier 4 take level.

During FY 2024, acoustic bat surveys continued at the Project (see Section 8.1.1) and management activities and acoustic bat surveys for Tier 1 mitigation continued at ʻUkoʻa Wetland (see Section 8.1.2). Mitigation for Tiers 2 through 4 is complete. Bat research projects for Tiers 2/3 mitigation were completed in FY 2022 (see Section 8.1.3), and funds were previously provided toward the acquisition of Waimea Native Forest to fulfill remaining obligations for Tier 3 (see Section 8.1.4). Tier 4 mitigation was completed in FY 2019 with the acquisition and long-term protection of Helemano Wilderness Area (see Section 8.1.5). Kawailoa Wind is continuing planning for Tier 5 bat mitigation should it be required during the Project's permit term (see Section 8.1.6).

8.1.1 On-site Acoustic Surveys

Following commitments outlined in the HCP (SWCA 2011), bat activity was intensively monitored at 42 sites (30 WTGs at ground and nacelle, and 12 gulch detectors) across the Project during the first 3 years of systematic fatality monitoring (beginning in August 2013, FY 2014). Having identified no significant correlation with acoustic bat activity that could inform curtailment during the required intensive acoustic monitoring period (April 2012 to November 2015), Kawailoa Wind reduced the acoustic monitoring effort at the Project in the second quarter of FY 2017 to four permanent, ground-based units located at WTGs 1, 10, 21, and 25 (Figure 2). These locations were randomly chosen after eliminating detectors with high or low detection rates. Currently, each monitoring site consists of one song meter SM2BAT+ ultrasonic recorder equipped with one SMX-U1 ultrasonic microphone (Wildlife Acoustics, Maynard, MA, USA) positioned 6.5 meters above ground level.

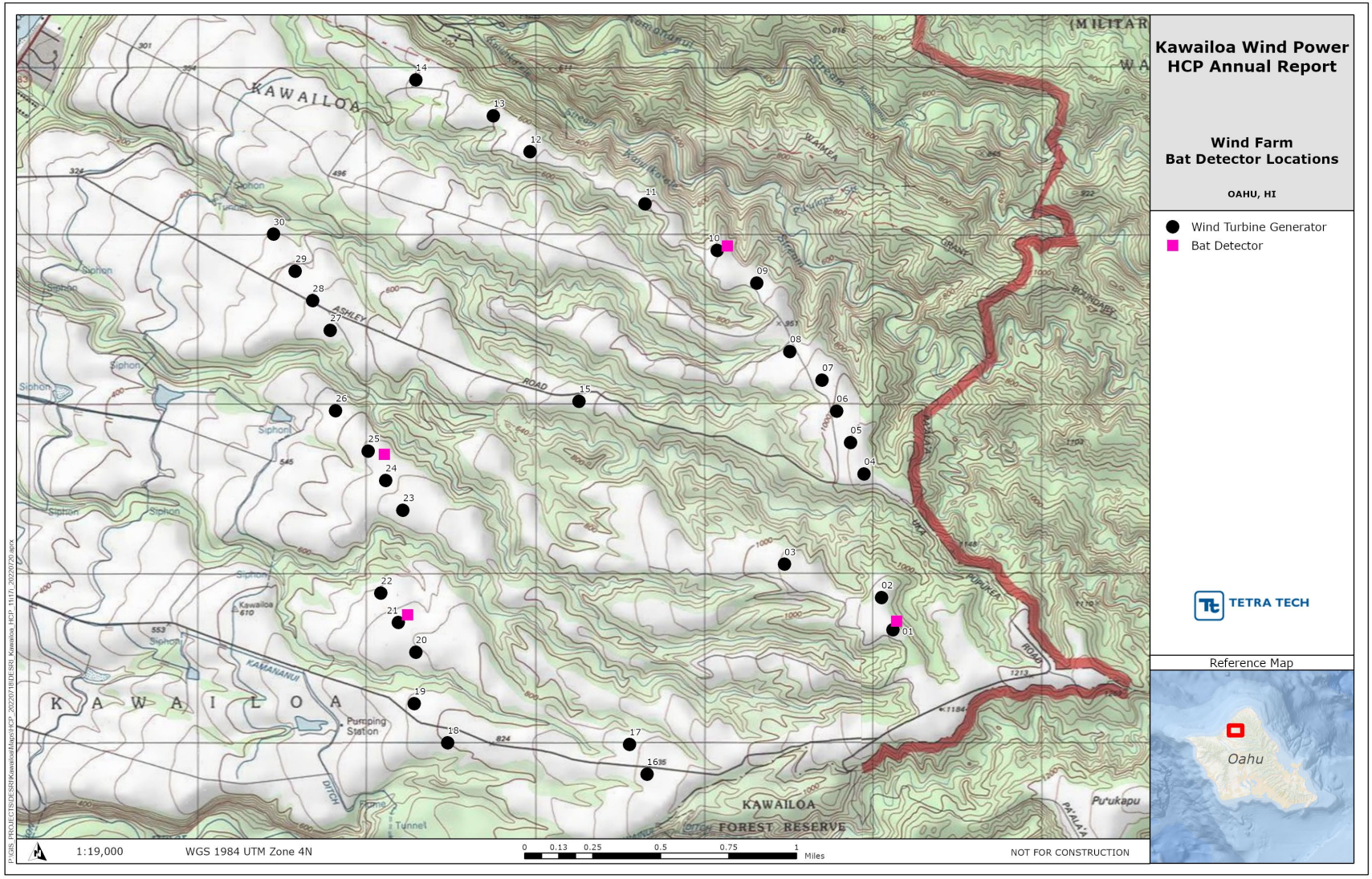

Figure 2. Four Permanent Bat Acoustic Detector Locations at the Project in FY 2024

The objective of acoustic monitoring is to better understand the annual and seasonal variations in bat activity at the Project. Analysis of variance (ANOVA) and Tukey's honest significance difference (Tukey's HSD) were used to test for differences in detection rates between the 2014 and 2024 Bat Sampling Periods and between monitoring sites. A linear model was used to test for a change in detection rates across all monitoring years. Data were normalized with an Ordered Quantile Normalization transformation using the 'bestNormalize' package in R (Peterson 2021). The distribution of residuals from the linear model were examined to check for violations of model assumptions. All tests were two-tailed, employed an alpha value of 0.05, and were conducted in R version 4.3.1 (R Core Team 2023). The characterization of Hawaiian hoary bat seasons corresponds approximately to Gorresen et al. (2013).

Hawaiian hoary bats were detected on 325 of 1285 (25.3 percent) detector-nights sampled throughout the 2024 Bat Sampling Period (June 2023 – May 2024) at the Project. The annual detection rate during the 2024 Bat Sampling Period was marginally higher than the annual detection rate during the 2023 Bat Sampling Period (17.1 percent; Table 8), although not significant (Tukey's HSD: $P = 0.996$). Annual detection rates varied between all years (Table 8); however, only differences between 2014 and 2019, 2014 and 2021, 2014 and 2022, and 2014 and 2024 were significant (ANOVA: $F_{10,119} = 2.72$, $P < 0.005$; Tukey's HSD: 2014-2019, $P < 0.026$; 2014-2021, $P < 0.041$; 2014-2022, $P < 0.032$; 2014-2024, $P < 0.007$).

Table 8. Number of Nights Sampled, Number of Nights with Detections, and Proportion of Nights with Bat Detections at Permanent Detectors from June 2013 through May 2024

Bat Sampling Period	No. of Nights Sampled	No. of Nights with Detections	Proportion of Nights with Detections
FY 2014 (June 2013 – May 2014)	1,211	82	0.068
FY 2015 (June 2014 – May 2015)	1,021	144	0.141
FY 2016 (June 2015 – May 2016)	1,321	213	0.161
FY 2017 (June 2016 – May 2017)	1,355	180	0.133
FY 2018 (June 2017 – May 2018)	1,451	280	0.193
FY 2019 (June 2018 – May 2019)	1,249	300	0.240
FY 2020 (June 2019 – May 2020)	1,272	169	0.133
FY 2021 (June 2020 – May 2021)	1,437	298	0.207
FY 2022 (June 2021 – May 2022)	1,217	266	0.219
FY 2023 (June 2022 – May 2023)	1,451	248	0.171
FY 2024 (June 2023 - May 2024)	1,285	325	0.253

Note: FY 2013 not included due to minimal number of detector-nights compared to other years.

Across all years (2014 to 2024), there is a significant increasing trend in the annual detection rates (linear model: R^2 = 10.46 percent; $F_{1,128}$ = 14.95, P < 0; Figure 3). Even if the 2014 Bat Sampling Period is removed, there is still a significant increasing trend in the annual detection rates (linear model: R^2 = 4.4 percent; $F_{1,116}$ = 5.35, P > 0.023). The low r-squared value of this trend suggests that little of the variation is explained by the linear model (i.e., year). This could be an indication of inherent inter-annual variation, or the importance of variables not included in the model.

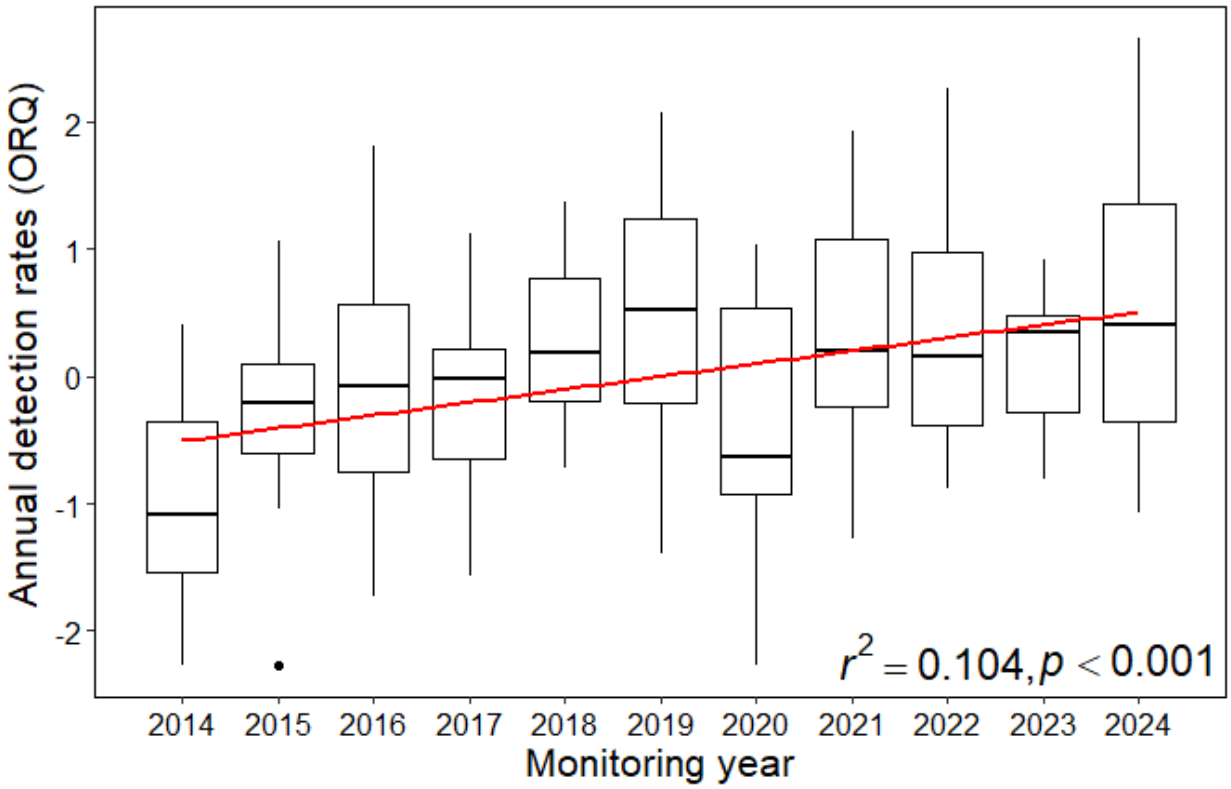

Figure 3. Box-plot Fitted with a Linear Regression Showing the Increasing Trend in the Annual Detection Rate at the Project between FY 2014 and FY 2024.

Note: Annual Detection Rates were Transformed using an Ordered Quantile Normalization Transformation (ORQ).

During the 2024 Bat Sampling Period, elevated detection rates were observed during the lactation reproductive period (mid-June through August), reaching an initial peak during the late lactation (August) reproductive period. A decline in detection rates occurred following the initial peak in August and the transition to the post-lactation (September to mid-December) reproductive period. Detection rates continued to decline into January of the pre-pregnancy reproductive period. Detection rates increased in February and again in April and May of the Pregnancy reproductive period (Figure 4).

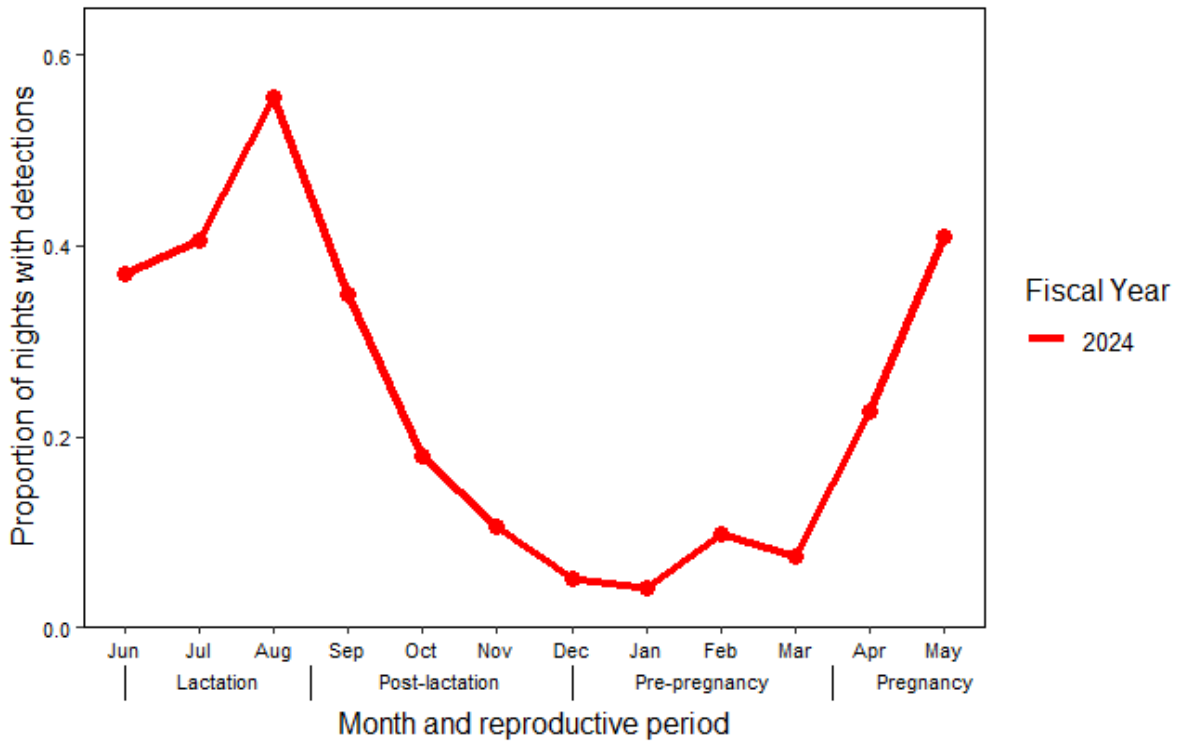

Figure 4. Monthly Detection Rates at Kawailoa in FY 2024 with Corresponding Reproductive Periods.

The temporal patterns in detection rates during the 2024 Bat Sampling Period were relatively similar to detection rates observed in previous sampling years (Figure 5). The general temporal pattern in the detection rates observed at the Project has also been reported at other low elevation acoustic monitoring sites on Oʻahu (Thompson and Starcevich 2022) and Hawaiʻi Island (Todd 2012).

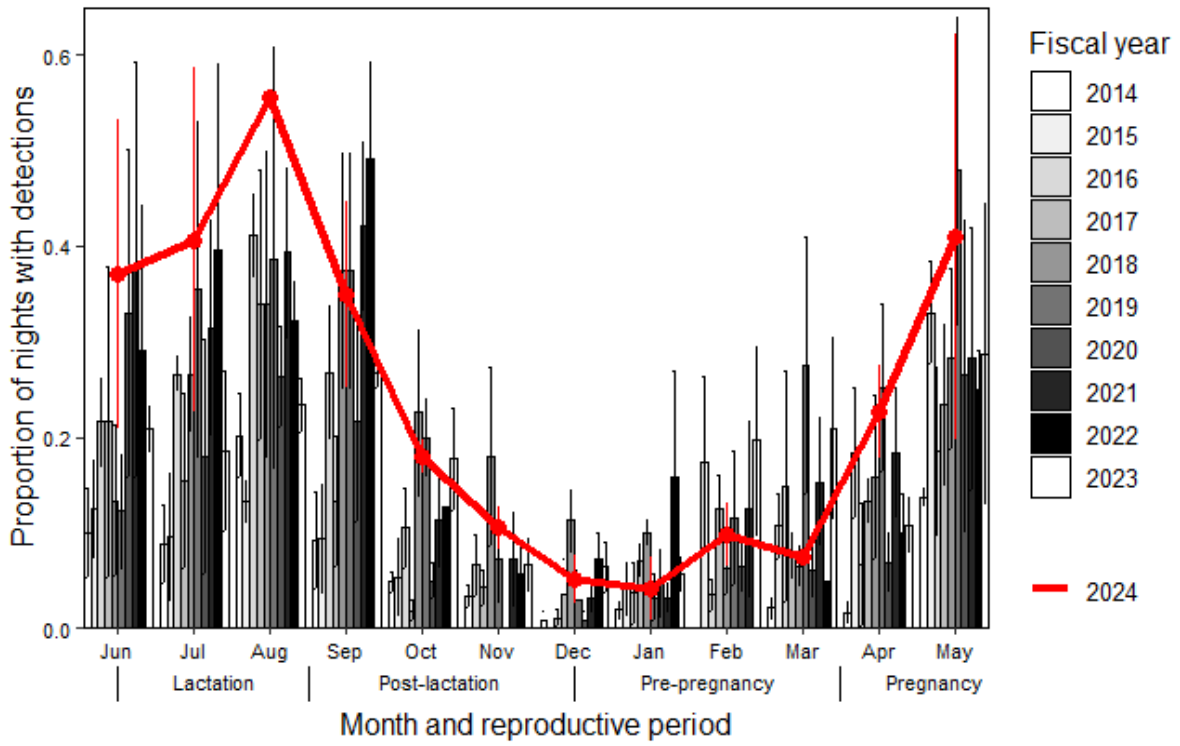

Figure 5. Monthly Bat Detection Rates at Kawailoa for FY 2014 to FY 2024 with Corresponding Reproductive Periods.

Across all monitoring years, the seasonal pattern in the mean detection rates were relatively similar among the four permanent monitoring sites (Figure 6). Detection rates were significantly greater at the WTG-25 site (ANOVA: $F_{3,505} = 11.78$, $P < 0.001$), most notable in June where detection rates at WTG-25 were significantly greater compared to all other monitoring sites (Tukey's HSD: WTG-1, $P < 0.001$; WTG-10, $P < 0.005$; and WTG-21, $P < 0.001$). Detections rates at WTG-25 were also significant greater in July comparted to site WTG-1 (Tukey's HSD: $P < 0.048$), and WTG-21 (Tukey's HSD: $P < 0.027$), in August compared to site WTG-1 (Tukey's HSD: $P < 0.05$), in November compared to site WTG-1 (Tukey's HSD: $P < 0.049$), and in May compared to site WTG-1 (Tukey's HSD: $P < 0.002$) (Figure 6).

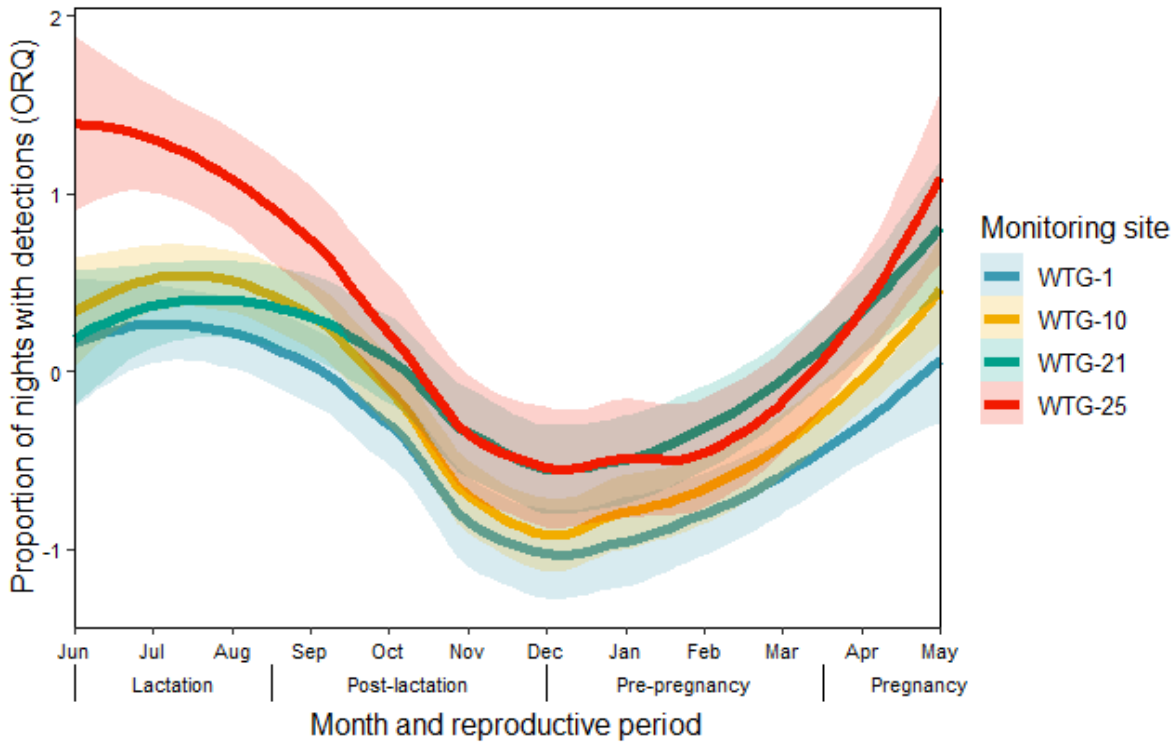

Figure 6. Site-Specific Variation in Mean Detection Rates for Each Month of FY 2024 with Corresponding Reproductive Periods.

Note: Trend Lines are fitted with Loess smoothing curve; see Figure 2 for spatial context.

8.1.2 ʻUkoʻa Wetland (Tier 1)

Mitigation for bats and waterbirds continued at ʻUkoʻa Wetland during FY 2024. In FY 2016 (March 2016), USFWS and DOFAW provided written confirmation permitting adaptive management for the original bat and waterbird mitigation proposed at ʻUkoʻa Wetland. This included the following:

1. Reduction from 40 acres of vegetation removal to assumed open water areas, as outlined in Figure 2 of the approved ʻUkoʻa Wetland Hawaiian Hoary Bat Mitigation Management Plan (H. T. Harvey and SWCA 2014);
2. Omit replanting of natives with assumption of natural recruitment after invasive plant species are removed;
3. Omit mosquitofish removal component; and
4. Tie success criteria for bats to completion of all other management and monitoring components instead of increased bat activity.

In FY 2024, activities associated with Tier 1 bat mitigation at ʻUkoʻa Wetland included invasive vegetation removal, predator control, monitoring predator presence, fence monitoring and maintenance, bat acoustic monitoring, and bat lane maintenance. Additional details for each are provided below.

8.1.2.1 Invasive Vegetation Removal

In FY 2024, Hapa Landscaping conducted quarterly maintenance visits to remove any areas of water hyacinth (*Eichhornia crassipes*) or other invasive vegetation that regenerated in the previously cleared, open water area including water lettuce (*Pistia stratiotes*) and California grass (*Urochloa mutica*). Quarterly scheduled visits were modified as needed to accommodate staff schedules and avoid disturbing Hawaiian common gallinule/ʻalae ʻula (*Gallinula galeata sandvicensis*) nests and chicks in the area. Figure 7 shows a representative photograph of the open water that resulted from this ongoing maintenance.

Figure 7. Open Water Resulting from Ongoing Removal of Invasive Vegetation at ʻUkoʻa Wetland in FY 2024.

Note: Photo Taken in June 2024.

8.1.2.2 Predator Control and Monitoring Predator Presence

The Project contracts Grey Boar Wildlife Services, LLC (Grey Boar) to conduct predator and ungulate removal at ʻUkoʻa Wetland, as well as to monitor and repair the fence. Predator control first began at ʻUkoʻa Wetland in June 2014 (FY 2014). The number and type of predators trapped at ʻUkoʻa Wetland from FY 2014 to FY 2024 is shown in Table 9. In FY 2024, a total of 138 predators were removed from ʻUkoʻa Wetland including 27 pigs, 95 mongoose, and 16 rats (Grey Boar 2023a, Grey Boar 2023b, Grey Boar 2024a, Grey Boar 2024b). The following trap types are used throughout ʻUkoʻa Wetland in FY 2024: pig corrals, pig box traps, GoodNature A24s, live cages, and Doc-250s. Pigs continue to move into the fenced area at ʻUkoʻa Wetland due to breaches in the fence caused by trespassers cutting the fence and tree fall.

Tracking tunnels are generally set out quarterly to assess the presence of rodents, mongoose, and cats within the wetland. In FY 2024, tracking tunnels were set out in September 2023 and March 2024, with 25 tracking tunnels placed during each event. The cards were baited with peanut butter and collected one day after setting. Tracks were then counted and recorded. Percent activity (number of cards with tracks divided by total number of cards set out) during FY 2024 is shown in Table 10. Overall, tracking tunnel data since 2014 (see Figure 8) shows a general reduction in predator presence since the predator program was initiated.

Table 9. Predators Trapped at ʻUkoʻa Wetland from FY 2014 to FY 2024

Predator	FY 2014[1]	FY 2015[2]	FY 2016[2]	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Rats	30	92	77	18	24	12	25	35	23	16	16
Cats	15	22	7	2	10	2	3	2	0	1	0
Mongoose	224	190	204	96	160	136	168	173	105	79	95
Mice	21	23	6	1	3	0	0	0	0	0	0
Pigs	51	56	20	103	29	42	7	9	48	23	27
Dogs	0	0	0	0	1	0	0	0	0	0	0
Total Removed	**341**	**383**	**314**	**220**	**227**	**192**	**203**	**219**	**176**	**119**	**138**

1. In FY 2014, trapping only occurred for 1 month (June 2014).
2. No trapping occurred at ʻUkoʻa Wetland from April 2016 to November 2016.

Table 10. Percent Predator Activity Based on Tracking Tunnels at ʻUkoʻa Wetland during FY 2024

Date	Rats	Mongoose	Mice	Cats
September 17, 2023	22.2%	8.0%	0.0%	0.0%
March 17, 2024	14.8%	25.9%	0.0%	0.0%

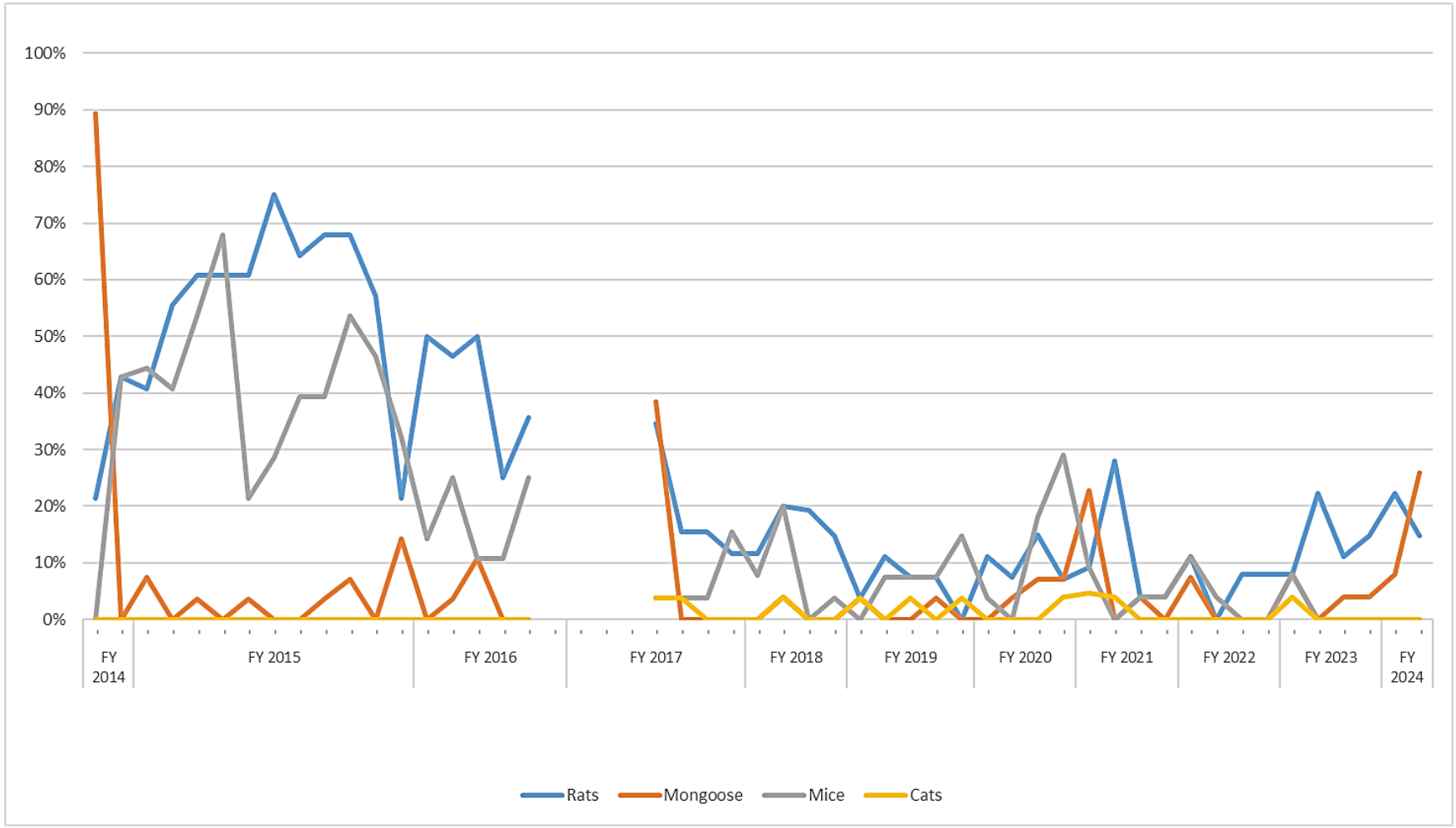

Figure 8. Percent Activity of Tracking Tunnels from FY 2014 to FY 2024

Source: Grey Boar 2024b.

8.1.2.3 Fence Monitoring and Maintenance

Fence inspections were conducted by Grey Boar while checking predator control traps. The fence was visually inspected for any signs of ungulate disturbance, damage, or vandalism. During FY 2024, several sections of fence were repaired. Causes of fence damage in FY 2024 included: tree falls, cutting by trespassers, and inadvertent damage from neighboring landowners.

8.1.2.4 Bat Lanes

Bat lane construction was completed in December 2017 (FY 2018). During FY 2024, bat lane maintenance occurred on eight lanes in May 2024. Figure 9 shows an example of a bat lane following the maintenance visits in FY 2024. In total, there are 16 bat lanes within 10 zones throughout ʻUkoʻa Wetland (Figure 10).

Figure 9. Bat Lane at ʻUkoʻa Wetland

Photo Taken in May 2024.

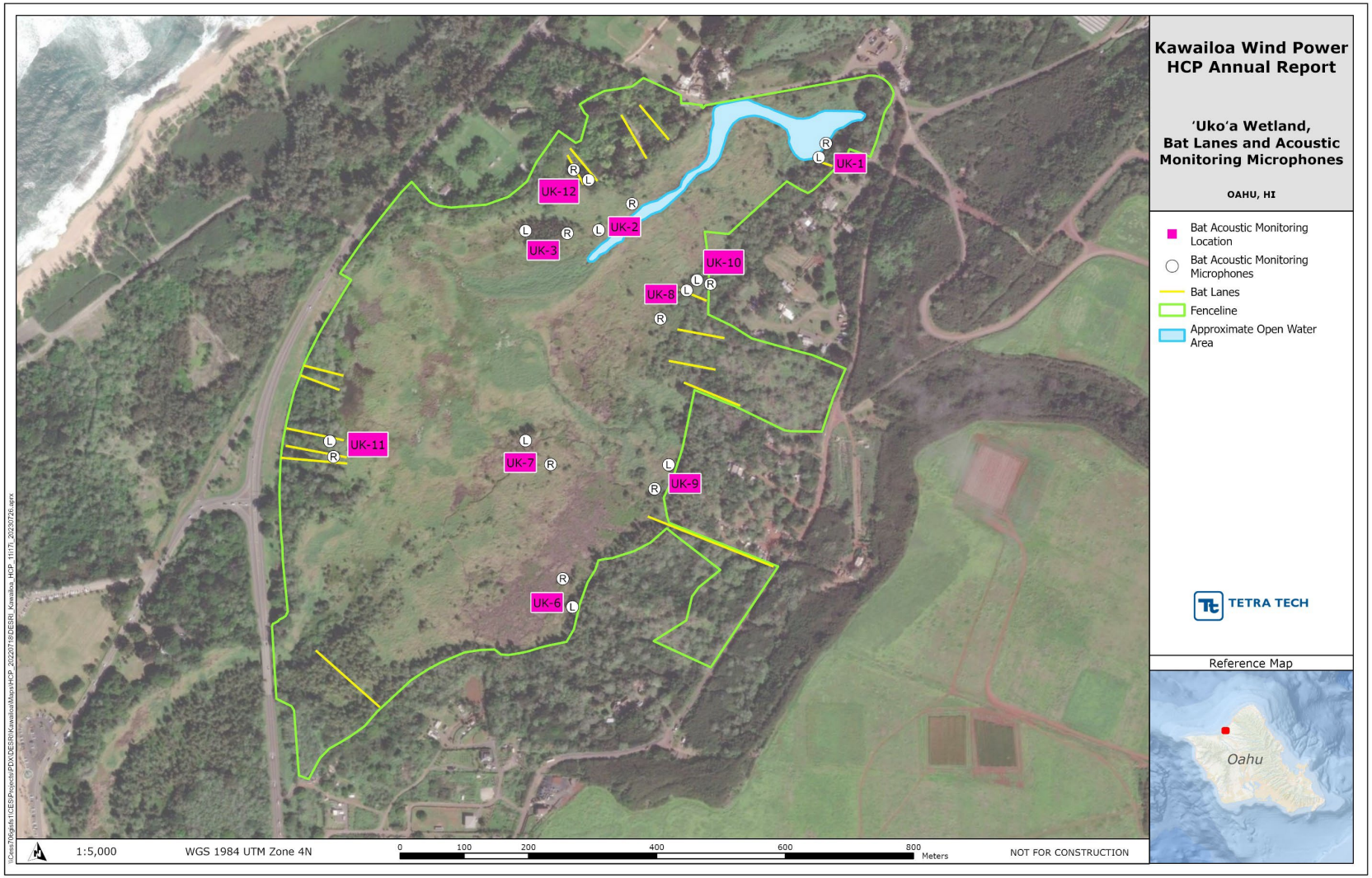

Figure 10. Bat Lanes and Bat Acoustic Detector Microphone Locations at 'Uko'a Wetland

8.1.2.5 Bat Acoustic Surveys at ʻUkoʻa Wetland

In June 2017, following the removal of invasive vegetation at the open water areas of ʻUkoʻa Wetland and construction of bat lanes, 10 Song Meter SM2BAT+ acoustic recorders (Wildlife Acoustics, Maynard, MA, USA) were deployed at locations previously monitored between 2012 to 2015 (see Figure 10). The SM2BATs deployed in June 2017 are similar to those used in previous sampling years to maintain consistency. Each SM2BAT+ was equipped with two SMX-U1 ultrasonic microphones (Wildlife Acoustics, Maynard, MA, USA) positioned between 3 and 6.5 meters above ground level.

The proportion of detector-nights containing a single bat pass (any call file containing two or more bat echolocation pulses; Gannon et al. 2003) was used as a measure to quantify bat activity. The sampling period and methods used to analyze bat acoustic data at ʻUkoʻa Wetland are the same as those used for acoustic data at the Project (see Section 8.1.1). During the 2024 Bat Sampling Period (June 2023 – May 2024), Hawaiian hoary bats were detected on 595 nights out of 2,227 detector-nights sampled (26.7 percent) at ʻUkoʻa Wetland. The annual detection rate during the 2024 Bat Sampling Period was greater than the annual detection rate during the previous sampling year (19.7 percent; Table 11), but not statistically different (Tukey's HSD: $P = 0.963$).

Table 11. Number of Nights Sampled, Number of Nights with Detections, and Proportion of Nights with Bat Detections at ʻUkoʻa Wetland from April 2012 to May 2024

Bat Sampling Period	Before or After Vegetation Removal	No. of Nights Sampled	No. of Nights with Detections	Proportion of Nights with Detections
FY 2012 (April – May 2012)	Before	142	18	0.127
FY 2013 (June 2012 –May 2013)	Before	2,036	191	0.094
FY 2014 (June 2013 – May 2014)	Before	2,694	100	0.037
FY 2015 (June 2014 – May 2015)	Before	2,552	175	0.069
FY 2016 (June – October 2015)	Before	1,211	218	0.180
FY 2018 (June 2017 – May 2018)	After	3,248	444	0.137
FY 2019 (June 2018 – May 2019)	After	3,391	506	0.149
FY 2020 (June 2019 – May 2020)	After	3,339	650	0.195
FY 2021 (June 2020 – May 2021)	After	3,182	613	0.193
FY 2022 (June 2021 – May 2022)	After	2,430	559	0.230
FY 2023 (June 2022 - May 2023)	After	2,708	534	0.197
FY 2024 (June 2023 - May 2024)	After	2,227	595	0.267

Note: The 2017 Sampling Period not included due to minimal number of detector-nights compared to other years; no detectors were deployed from November 2015 to May 2017. Beginning FY 2021, the time period for analyzing and reporting bat acoustic data (referred to as the Bat Sampling Period) was changed to June 1 to May 31 rather than the FY (July 1 to June 30) to allow adequate time for data review and analysis. All previous sampling years have been adjusted to reflect this same sampling period.

Annual detection rates varied across sampling years (Table 11); however, only differences between the following years were significant (ANOVA: $F_{11,113} = 4.39$, $P < 0.001$): 2013 and 2024 (Tukey's HSD: $P < 0.048$), 2014 and 2020 (Tukey's HSD: $P < 0.003$), 2014 and 2021 (Tukey's HSD: $P < 0.013$), 2014 and 2022 (Tukey's HSD: $P < 0.001$), 2014 and 2023 (Tukey's HSD: $P < 0.011$), 2014 and 2024 (Tukey's HSD: $P < 0.001$), 2015 and 2024 (Tukey's HSD: $P < 0.005$). Across all monitoring years there is a significant increase in the annual detection rates (linear model: $R^2 = 21.67$ percent; $F_{1,123} = 34.03$, $P < 0.001$; Figure 11). There are some inconsistencies in sampling periods for some of the monitoring years. Sampling in the 2012 and 2016 Bat Sampling Periods only occurred during the pregnancy and lactation reproductive periods, which have higher rates of detections, and sampling in 2015 did not occur during the months of November and December, which typically have lower rates of detection.

Detection rates in the 2024 Bat Sampling Period increased throughout the lactation reproductive period (mid-June to August) and peaked (0.54) in August of the lactation reproductive period (Figure 12). Following the peak in August, detection rates declined in September, October, and November of the post-lactation reproductive period (September to Mid-December) before increasing again in December. A second peak in detection rates occurred during the month of December followed by subsequent declines in detection rates during the months of January, February, and March of the pre-pregnancy reproductive period (Mid-December to March) and reached the lowest detection rate (0.11) in April at the start of the pregnancy reproductive period (April to Mid-June). A third increase and the second highest peak in detection rates (0.39) occurred in the month of May (Figure 12). The temporal patterns in the detection rates for the 2024 Bat Sampling Period are similar to the detection rates observed at 'Uko'a Wetland in previous sampling years (Figure 13).

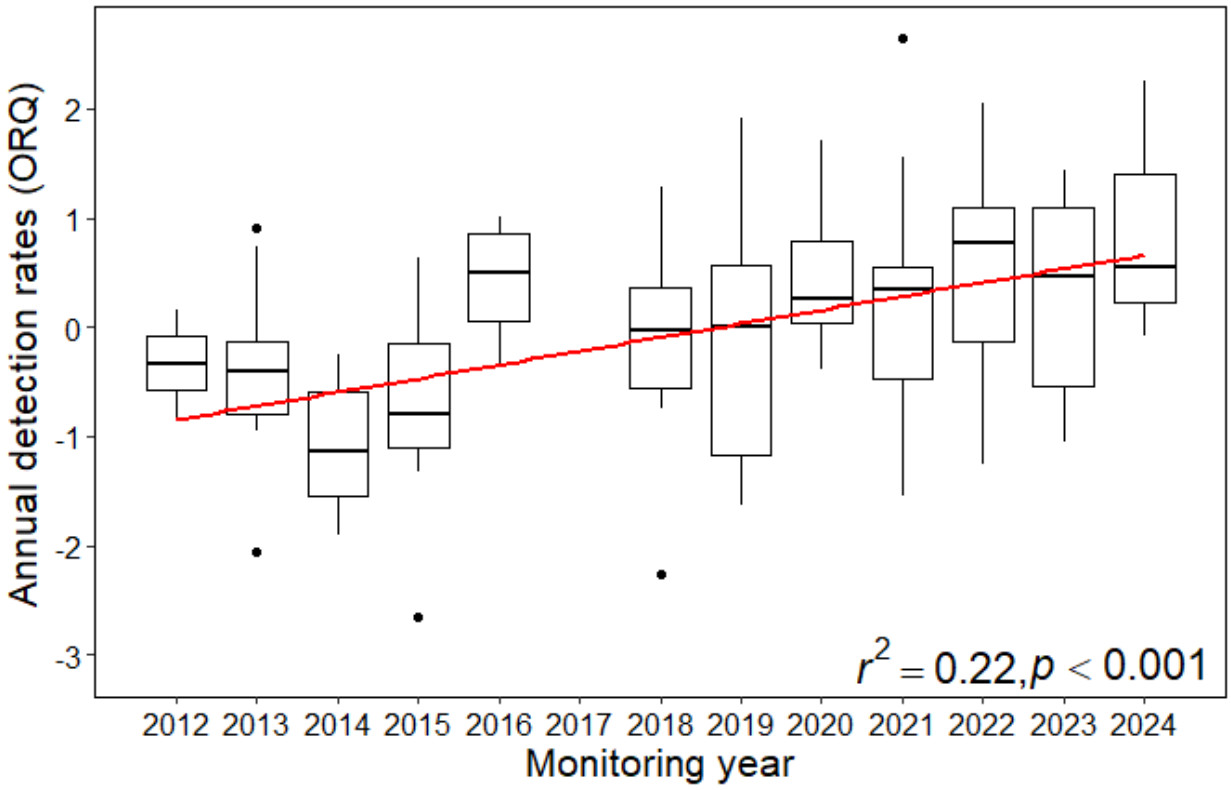

Figure 11. Box-plot Fitted with a Linear Regression Showing the Increasing Trend in the Annual Detection Rates at the Project between 2012 and 2024 Sampling Periods

Note: Annual Detection Rates were Transformed using an Ordered Quantile Normalization Transformation (ORQ).

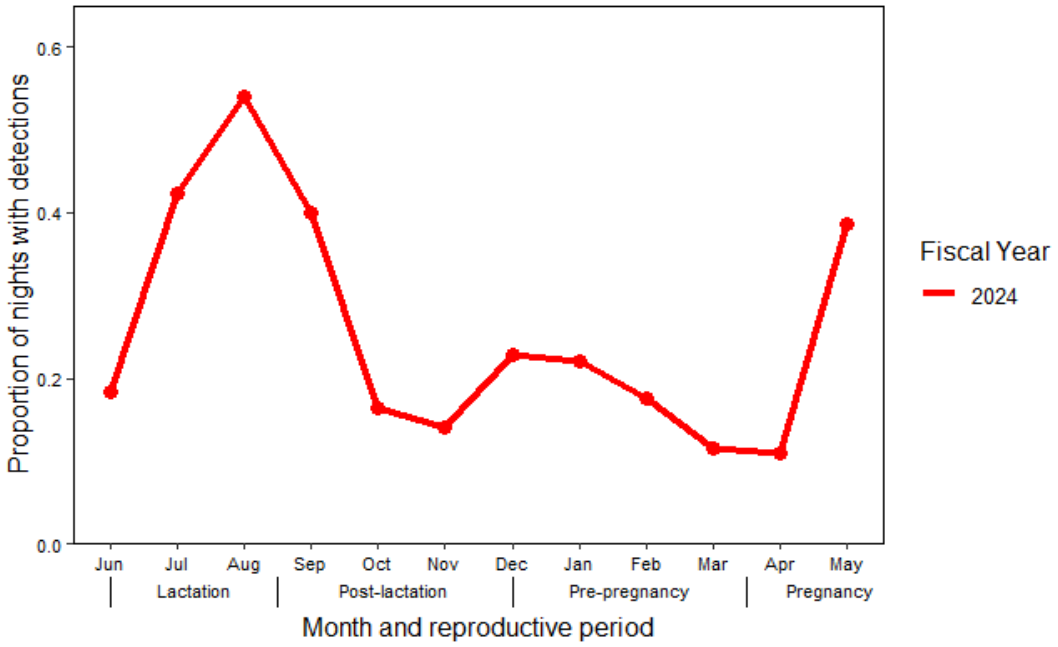

Figure 12. Monthly Bat Detection Rates at ʻUkoʻa Wetland during 2024 Bat Sampling Period with Corresponding Reproductive Periods

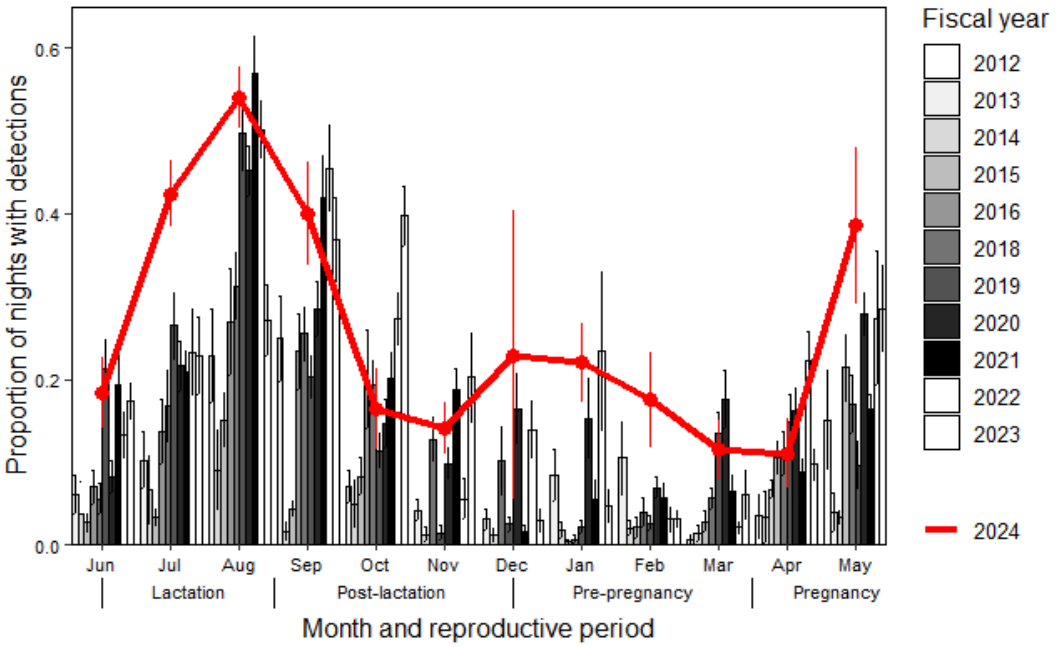

Figure 13. Monthly Bat Detection Rates at ʻUkoʻa Wetland for 2012 to 2024 Bat Sampling Periods with Corresponding Reproductive Periods

Comparison of detection rates for each month before (2012 to 2016 Sampling Period) and after (2018 to 2022 Sampling Period) management was implemented at ʼUkoʻa Wetland indicate an increase in the detection rates for several of the months throughout the year (Figure 14). In addition to observed increases in monthly detection rates, there was also an observed increase in the mean proportion of nights with feeding buzzes recorded at several of the monitoring sites after management was implemented (Figure 15). A feeding buzz is classified as a burst of pulses at a very high rate with less than 11 milliseconds between pulses (Griffin et al. 1960) and are indicative of foraging behaviors. Monitoring sites UK-1, UK-2, UK-6, UK-11, and UK-12 had the greatest observed increase following management activities (Figure 15). The observed increases in the detection rates and feeding buzzes are a positive indication for the effects of management but may correlate with factors other than the invasive plant species removal or bat lane installation.

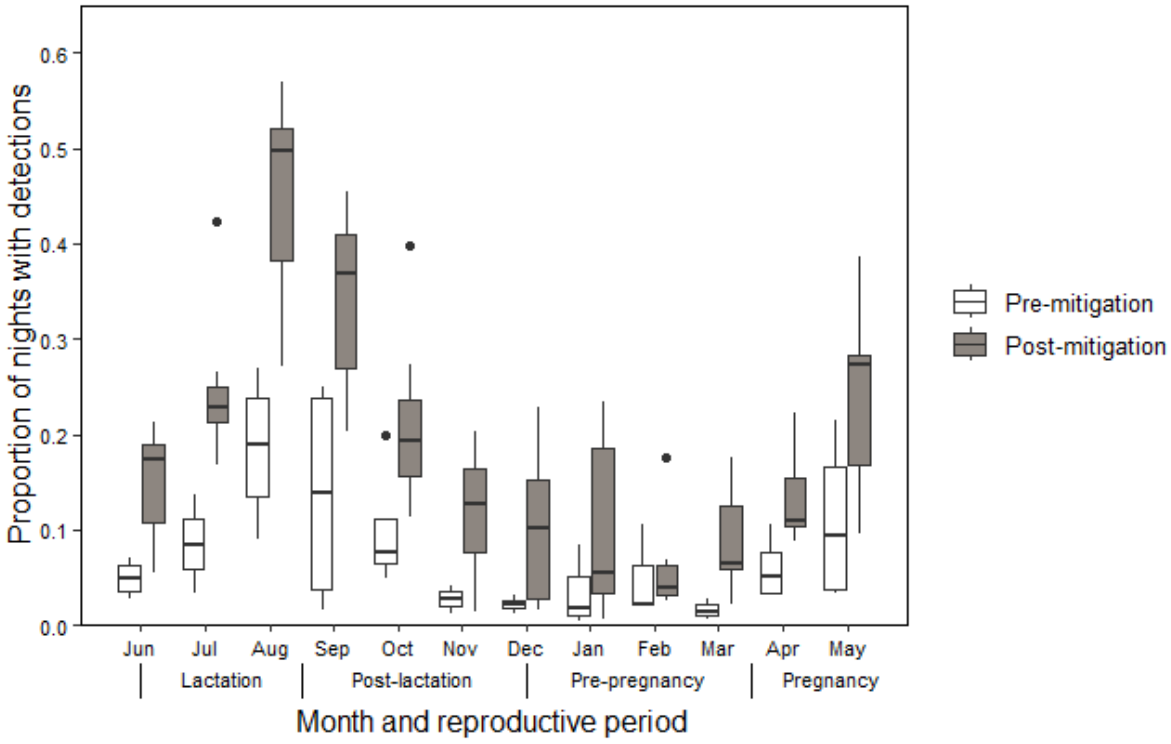

Figure 14. Box-plot Identifying the Median, Lower (Q1) and Upper (Q3) Quartiles, Whiskers (IQR x 1.5), and Outliers for Monthly Bat Detection Rates at ʻUkoʻa Wetland Before (2012 to 2016 Sampling Period) and After (2018 to 2024 Sampling Period) Management

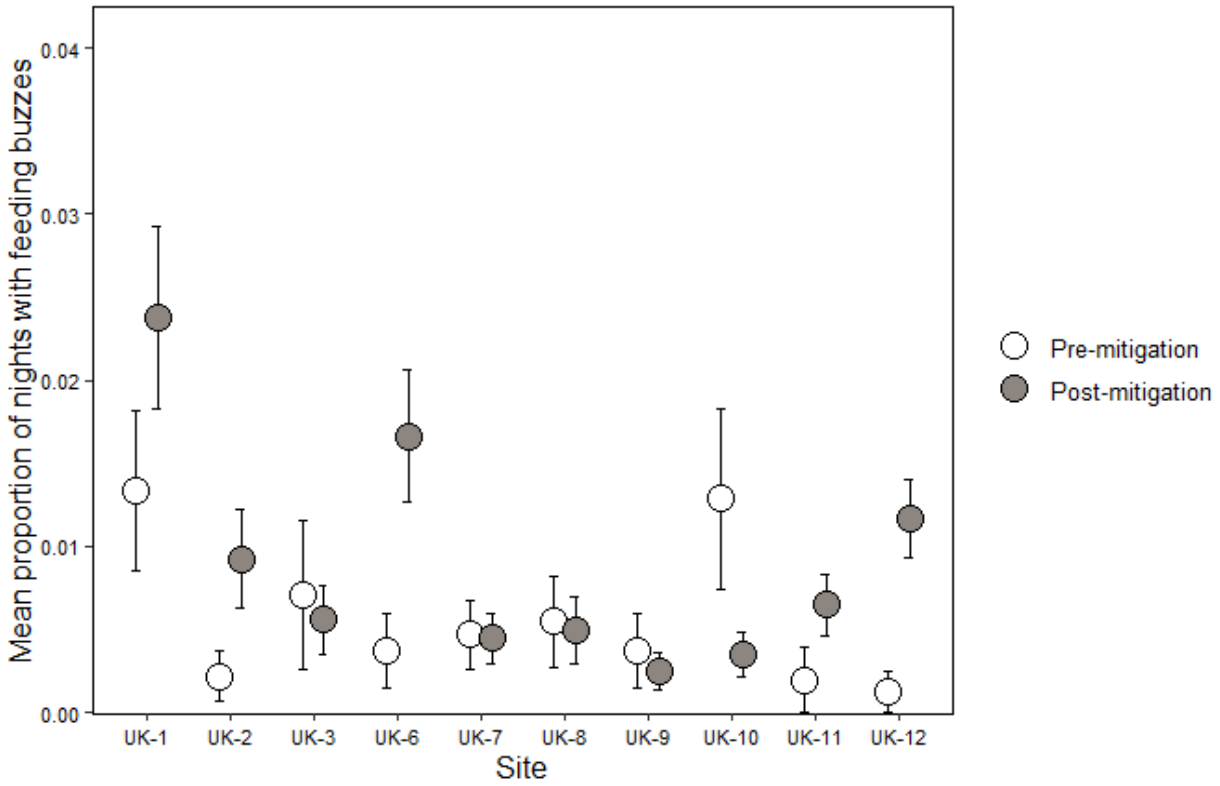

Figure 15. Mean and Standard Error for the Proportion of Feeding Buzzes for each monitoring site at ʻUkoʻa Wetland Before (2012 to 2016 Sampling Period) and After (2018 to 2024 Sampling Period) Management

Per the HCP, assessing bat activity at the mitigation site is required for three years post-restoration, and at subsequent five-year intervals. The Project has nearly 7 years of post-restoration bat acoustic data at ʻUkoʻa Wetland (June 2017 to May 2024). Acoustic monitoring was suspended at ʻUkoʻa Wetland on June 1, 2024, and is planned to resume in 2029.

8.1.3 Studies (Tier 2/3)

In FY 2017, Kawailoa Wind contracted USGS and Western EcoSystems Technology, Inc. (WEST) to conduct three multi-year studies as Tier 2/3 Hawaiian hoary bat mitigation. These studies were recommended to Kawailoa Wind by USFWS and DOFAW. The total funding for the three projects was over $1.6 million. All three agency-approved research projects have been completed. Several publications, data releases, presentations have been made available from the USGS projects (Gorresen et al. 2018, Pinzari et al. 2023) and WEST project (Thompson and Starcevich 2022). Kawailoa also provided an additional $10,000 to WEST in FY 2023 to support continued monitoring of a subset of the deployed detectors during a fifth year of their *Oahu Hawaiian Hoary Bat Occupancy and Distribution Study*. This funding was outside the Tier 2/3 mitigation obligations, which were complete in FY 2022.

8.1.4 Waimea Native Forest (Tier 3)

Funding the above-listed Tier 2/3 studies left an outstanding obligation of $353,702 for Tier 3 bat mitigation. To fulfill the remaining uncommitted funding obligation, Kawailoa Wind provided $353,702 to Trust for Public Land (TPL) in FY 2019 to contribute to the acquisition of the Waimea Native Forest. The acquisition was completed, and ownership of the parcel was transferred to DOFAW in December 2019; therefore, Tier 3 Hawaiian hoary bat mitigation is complete.

8.1.5 Helemano Wilderness Area (Tier 4)

As described in the HCP Amendment (Tetra Tech 2019), Tier 4 Hawaiian hoary bat mitigation included contributing $2,750,000 to TPL toward the purchase and long-term protection of the nearly 2,900-acre Helemano Wilderness Area (HWA). Kawailoa Wind provided these funds to TPL in October 2018, and ownership of the HWA was transferred from TPL to DOFAW in 2018. The area became the Helemano Section of the ʻEwa Forest Reserve in March 2021, and a draft management plan was completed; therefore, Tier 4 Hawaiian hoary bat mitigation is complete. In FY 2024, DOFAW conducted the following: performed road maintenance and road repair; controlled vegetation along road corridors; fence maintenance; maintained five acres in the koa (*Acacia koa*) wilt-resistant koa seed orchard; hydroseeded one acre of ʻaʻaliʻi (*Dodonaea viscosa*) to establish a seed orchard; and cleared additional areas of invasive species in areas where native plantings and fruit trees have been established by previous tenants (Ryan Peralta/DOFAW, pers. comm, July 2024).

8.1.6 Tier 5 Mitigation

As outlined in the HCP Amendment, Tier 5 bat mitigation will consist of implementation of one or a combination of the following: 1) contributing funding to acquire property that will protect bat roosting and foraging habitat in perpetuity, and/or 2) conduct bat habitat management/restoration to improve bat foraging and/or roosting habitat at the Central Koʻolau area, HWA, Waimea Native Forest, or similar sites (Tetra Tech 2019). In accordance with the mitigation planning requirements under the HCP Amendment, a Site-Specific Mitigation Implementation Plan for Tier 5 mitigation was submitted to USFWS and DOFAW on May 1, 2020; however, current results and projections suggest the Project is likely to remain within Tier 4 for the permit term (see Section 6.1). If Tier 4 take limit is exceeded, take is expected to stay well below the Tier 5 maximum. Therefore, Kawailoa Wind is considering the potential need to adjust the Tier 5 limit to accommodate the observed reduction in take rate. Kawailoa Wind is also currently working to identify new mitigation sites and actions based on recent research and agency requirements in the event Tier 5 bat mitigation should be required during the Project's permit term.

8.2 Waterbirds

As stated above, USFWS and DOFAW provided written confirmation permitting adaptive management for the original waterbird mitigation. Some activities completed for waterbird

mitigation at ʻUkoʻa Wetland (e.g., invasive vegetation removal, predator control, fence maintenance) overlap with bat mitigation requirements and are summarized in Section 8.1.2 above.

Tetra Tech conducts waterbird surveys at ʻUkoʻa Wetland as part of the required mitigation. Comprehensive weekly waterbird surveys began at ʻUkoʻa Wetland in January 2017 following invasive vegetation removal in the open water area and have continued annually throughout FY 2024. In FY 2024, waterbird surveys were conducted weekly from July 2023 through August 2023, and then again from December 2023 through June 2024. A total of 39 waterbird surveys were completed in FY 2024. A qualified biologist conducted surveys at nine point-count (PC) stations set up in the vicinity of the open water and in areas with previous waterbird sightings (Figure 16). Independent waterbird observations are also recorded while walking between stations. The detailed protocols for these surveys are provided in the FY 2017 Annual Report (Tetra Tech 2017).

In addition to the weekly surveys, a biologist conducts waterbird surveys prior to any invasive vegetation control (see Section 8.1.2.1). The purpose of these surveys is to identify if listed waterbird nests or chicks are present in the vicinity of the planned work area. If present, work is modified to avoid and minimize impacts to endangered Hawaiian waterbirds.

Results of the waterbird monitoring are detailed in the sections below. Waterbirds at ʻUkoʻa Wetland are not banded; therefore, assessments of changes on an individual basis are not possible. Although successful reproduction of Hawaiian common gallinule has been documented at ʻUkoʻa Wetland, no evidence of Hawaiian stilt/aeʻo (*Himantopus mexicanus knudseni*) or Hawaiian coot/ʻalae keʻokeʻo (*Fulica alai*) breeding has been observed despite years of ongoing management. As a result, Kawailoa Wind is in discussion with USFWS and DOFAW regarding adaptive management of waterbird mitigation. Considering no waterbird take has been recorded at Kawailoa to date, the Project is also considering reducing the take authorization for waterbirds.

8.2.1 Hawaiian Common Gallinule

In FY 2024, Hawaiian gallinules (either adults, chicks, or fledglings) were observed on every survey date and were recorded at eight out of the nine PC stations (Figure 16). Average monthly gallinule detections for FY 2024 are summarized in Table 12 and shown in Figure 17 and Figure 18.

Gallinule detections began to increase in FY 2022 and FY 2023 compared to the low detections in FY 2020 and FY 2021. Detections in FY 2024 were similar to those observed in FY 2022 and 2023 (Table 12). Table 12 also summarizes the number of observed gallinule breeding efforts since FY 2017. Two gallinule breeding events were observed in FY 2024. A breeding event observed in late April 2024 resulted in the successful fledging of two gallinules. A second breeding event was observed in early June 2024. The outcome of this second breeding effort has yet to be determined. Both breeding events in FY 2024 were observed in the open water areas around PC 03 and PC 08. All breeding observed during the last 5 years has been along the open water areas (PC 01, 03, 08). In total, 17 Hawaiian gallinule fledglings have been recorded since surveys began in FY 2017. Although no waterbird take has been recorded at Kawailoa to date, the Project is required to replace 20 gallinule fledglings.

Figure 16. Waterbird Point Count Station Locations at 'Uko'a Wetland

Table 12. Average Number of Hawaiian Common Gallinule Detected per Survey by Fiscal Year

Sampling Period	No. of Waterbird Surveys	Average No. of Adults Detected per Survey	Average No. of Chicks Detected per Survey	Average No. of Fledglings Detected per Survey	Total No. of Breeding Efforts Observed	No. of Failed Breeding Efforts Observed	Total No. Fledged
FY 2017 (Aug 2016 – Dec 2016)[1]	N/A	N/A	N/A	N/A	3	0	5
FY 2017 (Jan 2017 – June 2017)	25	5.7	0.8	1.0	4	2	3
FY 2018 (July 2017 – June 2018)	38	4.1	0.4	0.0	6	6	0
FY 2019 (July 2018 – June 2019)	41	3.0	0.4	0.0	4	4	0
FY 2020 (July 2019 – June 2020)	40	1.9	0.1	0.0	3	3	0
FY 2021 (July 2020 – June 2021)	40	1.9	0.4	0.1	1	0	1
FY 2022 (July 2021 – June 2022)	38	3.0	0.4	0.3	2	0	4
FY 2023 (July 2022 – June 2023)	39	5.3	0.5	0.3	2	0	2[2]
FY 2024 (July 2023 – June 2024)	39	4.3	0.3	0.2	2[3]	0	2
Total No. Hawaiian Common Gallinule Fledglings							**17**

1. FY 2017 is divided into 2 parts because comprehensive waterbird surveys at PC stations began in January 2017 and detections in late 2016 were incidental to other monitoring that occurred during vegetation removal in the open water areas.

2. The outcome of the undermined breeding effort at the end FY 2023 resulted in the successful fledging of one chick. As a result, the total number fledged in FY 2023 increased by 1 (2 fledglings versus 1 fledgling described in the FY 2023 Annual Report).

3. Currently, the outcome of one breeding effort documented in FY 2024 is yet to be determined. Results of this breeding effort will be reported in the FY 2025 HCP Annual Report.

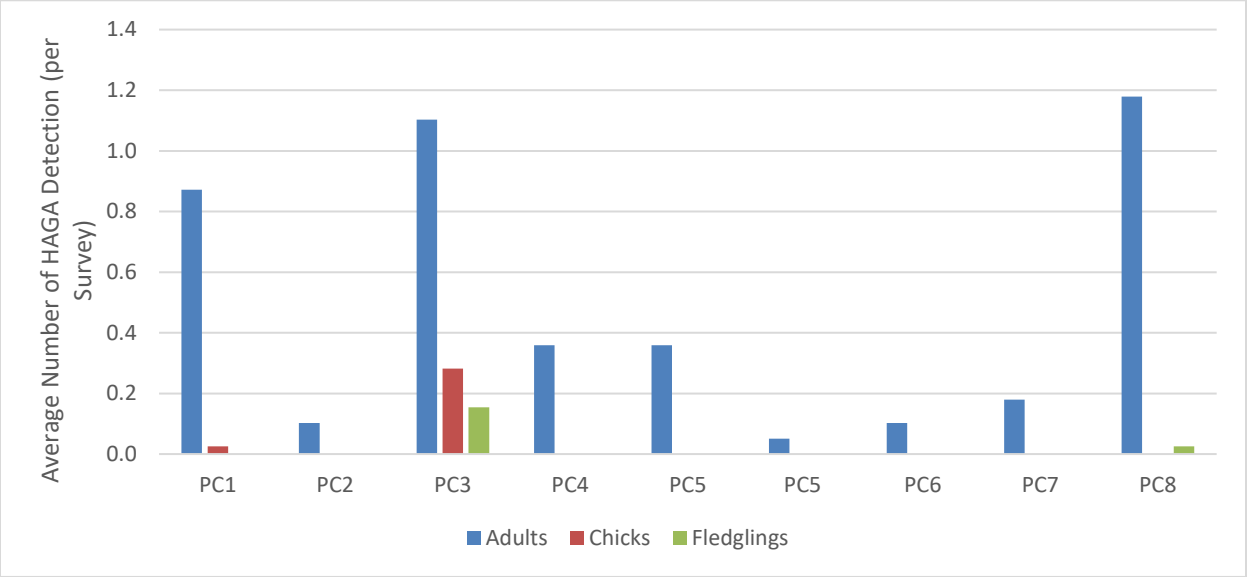

Figure 17. Average Number of Hawaiian Common Gallinule (HAGA) Detections per Survey at Point Count Stations in FY 2024

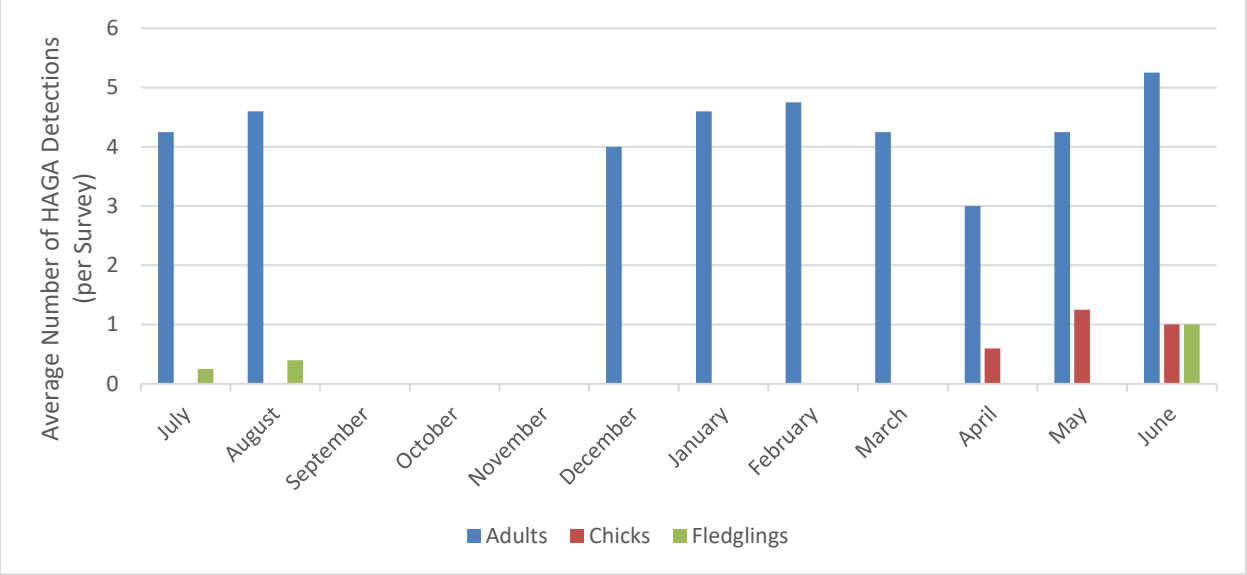

Figure 18. Average Number of Hawaiian Common Gallinule (HAGA) Detections by Month (per Survey) at Point Count Stations in FY 2024

8.2.2 Hawaiian Stilt

In FY 2024, Hawaiian stilts were observed on 31 of the 39 survey dates. As shown in Table 13, Hawaiian stilt detections have increased in comparison to previous fiscal years. Although the number of Hawaiian stilt individuals recorded continue to be low, the average number of adults detected per survey was highest in FY 2024 compared to all previous years.

While Hawaiian stilts have been observed using portions of Uko‘a Wetland for foraging, no Hawaiian stilt nests, chicks, or evidence of reproductive activity have been observed since comprehensive surveys began. No take of Hawaiian stilts has been recorded at Kawailoa to date; however, the Project is required to replace 24 stilt fledglings.

Table 13. Average Number of Hawaiian Stilts Detected per Survey and Proportion of Surveys with at Least One Detection by Fiscal Year

Sampling Period	No. of Surveys	Average No. of Adults Detected per Survey	Proportion of Surveys with at Least One Detection
FY 2017 (January 2017 – June 2017)	25	0.68	0.24
FY 2018 (July 2017 – June 2018)	38	0.71	0.29
FY 2019 (July 2018 – June 2019)	41	0.15	0.05
FY 2020 (July 2019 – June 2020)	40	0.13	0.07
FY 2021 (July 2020 – June 2021)	40	0.00	0.00
FY 2022 (July 2021 – June 2022)	38	0.05	0.03
FY 2023 (July 2022 – June 2023)	39	0.85	0.33
FY 2024 (July 2023 – June 2024)	39	1.7	0.80

8.2.3 Hawaiian Coot

Since comprehensive waterbird surveys begin in January 2017, only one Hawaiian coot has been detected during the surveys; a single adult Hawaiian coot was recorded in March 2017. Although no waterbird take has been recorded at Kawailoa to date, the Project is required to replace 20 coot fledglings.

8.3 Seabirds

8.3.1 Newell’s Shearwater

Tier 1 mitigation for Newell’s shearwater was completed in FY 2015.

8.3.2 Hawaiian Petrel

As stated in Section 1.0, the Hawaiian petrel was added as a Covered Species in the HCP Amendment (Tetra Tech 2019). To mitigate for impacts to this species, Kawailoa Wind funded 1 year of monitoring and predator control at the Hanakāpīʻai and Hanakoa seabird colonies within the Hono O Nā Pali Natural Area Reserve on Kauaʻi in 2020. Final reports from Kauaʻi Endangered Seabird Recovery Project (Raine et al. 2020) and Hallux Ecosystem Restoration LLC (Dutcher and Pias 2021) for this mitigation project were included in the FY 2021 Annual Report. The reports confirmed Kawailoa Wind's mitigation obligations for the Hawaiian petrel are complete.

8.4 Hawaiian Short-eared Owls or Pueo

Mitigation for the Hawaiian short-eared owl/pueo was completed in FY 2017.

9.0 Other Compliance Items

In response to a contested case settlement, Kawailoa Wind provided $250,000 to Pacific Rim Conservation in FY 2022 to carry out research related to Hawaiian petrels on Oʻahu. The goal of this research project is to determine whether Hawaiian petrels detected in previous surveys are prospecting or breeding on Oʻahu. Pacific Rim Conservation is conducting ground searches and auditory surveys, as well as deploying automated acoustic recording units to accomplish this goal. The funds from Kawailoa Wind were used in 2023 and will also be used for the 2024 to 2026 breedings seasons. No Hawaiian petrel nests were found in 2023 (Pacific Rim Conservation 2024).

10.0 Adaptive Management

Kawailoa Wind is committed to the ongoing implementation of operational avoidance and minimization measures described in the HCP and HCP Amendment. Kawailoa Wind has been evaluating options to reduce the risk to bats since Project operations began in 2012. Kawailoa Wind implemented multiple adaptive management actions to understand and reduce the risk to the Hawaiian hoary bat in previous fiscal years including modifying the low wind speed curtailment (LWSC) regime, implementing innovative approaches to post-construction mortality monitoring, supporting development of the latest technologies that could reduce WTG collision risk to bats, and installing acoustic deterrents. Details on the Project's adaptive management actions are provided in previous annual reports (Tetra Tech 2018, Tetra Tech 2019, Tetra Tech 2020, Tetra Tech 2021, Tetra Tech 2022, Tetra Tech 2023) and the HCP Amendment (Tetra Tech 2019).

As outlined in the FY 2021 Kawailoa Annual Report (Tetra Tech 2021), Kawailoa Wind returned to a 10-minute rolling average on April 3, 2021. The Project continued to operate under the 10-minute rolling average LWSC regime for all of FY 2024.

Kawailoa Wind was the first wind facility in Hawai‘i to install acoustic deterrents. Deterrents were installed at all 30 Project WTGs in May and June 2019. Deterrent functionality is monitored remotely to ensure the systems are functioning properly. Deterrent units (DU) and deterrent unit controllers (DUC) that are identified as underperforming are replaced as soon as possible based on manufacturer recommendations. Each WTG is installed with five DUs, each having overlap in coverage in the deterred airspace. The result of a single DU failure is less than one-fifth of the rotor swept area. If one DU is deficient, a WTG has adequate coverage across the rotor swept area due to redundancy provided by the other four DUs. Kawailoa Wind and NRG Systems work together to install replacements as quickly as feasible. Based on data provided by NRG Systems, the total sitewide deterrent availability for the Project was 95.4 percent in FY 2024.

11.0 Collection Permits

Annual reports for the Project’s federal and state collection permits were submitted in Q2 of FY 2024. The USFWS special purpose utility permit (MB22099C) expires March 31, 2025. The State’s Protected Wildlife Permit (Permit No. WL23-15) expires on February 10, 2025.

12.0 Agency Meetings, Consultations, and Visits

Kawailoa Wind and Tetra Tech participated in both virtual and in-person meetings with USFWS and DOFAW staff in FY 2024, as well as one Endangered Species Recovery Committee (ESRC) meeting. This included the following:

- October 31, 2023 – Consulted with USFWS and DOFAW on effectiveness of deterrents and modified rho value.
- November 6, 2023 – USFWS and DOFAW semi-annual meeting.
- November 6, 2023 – USFWS and DOFAW site visit to Kawailoa Wind facility and ‘Uko‘a Wetland mitigation site.
- February 1, 2024 – ESRC FY 2023 annual report review.
- March 20, 2024 – USFWS and DOFAW semi-annual meeting.
- June 25, 2024 – Consulted with USFWS and DOFAW on approval of modified rho value.

13.0 Expenditures

Total HCP-related expenditures for the Project in FY 2024 were approximately $542,050 (Table 14).

Table 14. Estimated HCP-Related Expenditures at the Project in FY 2024.

Category	Amount
Permit Compliance	$119,630
Facility Vegetation Management	$185,000
Fatality Monitoring	$135,480
ʻUkoʻa Wetland Mitigation Compliance	$100,250
Pacific Rim Seabird Research Coordination	$190
Tier 5 Bat Mitigation Preparation	$1,500
Total Cost for FY 2024	**$542,050**

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