

Kahuku Wind Power Habitat Conservation Plan FY 2020 Annual Report



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Incidental Take License ITL-10/ BO#2010-F-0190

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Executive Summary

This report summarizes work performed by Kahuku Wind Power, LLC (KAH) at the Kahuku Wind Power Project (Project) during the State of Hawai'i fiscal year (FY) 2020 (July 1, 2019 – June 30, 2020) under the terms of the approved Habitat Conservation Plan (HCP). The HCP is dated May 27, 2010, and describes KAH's compliance obligations under Kahuku Wind Power, LLC's state Incidental Take License ITL-10 and federal Incidental Take Statement BO 2010-F-0190. This HCP covers eight species: seven are federally and state-listed as threatened and endangered and one is exclusively a state-listed endangered species. The Project was constructed in 2010 and has been operating since March 23, 2011.

Fatality monitoring at the Project in FY 2020 continued within 35-meter radius circular search plots. These plots are centered on the wind turbine generators (WTGs) and were searched by canine teams once per week year-round. Bias correction trials were conducted quarterly at the Project in FY 2020 to measure the probability that a carcass would persist until the next search and the probability that an available carcass would be found by a canine search team. The results of these trials showed mean probabilities of persistence until the next search of 0.79 (bat surrogates) and 0.98 (medium-sized bird surrogates). Searcher efficiency was at or above 88 percent for both bat surrogates and medium-sized birds. No Hawaiian hoary bat fatalities were found in FY 2020, and no fatalities of other listed species have been observed at the Project. A total of four bats have been observed as direct take at the Project since beginning operations March 23, 2011. The fatality estimate for the four observed bats using the Evidence of Absence estimator at the upper 80 percent credibility level is nine bats, and the total indirect take for this estimate is two adult equivalents. Combining these values, there is an approximately 80 percent chance that cumulative take of Hawaiian hoary bats at the Project from the start of operations through FY 2020 was less than or equal to 11 adults.

During FY 2020, KAH monitored bat activity at the Project through four ground-based acoustic detectors located at Project WTGs. Between July 1, 2019 and June 30, 2020, Hawaiian hoary bats were detected on six nights out of 1,409 detector-nights (0.43 percent of detector-nights). Seasonal patterns of detection rate were comparable with previous years.

Tier 1 mitigation obligations for the Hawaiian hoary bat were met prior to FY 2020, and mitigation planning for Tier 2 take will continue into FY 2021 to ensure mitigation does not lag potential Project take. Mitigation obligations for baseline levels of take of waterbirds, seabirds, and the Hawaiian short-eared owl were met prior to FY 2020.

KAH communicated actively with USFWS and DOFAW throughout FY 2020. The communication was conducted through in-person meetings, conference calls, submittal of quarterly reports, and e-mail communications related to the Project's HCP and associated mitigation. These communications included focused discussions regarding Hawaiian hoary bat Tier 2 mitigation funding and strategy.

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1.0 Introduction

The Habitat Conservation Plan (HCP) for the Kahuku Wind Project (Project) was approved by the Hawai'i Division of Forestry and Wildlife (DOFAW) in 2010. A federal Biological Opinion (BO 2010-F-0190) and associated Incidental Take Statement (ITS) from the U.S. Fish and Wildlife Service (USFWS) and a state Incidental Take License (ITL; ITL-10) from DOFAW were issued to Kahuku Wind Power, LLC (KAH) in May and June of 2010, respectively. The ITS and ITL cover the incidental take of eight species: seven federally and state-listed threatened and endangered species and one state-listed endangered species (collectively referred to as the Covered Species) over a 20-year permit term. The Covered Species include: 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 gallinule or 'alae 'ula (*Gallinula galeata sandvicensis*), Hawaiian petrel or ua'u, (*Pterodroma sandwichensis*), Newell's shearwater or 'a'o (*Puffinus newelli*), Hawaiian hoary bat or 'ope'ape'a (*Lasiurus cinereus semotus*), and the state-listed Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*).

The Project was constructed in 2010 and 2011 and commissioned for operating on March 23, 2011. TerraForm Power, LLC (TerraForm) acquired the Project's LLC in 2016; the Project continues to be operated by KAH. Brookfield Renewable Partners, LP acquired a majority stake in Terraform in 2017.

On behalf of KAH, Tetra Tech, Inc. (Tetra Tech) has prepared this progress report which describes work performed for the Project during the 2020 fiscal year for the State of Hawai'i (FY; July 1, 2019 – June 30, 2020) pursuant to the terms and obligations of the approved HCP, ITL, and ITS. Kahuku Wind has previously submitted annual HCP progress reports for FY 2011 through FY 2019 to USFWS and DOFAW (Kahuku Wind 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018; Tetra Tech 2019).

2.0 Fatality Monitoring

In consultation with USFWS, DOFAW, and the Endangered Species Recovery Committee (ESRC), fatality search areas and search frequency have evolved over time from the start of operations in 2011 through the initiation of the current approach in April 2015.

- In March 2011, the fatality monitoring effort entailed full, intensive monitoring that involved twice weekly searches within a 64-meter radius circular monitoring plot (plot) centered on each wind turbine generator (WTG) in addition to searches every other week within a larger 96-meter radius plot.
- In September 2014, the 96-meter radius plot searches were suspended, but searches within the 64-meter radius plots continued on a twice weekly schedule.

- In December 2014, plots were reduced in size to the current 35-meter radius (Figure 1). Monthly searches were carried out from December 2014 through March 2015.
- In April 2015, the search frequency of the 35-meter radius plots was increased to weekly.

Weekly searches of the 35-meter radius plots were completed throughout FY 2020. Fatality monitoring in FY 2020 achieved a mean search interval for WTGs of 7.0 days (Standard Deviation = 0.44 days). The plots were searched by trained detector dogs accompanied by their handlers. If conditions had limited the use of dogs (e.g., weather, injury, availability of canine search team, etc.), plots would have been visually surveyed by Project staff. However, no visual searches were required in FY 2020; 100 percent of searches were conducted by canine teams.

No Covered Species were detected during fatality searches in FY 2020. Other species fatalities are reported in Section 7.2, and no fatalities of other listed species have been observed at the Project. An estimate of Project take based on bat fatalities found in previous years is provided in Section 7.1.

3.0 Carcass Persistence Trials

One 28-day carcass persistence trial was conducted in each quarter of FY 2020 for a total of four trials. These trials used black rats (*Rattus rattus*) as surrogates for Hawaiian hoary bat and wedge-tailed shearwater (*Ardenna pacifica*) carcasses to represent medium-sized birds (surrogates for the avian Covered Species [Section 1.0]). In FY 2020, the mean probability that a bat surrogate carcass persisted until the next search was 0.79 (95 percent Confidence Interval [CI] = 0.63, 0.90; N=22) and for medium-sized bird carcasses was 0.98 (95 percent CI = 0.82, 1.00; N=7).

4.0 Searcher Efficiency Trials

Fifty-nine searcher efficiency trials were administered over 12 trial days during FY 2020. As in the carcass persistence trials, black rats were used as surrogates for bats. Wedge-tailed shearwaters and cattle egrets (*Bubulcus ibis*) were used as surrogates for avian Covered Species. Searcher efficiency trials occurred throughout the year and exclusively tested canine search teams (no un-aided human searches occurred in FY 2020). Of the 59 trial carcasses placed, none were lost to scavenging. The overall searcher efficiency (i.e., combined vegetation classes) in FY 2020 for bat surrogates was 88 percent (95 percent CI = [0.76, 0.95]; N = 42) and for medium-sized bird carcasses was 100 percent (95 percent CI = [0.87, 1.00]; N = 17).



Figure 1. HCP Implementation Components

5.0 Vegetation Management

Search plots primarily consist of bare ground and vegetation that is mowed when it reaches 4 to 6 inches in height. The search plots generally overlap with the maintained WTG pad providing a relatively flat search area that is easily maintained; however, a small portion of the WTG 3 search plot has a slope that precludes vegetation management and is consequently not searched.

Vegetation within the plots consists mainly of Bermuda grass (*Cynodon dactylon*), sensitive plant (*Mimosa pudica*), and Guinea grass (*Megathyrsus maximus*). Vegetation management has been completed in prior monitoring years; in FY 2020, vegetation management began in August 2019 with all plots mowed approximately every 4 weeks to increase visibility during fatality searches. Plots were generally mowed the first Wednesday of each month, immediately following weekly fatality searches.

In June of FY 2020, the weed *Cenchrus echinatus* was identified within the search areas of WTG 12 and WTG 4. This weed produces sharp, bur-like seed heads that are harmful to canine searchers. The weed was removed by hand from these areas after positive identification. Seed heads were collected and destroyed. These areas will be monitored and managed if reemergence occurs.

6.0 Scavenger Trapping

A scavenger control program was re-implemented at the Project starting September 6, 2019. Weekly trap checks at 34 (Doc 250) traps occurred in September, focusing on rats (*Rattus spp.*) and mongoose (*Herpestes auropunctatus*). In October, the number of traps on site was increased up to a maximum of 105 traps (75 Doc 250s, 15 Timms and between 2 and 15 Steve Allan traps) and included trapping for feral cats (*Felis cattus*). Trap check frequency was reduced at that time to twice a month. In FY 2020, a total of 618 target animals were removed (552 mongoose, 58 rats, and 8 feral cats). The probability of carcass persistence for a bat surrogate until the next search increased from 0.63 (95 percent CI=0.51, 0.75; N=20) in FY 2019 to 0.79 (95 percent CI=0.63, 0.90; N=22) in FY 2020.

7.0 Documented Fatalities and Take Estimates

All downed wildlife observed during the fatality monitoring were handled and reported in accordance with the Downed Wildlife Protocol provided by USFWS and DOFAW (DOFAW and USFWS 2019). No Covered Species were detected during FY 2020, and no injured (live) downed wildlife were observed at the Project in FY 2020.

Various factors affect how the number of observed fatalities is scaled to account for unobserved fatalities. Unobserved fatalities are the result of three primary factors:

- Carcasses may be scavenged before searchers can find them,

- Carcasses may be present and not detected by searchers, and
- Carcasses may fall outside of the search area.

Sections 3.0 and 4.0 describe methods that are used to estimate the effect of the first two factors. The search area for fatalities at the Project has evolved over time; therefore, the proportion of the carcass distribution searched has varied. However, no change to the search area has been made since December 2014 (Section 2.0). Thus, the estimate of the proportion of the carcass distribution searched in FY 2020 remains the same as described in the FY 2018 annual report (Kahuku Wind 2018).

7.1 Hawaiian Hoary Bat

7.1.1 Estimated Take

A total of four Hawaiian hoary bat fatalities have been observed at the Project since operations began on March 23, 2011. The most recent documented Hawaiian hoary bat fatality was observed on August 29, 2014. All bat carcasses were transferred to the U.S. Geological Survey for genetic sexing. Each of the four bats was found inside of search plots; no incidental bat fatality detections have occurred to date.

An upper credible limit (UCL) of cumulative take is estimated from three components: (1) observed direct take (ODT) during protocol (standardized) fatality monitoring, (2) unobserved direct take (UDT), and (3) indirect take. The Evidence of Absence software program (EoA; Dalthorp et al. 2017), the agency-approved analysis tool for analyzing direct take, uses results from bias correction trials and ODT to generate a UCL of direct take (i.e., ODT + UDT). USFWS and DOWFAW have requested that estimates of direct take be reported at the 80 percent UCL. Direct take values from this analysis can be interpreted as: 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 the sex and age characteristics of bat fatalities found at the Project, and the life history characteristics of (or assumed to be representative of) the Hawaiian hoary bat, as described in the Project's approved HCP and current agency guidance (USFWS 2016).

The estimated direct take (ODT + UDT) for the four Hawaiian hoary bat fatalities found between the start of operation (March 23, 2011) and end of FY 2020 (June 30, 2020) is less than or equal to nine bats (80 percent UCL). Details of the estimated direct take parameters are presented in Appendix 1.

Indirect take is estimated to account for the potential loss of individuals that may occur 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 USFWS (2016) guidance as follows:

- The average number of pups attributed to a female that survive to weaning is assumed to be 1.8.

- The sex ratio of bats taken through UDT is assumed to be 50 percent female, unless there is substantial evidence (10 or more bats) to indicate a different sex ratio.
- The assessment of indirect take from the 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 (2016) guidance, the estimate of cumulative indirect take in FY 2020 is calculated as:

- **Total juvenile take calculated from observed female take (April 1 – September 15)**
 - $2 \text{ (observed females)} * 1.8 \text{ (pups per female)} = 3.6 \text{ juveniles}^1$
- **Total juvenile take calculated from observed unknown sex take (April 1 – September 15)**
 - $1 \text{ (observed unknown sex)} * 0.5 \text{ (assumed sex ratio)} * 1.8 \text{ (pups per female)} = 0.9 \text{ juveniles}$
- **Total juvenile take calculated from unobserved take**
 - $5 \text{ (unobserved direct take)} * 0.5 \text{ (assumed sex ratio)} * 0.25 \text{ (proportion of calendar year females could be pregnant or have dependent pups)} * 1.8 \text{ (pups per female)} = 1.1 \text{ juveniles}$
- **Total Calculated Juvenile Indirect Take** = $5.6 \text{ (} 3.6 + 0.9 + 1.1 \text{)}$
- **Total Adult Equivalent Indirect Take** = $0.3 \text{ (juvenile to adult conversion factor)} * 5.6 = 1.7$

Therefore, the estimated indirect take based on the UCL of Hawaiian hoary bat direct take at the Project is two adults (rounded up from 1.7).

The UCL for cumulative Project take of the Hawaiian hoary bat at the 80 percent credibility level is 11 adult bats (9 [estimated direct take] + 2 [estimated indirect take]). That is, there is an approximately 80 percent probability that actual take at the Project at the end of FY 2020 is less than or equal to 11 bats.

7.1.2 Projected Take

EoA includes a module that allows users to project future estimates of mortality based on results of past fatality monitoring. Due to the inherent uncertainty of these projections (including the potential future contribution of indirect take) and the amplification of this uncertainty resulting

¹ DNA results have identified the sex of three of the four bat fatalities detected at the Project, confirming that two of the fatalities were female (Pinzari and Bonaccorso 2018).

from the use of the 80 percent UCL as the estimate of take for regulatory compliance, long term projections have limited utility. Nevertheless, they do help gauge the likelihood of permitted take exceedance, and may help operators in their mitigation planning, assuming future management and monitoring conditions can be reasonably estimated.

KAH projected take through the end of the permit term using the fatality monitoring data collected through FY 2020. The objective of this analysis was to evaluate the potential for the Project to exceed the permitted take limit at the 80 percent UCL prior to the end of the permit term (Appendix 2). The proportion of risk in the model was not adjusted to reflect that the Low Wind Speed Curtailment (LWSC) regime (Section 10.0) likely reduces the risk to bats, and that this method of reducing risk will remain in place for the remainder of the Project's permit term. For this analysis, the detection probability for future years is assumed to be constant at 0.52 (95 percent CI = [0.43, 0.61]), similar to the FY 2020 detection probability. As future indirect take is unknown and will potentially vary based on the timing of ODT, we assumed total indirect take for the Project over the permit term would be a maximum of five adult equivalents (16 juveniles based on assumed Hawaiian hoary bat survival rates [USFWS 2016]), or 21.7 percent of the permitted take. Currently, the proportion of total take that is attributable to indirect take is 18.2 percent, making the assumption of five indirect take conservative. Assuming five adult bat equivalents are attributed to the Project as indirect take, the permitted direct take under the Project's ITP and ITL would be 18 bats (i.e., 23 permitted take – 5 indirect take = 18 direct take).

Based on the analysis described above and presented in Appendix 2, there is a 51.9 percent chance that the 80 percent UCL of cumulative take will not be exceeded during the permit term. Specifically, the median of the projected mortality estimate is equivalent to the assumed Threshold value (T) of 18 (Appendix 2). The probability of permit exceedance at the Project may be overestimated given that the estimate of indirect take is conservatively high, and Tetra Tech did not ascribe a benefit to the implementation of LWSC although a benefit is expected based on estimates of the reduction in fatalities on other bat species from large studies at industrial scale wind projects in North America (Arnett et al. 2011, Good et al. 2011, Hein et al. 2014). Furthermore, results from on-going research on bat deterrents and LWSC may provide improvements to avoidance and minimization measures in the next few years. Therefore, between the conservative assumptions used in this analysis, the inherent uncertainty in projecting future outcomes, and potential improvements in our ability to further reduce risk to bats, the Project is likely to remain below the permitted take limit for the permit term.

7.2 Fatalities of Non-Covered Species

Thirteen bird fatalities, representing seven species, were documented at WTGs at the Project site in FY 2020. Two of the species observed in FY 2020 are protected by the Migratory Bird Treaty Act (MBTA): Pacific golden-plover (*Pluvialis fluva*; one fatality), and cattle egret (three fatalities). For a complete list of fatalities detected in FY 2020 see Appendix 3.

8.0 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 with the information they need to be able to respond appropriately if they observe a Covered Species or encounter downed wildlife while on-site. WEOP trainings were provided to 10 individuals over three dates in FY 2020.

9.0 Mitigation

The Project's mitigation requirements are described in Section 7.6 of the approved HCP.

9.1 Hawaiian Hoary Bats

9.1.1 On-Site Acoustic Surveys

The HCP commits to performing acoustic monitoring for bat activity during years when systematic fatality monitoring is conducted. Acoustic monitoring results are based on detection rates (nights with detections per detector-night in which a detector-night represents a night the detector was active). Bat acoustic monitoring has been conducted continuously at the Project since the start of operations; Anabat detectors were replaced with Wildlife Acoustics detectors beginning in FY 2014 (July 2013). Between FY 2014 and FY 2017, monitoring was conducted at twelve locations distributed across the Project. However, due to the proportion of the number of nights with recorded bat activity, monitoring efforts were reduced to seven locations beginning in FY 2018 (Kahuku Wind 2018), and then reduced to four locations (WTGs 2, 5, 9, and 12; Figure 1) beginning in FY 2019. Acoustic monitoring units were located within 50 meters of the WTGs and consisted of a ground-based Song Meter SM2BAT+ ultrasonic recorder equipped with one SMX-U1 ultrasonic microphone (Wildlife Acoustics, Maynard, MA, USA) positioned 6.5 meters above ground level.

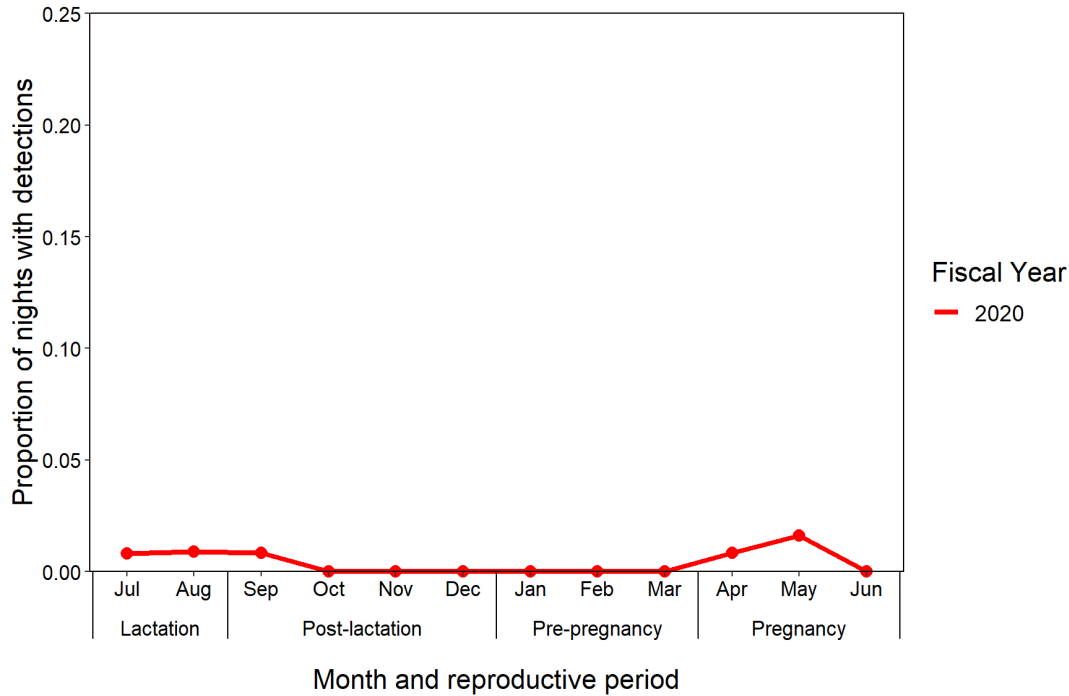


Figure 2. Monthly Bat Acoustic Activity at Kahuku for FY 2020 with Corresponding Reproductive Periods

Bat activity at the Project is generally very low. Across the four WTGs monitored during FY 2020, Hawaiian hoary bats were only detected on six nights out of the 1,409 (0.43 percent) detector-nights sampled. The annual detection rate in FY 2020 was lower than the annual detection rate in FY 2019 (1.09 percent). Among all monitoring years, annual detection rates were consistently low, regardless of variation in the sampling effort, with no significant difference in the annual detection rate between years (ANOVA: $F_{7,60} = 1.03$, $P = 0.417$; Table 1)². Annual detection rates appear to be stable, with no significant increasing or decrease trend, across all monitoring years (LM: $R^2 = -1.61\%$; $F_{2,60} = 0.25$, $P = 0.801$).

² Log transformations were conducted to normalize data for all statistical tests.

Table 1. Number of Detector-Nights Sampled and Proportion of Detector-Nights with Bat Detections Between FY 2014 and FY 2020

Dates	No. of Detector-Nights Sampled	No. of Detector - Nights with Detections	Proportion of Detector-Nights with Detection(s)
FY 2014 (July 2013 – June 2014) ¹	3487	32	0.009
FY 2015 (July 2014 – June 2015) ¹	3072	11	0.004
FY 2016 (July 2015 – June 2016) ¹	2922	28	0.010
FY 2017 (July 2016 – June 2017) ¹	3146	15	0.005
FY 2018 (July 2017 – June 2018) ²	1273	10	0.008
FY 2019 (July 2018 – June 2019) ³	1105	12	0.011 ⁴
FY 2020 (July 2019 – June 2020) ³	1412	6	0.004
1. Number of detectors = 12. 2. Number of detectors = 7. 3. Number of detectors = 4. 4. Estimate corrected from FY 2019 annual report			

In FY 2020 detection rates occurred throughout the lactation reproductive period (mid-June to August), in September of the post-lactation period (September to mid-December) and again in April and May during the pregnancy period (Figure 2). The highest detection rate occurred in the month of May (0.016, N = 124), consisting of two nights each with a detection. All other months with activity consisted of only a single night with a detection each. No activity was observed between October of the post-lactation reproductive period through March of the pre-pregnancy reproductive period (mid-December to March), or in June of the pregnancy reproductive periods (Figure 2). The temporal pattern of the detection rates in FY 2020 was similar to the pattern of detection rates observed in previous years (Figure 3). The general temporal pattern in the detection rates observed at the Project has also been previously reported in Hawaiian hoary bats monitored at other low elevation sites on Oahu (Starcevich et al. 2019) and Hawai‘i Island (Todd 2012).

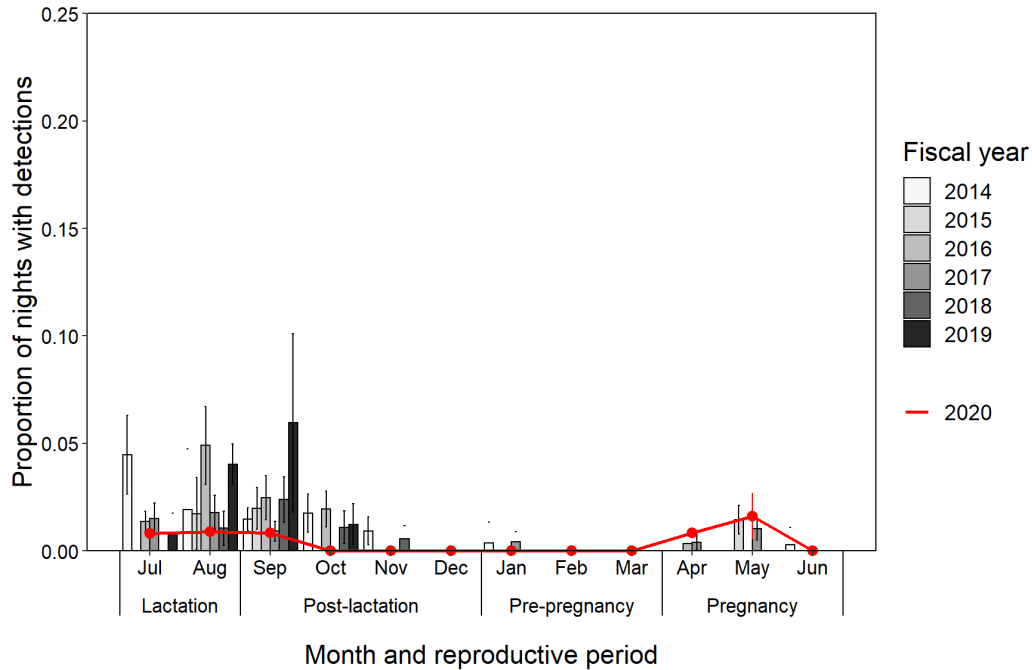


Figure 3. Monthly Bat Acoustic Activity at Kahuku for FY 2014 through FY 2020 with Corresponding Reproductive Periods

9.1.2 Kahikinui Forest Reserve Mitigation

The Baseline (Tier 1) Mitigation obligation for the Hawaiian hoary bat is complete. Kahuku Wind paid the full obligation of \$150,000 for Tier 1 bat mitigation conducted by DOFAW at the Kahikinui Forest Reserve on Maui in September 2011 (Kahuku Wind 2012). These funds were used for 2,500 meters of ungulate fencing around a 280-acre enclosed restoration area (Landon 2015).

Mitigation planning for a Higher Level of Take (Tier 2) was initiated in FY 2020. Although 75 percent of take within Tier 1 (a threshold identified in previous discussions with the agencies as appropriate for subsequent tier planning) has not yet occurred at the Project, KAH anticipates providing funding for the 2.63 bats credited through not-yet-funded portions of the Hawai'i Island Hawaiian hoary bat ecological research study (U.S. Geological Survey Hawaiian Hoary Bat Research Group) approved for the KAH wind project under the ESRC's bat research project review process. This action preemptively funds part of the Project's Tier 2 Mitigation to ensure bat mitigation for the Project does not lag potential Project take. The 2.63 bats described represent credit for ESRC-approved bat mitigation to be funded by KAH. This credit is based on (1) USFWS input and DOFAW approval and (2) research funding assigned to the TerraForm wind projects that is not necessary to meet existing Tier 2 Hawaiian hoary bat mitigation obligations for the Kaheawa I Wind Project nor existing Tier 3 obligations of the Kaheawa II Wind Project.

9.2 Other Covered Species

Mitigation efforts for waterbirds were completed as of FY 2015 and no further reporting is required (Kahuku Wind 2016). All mitigation efforts for Newell's shearwater and Hawaiian petrel were completed as of FY 2017; no further reporting is required (Kahuku Wind 2017; Pacific Cooperative Studies Unit and DOFAW 2017). Mitigation efforts for the Hawaiian short-eared owl were completed as of FY 2017 and no further reporting is required (Kahuku Wind 2017).

10.0 Adaptive Management

Kahuku Wind has implemented adaptive management steps in accordance with the adaptive management framework in Section 8.3 of the approved HCP to understand and reduce the risk to the Hawaiian hoary bat. Adaptive management measures that have been and continue to be implemented include adjustments in vegetation management and scavenger control efforts to maintain a high probability of detecting Project-related wildlife fatalities and implementing a Project-wide LWSC regime. LWSC of all turbines at wind speeds of up to 5 meters per second (m/s) began April 27, 2012 and continues to be implemented between sunset and sunrise from April through November. Curtailment is achieved by feathering blades to minimize rotation.

11.0 Agency Meetings, Consultations, and Visits

KAH communicated actively with USFWS and DOFAW throughout FY 2020 through in-person meetings, conference calls, submittal of quarterly reports, and e-mail communications related to the Project's HCP (Table 2). These communications included focused discussions regarding Hawaiian hoary bat Tier 2 mitigation funding and strategy.

Table 2. Summary of Agency Coordination and Communication in FY 2020

Date	Communication	Participants
October 3, 2019	Call with USFWS regarding HCP planning	KAH Tetra Tech, USFWS
November 7, 2019	Annual HCP implementation review meeting (in person)	KAH, Tetra Tech, USFWS, DOFAW
November 13, 2019	Submittal of FY2020 Q1 report	Submitted to DOFAW, USFWS by Tetra Tech
January 15, 2020	Annual HCP implementation review by ESRC	KAH, Tetra Tech, ESRC
January 30, 2020	Submittal of FY 2020 Q2 report	Submitted to DOFAW, USFWS by Tetra Tech
April 23, 2020	Semi-annual HCP implementation review meeting (via conference call)	KAH, Tetra Tech, USFWS, DOFAW
April 29, 2020	Submittal of FY 2020 Q3 report	Submitted to DOFAW, USFWS by Tetra Tech

12.0 Expenditures

Total HCP-related expenditures for the Project in FY 2020 were \$193,000 (Table 3).

Table 3. HCP-related Expenditures at the Project in FY 2020

Category	Amount
Permit compliance	\$67,000
Fatality monitoring	\$51,000
Acoustic monitoring for bats	\$12,000
Scavenger control	\$35,000
Vegetation management	\$25,000
Equipment and supplies	\$3,000
Staff labor ¹	--
Total Cost for FY 2020	\$193,000
¹ Staff labor costs are included in the overall costs for each other category	

13.0 Literature Cited

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**Appendix 1. Dalthorp et al. (2017) Fatality Estimation for
Hawaiian hoary bats at the Project through FY 2020**

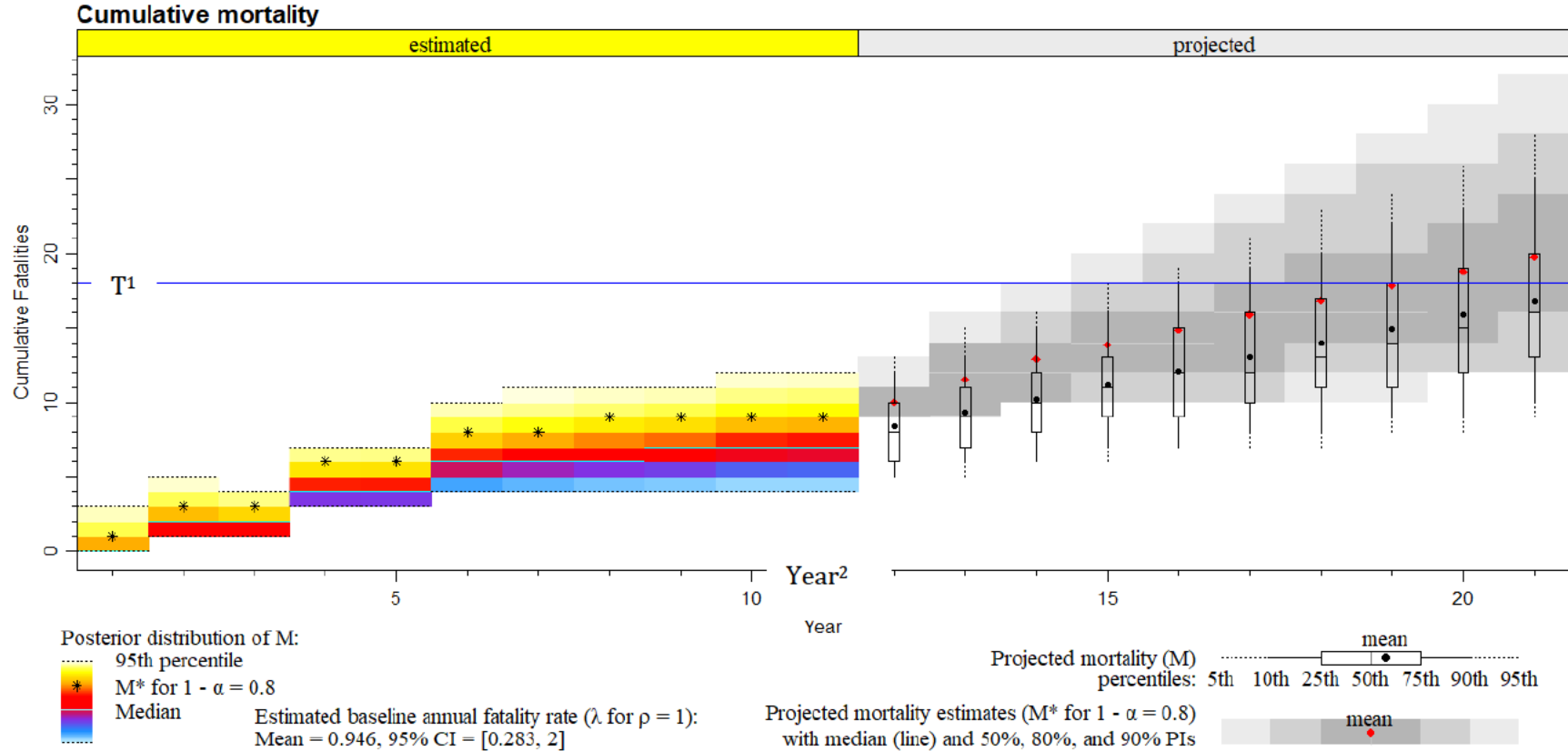
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Modelling parameter		Modelling Period										
		1	2	3	4	5	6	7	8	9	10	11 (current)
LWSC		N/A	N/A	Partial	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s
Date Range of Modelling Period	Begin	1/1/2011	10/1/2011	4/1/2012	9/1/2013	8/1/2014	11/1/2014	4/1/2015	7/1/2016	7/1/2017	7/1/2018	7/1/2019
	End	10/1/2011	3/31/2012	8/1/2012	7/31/2014	10/31/2014	3/31/2015	6/30/2016	6/30/2017	6/30/2018	6/30/2019	6/30/2020
Period length (days)		273	182	122	333	91	150	456	364	364	364	364
Percent of Year		0.75	0.50	0.33	0.91	0.25	0.41	1.25	1.00	1.00	1.00	1.00
Search Interval (days)		3.5	2.5	3.5	3.5	3.5	30.0	7.0	7.0	7.0	7.0	7.0
Number of Searches in Modelling period		77	72	34	94	25	4	64	51	51	52	52
Observed fatalities (X)		1	0	2	0	1	0	0	0	0	0	0
K		0.7	0.7	0.7	0.7	0.7	0.7	1 ¹	1 ¹	1 ¹	1 ¹	1 ¹
DWP		1.0	1.0	1.0	1.0	1.0	1.0	0.7 ²	0.7 ²	0.7 ²	0.7 ²	0.7 ²
g	G	0.464	0.796	0.746	0.830	0.670	0.347	0.565	0.530	0.535	0.413	0.527
	95% LCI	0.262	0.675	0.611	0.647	0.460	0.166	0.486	0.465	0.464	0.328	0.434
	95% UCI	0.672	0.894	0.861	0.955	0.850	0.554	0.642	0.595	0.605	0.501	0.618
B	Ba	9.841	39.66	33.65	17.27	13.94	7.456	87.01	119.5	101.7	50.73	58.89
	Bb	11.38	10.18	11.43	3.528	6.853	14.05	67.09	105.8	88.60	72.82	52.93
M* ³		4	3	7	6	7	8	8	9	9	9	9
1. Searches performed by canine teams. 2. Reduced search area (See FY 2018 Annual Report for detailed analysis). 3. Cumulative value representing estimate of total direct take from the start of operations through the identified monitoring period at the 80 percent UCL.												

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Appendix 2. Hawaiian Hoary Bat 20-Year Projected Take at the Project in FY 2020

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1. Permitted take for the Hawaiian hoary bat at the Project is 23; however, projected take as calculated using EoA only includes direct take. To account for indirect take in this analysis, an approximate take threshold (T) of 18 is shown, representing permitted bat take (23) minus 5 adult equivalents of indirect take (21.7 percent of the permitted limit). Currently, the proportion of total take that is attributable to indirect take is 18.2 percent. T overlaps the median (line) for projected mortality estimates at modelling period 21 (19.5 years of operation).
2. The “years” 1 – 7 represent unique modelling periods rather than FY and cumulatively represent 5.5 years of operation. In contrast, starting with year 8 the years represent FYs. Therefore, the length of time displayed represents 19.5 years, or the actual time turbines are anticipated to be operational during the 20-year permit term.

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Appendix 3. Documented Fatalities at the Project during FY 2020

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Species	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)
<i>Pluvialis fluva</i> (Pacific golden plover) ¹	9/11/2019	4	30	218
<i>Bubulcus ibis</i> (cattle egret) ¹	9/18/2019	8	13	50
<i>Geopelia striata</i> (zebra dove)	12/18/2019	12	1	90
<i>Bubulcus ibis</i> (cattle egret) ¹	12/20/2019	10	6	18
<i>Estrilda astrild</i> (common waxbill)	1/15/2020	12	1	135
<i>Pycnonotus cafer</i> (red vented bulbul)	2/5/2020	1	1	25
<i>Spilopelia chinensis</i> (spotted dove)	3/25/2020	4	1	80
<i>Spilopelia chinensis</i> (spotted dove) ²	3/25/2020	5	1	10
<i>Spilopelia chinensis</i> (spotted dove)	4/29/2020	4	3	100
<i>Bubulcus ibis</i> (cattle egret) ¹	5/6/2020	9	6	315
<i>Lonchura punctulata</i> (nutmeg mannikin)	5/13/2020	4	17	85
<i>Geopelia striata</i> (zebra dove)	5/20/2020	2	0	2
<i>Streptopelia chinensis</i> (spotted dove)	6/10/2020	7	2	20
¹ Species protected under the MBTA.				
² Fatality erroneously not reported in FY 2020 Q3 report				

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