Kaheawa Wind Project II
Habitat Conservation Plan
FY 2021 Annual Report

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Incidental Take License ITL-15 / Incidental Take Permit TE27260A-1

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Executive Summary

This report summarizes work performed by Kaheawa Wind Power II, LLC (KWP II), owner of the Kaheawa Wind Project II (Project), during the State of Hawaiʻi fiscal year 2021 (FY 2021; July 1, 2020– June 30, 2021) under the terms of the approved Habitat Conservation Plan (HCP). The original HCP was dated December 2011 and described KWP II's compliance obligations under the Project's state Incidental Take License ITL-15 and federal Incidental Take Permit ITP-TE27260A-1. In 2019, the HCP was amended to address higher than expected take of two species at the Project, and the Project continues to operate under updated versions of the ITL and ITP. Species covered under the amended HCP (hereafter HCP; Covered Species) include four federally and state-listed threatened and endangered species. The 14-turbine Project was constructed in 2011– 2012 and has been operating since July 2, 2012.

Fatality monitoring at the Project in FY 2021 continued within search plots limited to cleared areas within 70 meters of each Wind Turbine Generator. Canine teams searched within each of the fatality monitoring plots once per week year-round. Bias correction trials were conducted quarterly at the Project 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. In FY 2021, probabilities of a carcass persisting until the next search were 0.99 (Hawaiian goose surrogates), 0.75 (bat surrogates), and 1.00 (seabird surrogates). Searcher efficiency was 0.94 for bat surrogates, and 1.00 for the Hawaiian goose and seabird surrogates.

No fatalities of any of Covered Species were found at KWP II during FY 2021. Through FY 2021, the Project's total observed direct take of Covered Species has been three Hawaiian hoary bats, and eight Hawaiian geese. No Covered seabird Species (Hawaiian petrel and Newell's shearwater) have been detected as fatalities at the Project to date. The fatality estimates using the Evidence of Absence estimator at the upper 80 percent credibility level are 11 for the Hawaiian hoary bat and 22 for the Hawaiian goose. Indirect take estimates for the Covered Species are one adult equivalent for the Hawaiian hoary bat and two adult equivalents for the Hawaiian goose. Combining direct and indirect take estimate values, there is an approximately 80 percent chance that cumulative take of Covered Species at the Project from the start of operations through FY 2021 was less than or equal to 12 for the Hawaiian hoary bat and 24 for the Hawaiian goose.

The bat acoustic monitoring program data captured bat activity across the Project at five detector locations throughout FY 2021. Between July 2020 – June 2021, Hawaiian hoary bats were detected on 232 of 1,671 detector-nights (13.9 percent of detector-nights). The seasonal pattern of detection rates was comparable with previous years.

Mitigation commitments to offset the take of Covered Species are ongoing. Current estimated take for the Hawaiian hoary bat is within the Tier 3 limit of the HCP. Tier 1 and Tier 2 mitigation in the form of habitat management have been funded and are ongoing at Kahikinui State Forest Reserve. Tier 3 mitigation began in FY 2018 through a contract with the U.S. Geological Survey's Hawaiian Hoary Bat Research Group to conduct bat ecological research on Hawaiʻi Island. The research study

is intended to better inform future bat habitat restoration and conservation. Current estimated take for the Hawaiian goose is within the Tier 2 limit of the HCP. Although funding for FY 2021 mitigation was provided to DOFAW in June 2020, processing delays resulted in no Hawaiian goose mitigation being carried out for the Project in FY 2021. Cumulatively, the increases in adult and juvenile survival and productivity achieved by the release pen have not been sufficient to fully offset Tier 1 or Tier 2 mitigation obligations. KWP II is actively working with DOFAW to adaptively manage the Hawaiian goose mitigation program. In addition, KWP II is working with USFWS and DOFAW to develop consensus on quantifying the Hawaiian goose mitigation benefits attributable to the Project. For seabirds, current estimated take is within the Tier 1 limit of the HCP. Tier 1 mitigation is on-going as implementation of a comprehensive plan for seabird colony management at the Makamakaʻole Seabird Mitigation Site as well as implementation of predator control efforts at a Hawaiian petrel breeding colony on Lānaʻi. For the 2021 breeding season, the Maui Nui Seabird Recovery Project is contracted to perform work at Makamakaʻole and Pūlama Lānaʻi is contracted to perform predator control efforts on Lānaʻi through the 2021 breeding season. KWP II continues to work with wildlife agencies to assess overall benefits of Project's seabird mitigation project.

KWP II communicated actively with USFWS and DOFAW throughout FY 2021. The communication was conducted through conference calls, submittal of quarterly reports, and e-mail communications related to the Project's HCP. No in-person meetings were conducted in FY 2021. Communications content included focused discussions regarding mitigation projects, mitigation funding, Hawaiian goose minimization measures, and the evaluation of mitigation benefits.

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1.0 Introduction

The Hawaii Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) and U.S. Fish and Wildlife Service (USFWS) approved the Kaheawa Wind Project II (Project) Habitat Conservation Plan (HCP) in 2012. In January 2012, the Project received a federal incidental take permit (ITP; ITP-TE27260A-0) from the USFWS and a state incidental take license (ITL; ITL-15) from DOFAW. In 2019, DOFAW and USFWS approved an HCP Amendment to (hereafter HCP; SWCA 2019) to address the higher than expected take of two species, and the ITP and ITL were reissued (ITP-TE27260A-1 and amended ITL-15). The ITP and ITL cover the incidental take of four federally and state-listed, threatened and endangered species (the Covered Species) over a 20-year permit term.

The Covered Species include:

- Hawaiian hoary bat or ʻōpeʻapeʻa (*Lasiurus cinereus semotus*)[1];
- Hawaiian goose or nēnē (*Branta sandvicensis*)[1];
- Hawaiian petrel or ʻuaʻu (*Pterodroma sandwichensis*); and
- Newell's shearwater or ʻaʻo (*Puffinus newelli*).

The Project was constructed in 2011 and 2012 and was commission on July 2, 2012. Brookfield Renewable Partners, LP acquired the Project's LLC through acquisition of a controlling interest in TerraForm, LLC in 2017; the Project continues to be operated by Kaheawa Wind Power II, LLC (KWP II).

On behalf of KWP II, Tetra Tech, Inc. (Tetra Tech) has prepared this report to describe the work performed for the Project during the State of Hawaiʻi 2021 fiscal year (FY 2021; July 1, 2020–June 30, 2021) pursuant to the terms and obligations of the approved HCP, ITL, and ITP. An updated ITP and ITL were issued in September and November 2019, respectively. The Project has previously submitted annual HCP progress reports to DOFAW and USFWS for FY 2013 through FY 2020 (KWP II 2013, KWP II 2014, KWP II 2015, KWP II 2016, KWP II 2017, KWP II 2018, Tetra Tech 2019, Tetra Tech 2020).

2.0 Fatality Monitoring

The Project has implemented a year-round intensive monitoring program to document downed (i.e., injured or dead) wildlife incidents involving Covered Species and other species at the Project since operations began in July 2012. In consultation with USFWS, DOFAW, and the Endangered Species Recovery Committee (ESRC), fatality search areas have evolved over time from the start of

[1] Among other modifications, increased take and mitigation for impacts to the Hawaiian goose and Hawaiian hoary bat were addressed in the 2019 approved HCP Amendment.

operations through the initiation of the current approach in 2015. The last modifications were in response to the March 31, 2015 ESRC meeting wherein members agreed to "encourage the applicant to work with the statistical experts and researchers to develop an alternative more efficient and focused monitoring strategy which still meets the committees expressed preference for continuation of annual monitoring." Initially, monitoring occurred within the entirety of the 70-meter circular plots centered on each wind turbine generator (WTG). Beginning in July 2015, with agreement from the agencies, the search area was reduced to graded WTG pads and access roads (search plots) that fall within a 70-meter radius circle centered on each of the Project's 14 WTGs (Figure 1). This search area continued to be used for monitoring in FY 2021.

In FY 2021, all 14 WTGs were searched for fatalities once per week. The FY 2021 mean search interval for all WTGs was 7.0 days (Standard Deviation = 0 days); no search dates were missed or adjusted. The search plots were searched by a canine search team which included a trained detector dog accompanied by a handler. Should search conditions limit the use of a canine (e.g., weather, injury, availability of canine search team, etc.), plots would be visually surveyed by Project staff. However, all searches were conducted by canine teams in FY 2021; no visual searches occurred.

Special precautions have been taken to eliminate any potential canine interactions with wildlife, with a focus on the Hawaiian goose. If Hawaiian geese were present nearby by, the canine handler was directed to immediately retrieve and restrain the dog, avoid disturbing the birds, and postpone searching in the vicinity of the birds, work on leash away from wildlife or temporarily skip canine searches in the proximity of the Hawaiian goose. Hawaiian geese were observed over 38 days in FY 2021. Hawaiian geese were observed by the canine handler in each month, with the exception of July and October. In each case, the handler moved the canine to a different WTG search area and returned to finish the disrupted search later in the day. No canine wildlife interactions were observed.

3.0 Carcass Persistence Trials

Four, 28-day carcass persistence trials were conducted in FY 2021 using black rats (*Rattus rattus*) for Hawaiian hoary bat surrogates, large chickens (*Gallus gallus*) for Hawaiian goose surrogates (i.e., large birds), and wedge-tailed shearwater (*Ardenna pacifica*) carcasses as surrogates for the Hawaiian petrel and Newell's shearwater (i.e., medium birds; Covered Seabird Species). In FY 2021, the probability that a carcass persisted until the next search was 0.75 for all bat surrogates (95 percent Confidence Interval [CI] = 0.60, 0.87; N=20), 0.99 for large birds (95 percent CI = 0.88, 1.00; N=10), and 1.00 for medium-sized birds (95 percent CI = 0, 1.00; N=10).

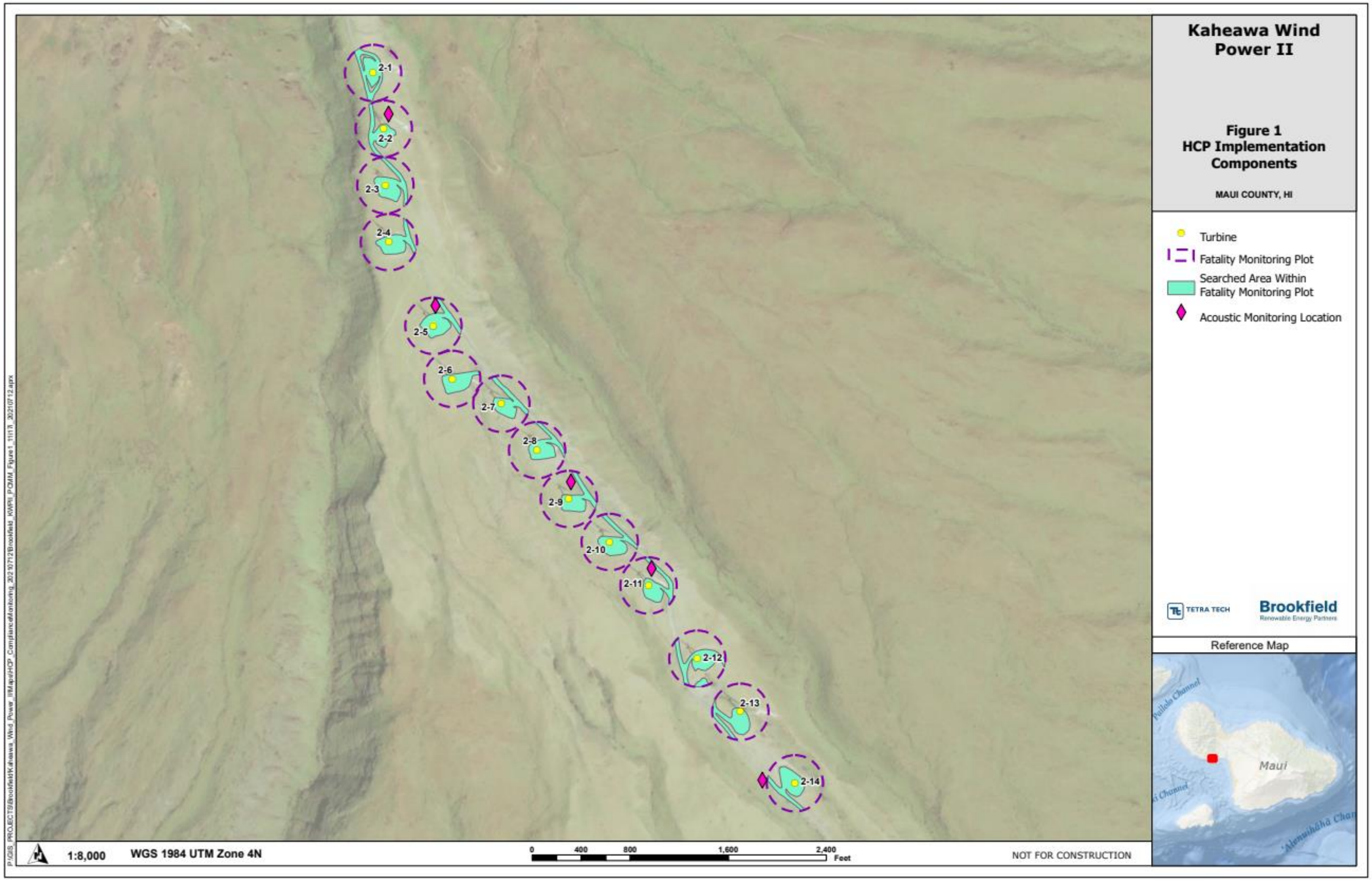

Figure 1. HCP Implementation Components

4.0 Searcher Efficiency Trials

A total of 72 searcher efficiency trials over 21 trial days were administered during FY 2021. Similar to the carcass persistence trials, black rats as surrogates for bats, large chickens were used as surrogates for the Hawaiian goose, and wedge-tailed shearwaters and other medium-sized birds collected or procured under the Project's Special Purpose Utility Permit (MB22096C-0) as surrogates for Covered Seabird Species. Searcher efficiency trials occurred approximately monthly throughout the year; all trials tested canine search teams in FY 2021 (no un-aided human searches occurred in FY 2021). Of the 72 trials placed, four bat surrogates, five chickens, and one wedge-tailed shearwaters were not available for detection. For FY 2021, the probability that a canine search team would find a carcass was 0.94 for bat surrogates (95 percent CI = [0.83, 0.99]; N=36), 1.00 for large birds (95 percent CI = [0.80, 1.00]; N=11), and 1.00 for medium-sized birds (95 percent CI = [0.85, 1.00]; N=15).

5.0 Vegetation Management

In order to maximize fatality monitoring efficiency and minimize impacts to native plants without compromising soil stability, KWP II performs vegetation management at the Project. Vegetation management activities have evolved over time, and account for the Hawaiian goose nesting season restrictions:

- The vegetation management activities within the search plots were initially limited to between April 1 and October 31 to minimize risk during the Hawaiian goose nesting season.
- In November 2016, Stephanie Franklin of DOFAW-Maui verbally approved using hand management tools (spray packs and weed whackers) during the Hawaiian goose nesting season if the activity was within the current search area and did not disturb wildlife.
- In March 2017, Stephanie Franklin of DOFAW-Maui verbally approved the removal of Christmas berry (*Schinus terebinthifolius*) within 70 meters of the WTGs to reduce potential Hawaiian goose nesting habitat in the vicinity.

Vegetation management was implemented at the Project throughout FY 2021. Quarterly glyphosate-based herbicide treatments using a boom sprayer were applied to the cleared areas within each search plot, supplemented by weed whacking to maintain consistency of the extent of the cleared area within 70 meters of each WTG. Limited application of herbicide occurred in Q3 by spot treatment with a hand sprayer. On March 19, 2021, DOFAW was contacted for guidance on when herbicide application using a boom sprayer could resume. DOFAW requested that boom spraying be put on hold due to Hawaiian goose nesting season extending longer in 2021 than it has in the past. With the approval of DOFAW, the regular vegetation management program resumed on April 16, 2021.

6.0 Scavenger Trapping

KWP II has implemented periodic scavenger trapping at the Project to extend carcass persistence times and contribute to a high probability of a carcass persisting until the next search. Additionally, this program benefits the resident wildlife by reducing the potential for predation. The scavenger trapping program at the Project was implemented in FY 2021. Active trapping occurred approximately bi-weekly at 12 turbines throughout this time period. Trapping included the use of nine DOC250 body grip traps and six live traps. The trapping program documented the removal of 26 mongooses (*Herpestes auropunctatus*), and seven feral cats (*Felis cattus*) in FY 2021. No non-target animals were trapped.

7.0 Documented Fatalities and Take Estimates

No take of HCP Covered Species was documented in FY 2021. All observed downed wildlife were handled and reported in accordance with the Downed Wildlife Protocol provided by USFWS and DOFAW (USFWS and DOFAW 2020). No injured (live) downed wildlife were observed at the Project in FY 2021.

To calculate take estimates, the number of observed fatalities is scaled to account for fatalities that are not detected, or unobserved. Unobserved fatalities are the result of three primary factors:

- Carcasses may be scavenged before searchers can find them;
- Carcasses may be present, but not detected by searchers; and
- Carcasses may fall outside of the searched area.

Carcass persistence and searcher efficiency (bias correction; see Sections 3.0 and 4.0) measure the effect of the first two factors. The third factor, the number of carcasses that fall outside of the searched area, is dependent upon the proportion of the carcass distribution that is actually searched. 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 plots has been made since FY 2016 (Section 2.0). Thus, the estimate of the proportion of the carcass distribution searched (DWP; Appendix 1) has remained the same as described in the FY 2017 annual report (KWP II 2017).

Cumulative take at an upper credible limit (UCL) of 80 percent was calculated for each Covered Species for which documented fatalities have occurred, per request of USFWS and DOFAW. The UCL 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). 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. Indirect take calculations are based on the HCP and agency guidance. Indirect take is estimated based on factors such as the breeding season in which fatalities are observed, sex, and age characteristics of Covered Species fatalities found at the Project, their associated life history characteristics as described in the Project's approved HCP, and current agency guidance (e.g., USFWS [2016] for Hawaiian hoary bats).

Additionally, 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 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.

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 in July 2012. Three of the four observed bat fatalities have been found within the searched area and are used to estimate UDT. All bat carcasses were transferred to the U.S. Geological Survey for genetic sexing (Pinzari and Bonaccorso 2018). Hawaiian hoary bat fatalities by fiscal year are listed in Table 1.

Table 1. Observed Hawaiian Hoary Bat Fatalities at KWP II through FY 2021

Fiscal Year	Hawaiian Hoary Bat Observed Direct Take	Hawaiian Hoary Bat Incidental Fatality Observations	Total
2013	1	0	1
2014	2	0	2
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	1	1
2020	0	0	0
2021	0	0	0
Total	**3**	**1**	**4**

The estimated direct take (ODT + UDT) for the four Hawaiian hoary bat fatalities found between the start of operation (November 2, 2012) and end of FY 2021 (June 30, 2021) is less than or equal to 11 bats (80 percent UCL; Appendix 1a). Because one of the four observed bat fatalities was found outside of the search areas (i.e., incidental observation), three fatalities were used in the analysis and considered ODT; the one incidental observation detected in FY 2019 is accounted for in the estimated value of UDT.

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. The timing and sex of all observed fatalities (those observed in fatality monitoring as well as incidental to fatality monitoring) is used in the calculation of indirect take. Cumulative indirect take through FY 2021 was 0.47 adults (Appendix 2a).

The UCL for Project take of the Hawaiian hoary bat at the 80 percent credibility level is 12 adult bats (11 estimated direct take + one estimated indirect take, rounded up). That is, there is an approximately 80 percent probability that actual take at the Project at the end of FY 2021 is less than or equal to 12.

7.1.2 Projected Take

KWP II projected take through the end of the permit term using the fatality monitoring data collected through FY 2021 to evaluate the potential for the Project to exceed the requested take limit at the 80 percent UCL prior to the end of the permit term (Appendix 3a). For this analysis, the detection probability for future years is assumed to match the detection probability of FY 2021, and the fatality rate is unaltered for all future years (rho=1). Future indirect take is unknown and will potentially vary based on the timing of ODT. Based on historical Project data, we assumed total indirect take for the Project over the permit term would be a maximum of two adult equivalents (approximately six juveniles based on assumed Hawaiian hoary bat survival rates; USFWS 2016), or 5.3 percent of the requested take). Currently, the proportion of total take that is attributable to indirect take is 4.1 percent (0.47 adult bat equivalents estimated from indirect take / 11.47 bats estimated combining the direct and indirect take), making the assumption of the indirect take of two adult bats conservative. Assuming two adult bat equivalents are attributed to the Project as indirect take, direct take under the HCP would be 36 bats (permitted take of 38 bats – estimated take of 2 bats attributed to indirect take = 36 bats estimated direct take maximum).

Based on the analysis described above and presented in Appendix 3, there is a 93 percent chance that the 80 percent UCL of cumulative take will not be exceeded during the permit term. In addition, the median years of operations without exceeding this direct take threshold is 20. Finally, the median projection of direct take over the permit term is 22 with an interquartile range [17 – 28], suggesting that even with an indirect take contribution of two adult equivalents, the Project is unlikely to exceed a cumulative take estimate of 30. Therefore, the Project is likely to remain below both the permitted take limit of Hawaiian hoary bats for the permit term (38) and the Tier 3 take threshold of 30 bats.

7.2 Hawaiian Goose

7.2.1 Estimated Take

A total of 12 adult Hawaiian goose fatalities and one gosling fatality have been observed at the Project since operations began in July 2012. Four of the 12 observed fatalities were classified as incidental observations and the remaining eight were considered ODT. As the gosling (detected in FY 2018) was not capable of flight it was not considered ODT (see below). The observed Hawaiian goose fatalities by fiscal year are listed in Table 2.

Table 2. Observed Hawaiian Goose Fatalities at KWP II through FY 2021

Fiscal Year	Hawaiian Goose Observed Direct Take	Hawaiian Goose Incidental Fatality Observations	Total
2013	1	0	1
2014	0	0	0
2015	2	0	2
2016	1	0	1
2017	0	0	0
2018	1	3 [1]	4
2019	0	1	1
2020	3	0	3
2021	0	0	0
Total	**8**	**4**	**12[1]**
1. Excludes one gosling detected in FY 2018 attributable to other wind farm operations.			

The estimated direct take (ODT + UDT) based on the Hawaiian goose fatalities found between the start of operation (July 2012) and end of FY 2021 (June 30, 2021) is less than or equal to 22 geese (80 percent UCL; Appendix 1b). The gosling was added as a single additional juvenile fatality, adjusted to an adult based on estimated survival rates ([$1*0.8^3$]; gosling fatality translates to 0.512 adult equivalents). The gosling was then added to the estimate of 22 geese at the 80 percent UCL that resulted from the EoA analysis.

Indirect take is estimated to account for the potential loss of individuals that may occur as the result of the loss their parents. Both parents for the Hawaiian goose care for young well after post-fledging (Banko et al 2020). The point during the breeding season when an adult is taken determines to what extent offspring may be affected (SWCA 2011). Cumulative indirect take was 1.63 fledglings (0.83 adult equivalents, assuming a 0.8 annual survival rate and 3 years from fledging to adult; Appendix 2b).

The Project may cause a net loss in productivity in the event that take outpaces the number of individuals produced from mitigation efforts. The lag between production of geese through mitigation efforts and the take of geese at the Project drive the estimates of lost productivity. Accrued lost productivity at a given point in time is calculated as the cumulative take less the number of individuals generated from mitigation efforts to date, and then adjusted by a factor of 0.1 to account for the probability that those unmitigated birds would have produced young (SWCA 2011).

DOFAW provided KWP II with Hawaiian goose fledgling data for Project-funded release efforts at the Pi'iholo Ranch and Haleakalā Ranch pens in July 2020. KWP II believes that the current approach to account for mitigation credit undervalues the full extent of benefits the Project's mitigation efforts have provided to the species and is working with USFWS and DOFAW to develop consensus on a modified approach. Accrued lost productivity will be calculated once agreement on the allocation of mitigation credit has been achieved. KWP II hopes to incorporate this analysis in a subsequent draft of the FY 2021 annual report.

The UCL for cumulative Project take of the Hawaiian goose at the 80 percent credibility level is 24 geese (22 [estimated direct take from EoA] + 1 observed gosling fatality*0.512 adults/gosling + 0.83 [estimated adult indirect take], rounded up). That is, there is an approximately 80 percent probability that actual take at the Project at the end of FY 2021 is less than or equal to 24 adult geese.

7.2.2 Projected Take

KWP II projected Hawaiian goose take through the end of the permit term using the fatality monitoring data collected through FY 2021 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 3). The permitted take limit for the Hawaiian goose is 44. Future indirect take is unknown and will potentially vary based on the timing of ODT. Based on historical Project data, we assumed total indirect take for the Project over the permit term would be a maximum of two adult equivalents (approximately four juveniles based on an assumed Hawaiian goose survival rate from juvenile to adult of 0.512; SWCA 2011), or 4.5 percent of the permitted take limit in the HCP. Currently, the proportion of total take that is attributable to indirect take is 3.6 percent (0.83 adult geese equivalents estimated from indirect take / 23.34 geese estimated combining the direct and indirect take) making the assumption of three adult indirect take conservative. Assuming two adult Hawaiian geese equivalents are attributed to the Project as indirect take, the permitted direct take under the HCP would be 42 Hawaiian geese (permitted take of 44 geese – take of 2 geese estimated attributed to indirect take = 42 geese estimated direct take maximum).

Based on the analysis described above and presented in Appendix 3, there is approximately 38 percent probability that the 80 percent UCL of cumulative take will not be exceeded during the permit term (Appendix 3); EoA calculated a median estimate of 19 years of Project operation without a direct take estimate exceeding 42 geese. KWP II has taken actions to minimize the threats to the Hawaiian goose and continues to work with USFWS, DOFAW, and technical experts to further reduce risk (Section 10.0).

7.3 Non-listed Species

In addition to the Covered Species detected as fatalities, four bird species were documented as fatalities at WTGs at the Project site in FY 2021: gray francolin (*Francolinus pondicerianus*; one fatality), black francolin (*Francolinus francolinus*; two fatalities), cattle egret (*Bubulcus ibis*; one fatality) and spotted dove (*Strptopelia chinensis*; two fatalities). These species are non-native, introduced birds; only the cattle egret is protected under the Migratory Bird Treaty Act. For details of these fatalities for FY 2021, see Appendix 4.

8.0 Wildlife Education and Observation Program

The wildlife education and observation program (WEOP) helps to ensure the safety and well-being of native wildlife in work areas and along site access roadways. The training provides useful information to assist staff, contractors, and visitors to be able to conduct their business in a manner consistent with the requirements of the HCP, the Conditional Use Permit, land use agreements and applicable laws. Personnel are trained to identify Covered Species and other species of wildlife that may be found on-site and what protocol to follow, as determined in the HCP and through relevant agency guidance (e.g., USFWS and DOFAW 2020), when downed wildlife is found. The trainees are also made aware of driving conditions and receive instruction on how to drive and act around wildlife. Records of wildlife observations by WEOP-trained staff are also used by the HCP program to identify the patterns of wildlife use of the site.

WEOP trainings were provided in 2020 on September 21, 26, 29 and October 13. In 2021, WEOPs trainings were provided on January 27 and March 16 and 19 at the Project, training total of 22 people in FY 2021. WEOP trainings will continue to be conducted on an as-needed basis to provide on-site personnel with the information to respond appropriately in the event they observe a Covered Species or encounter downed wildlife while on-site.

9.0 Mitigation

The Project's mitigation requirements are described in Section 6.0 of the HCP (SWCA 2011, SWCA 2019).

9.1 Hawaiian Hoary Bats

9.1.1 Mitigation

Mitigation for Tier 1 and Tier 2 estimated bat take has been completely funded and is ongoing as habitat management at Kahikinui State Forest Reserve (KWP II 2018). Mitigation for Tier 3 estimated take (19 bats within Tier 3) has been contracted to the U.S. Geological Survey Hawaiian Hoary Bat Research Group (Appendix 5). Bat ecological research on Hawaiʻi Island began in FY 2018 and is intended to better inform future bat habitat restoration and conservation. KWP II contributed $205,500 to this contract in FY 2021, fulfilling its full contribution to the contract. The research project is expected to be completed in FY 2022. Because the total funding amount of $1.7M required to mitigate for identified portions of the Project's and Brookfield's Kaheawa I Wind Project (KWP I) mitigation obligations was exceeded, Brookfield has engaged with DOFAW and USFWS requesting authorization to fund USGS research costs above $1.7M from Brookfield's Kahuku Wind Project for mitigation credit of 2.63 bats. This engagement yielded differing agency conclusions. DOFAW agreed with Brookfield's interpretation that Brookfield's funding of costs beyond that required for the Project's and KWP II's mitigation obligations could represent a partial fulfillment of Kahuku's Tier 2 bat obligation; USFWS did not. Assuming the current take rate and search conditions remain unchanged through the remainder of the permit term, Tier 4 mitigation will not be necessary.

9.1.2 Acoustic Monitoring at the Project

The HCP commits KWP II to performing acoustic monitoring for bat activity throughout the 20-year permit period. Acoustic monitoring for bat activity has been conducted continuously beginning in 2012. In October 2013 (FY 2014) eight Song Meter SM2BAT+ ultrasonic recorders (SM2) were deployed, replacing the Anabat SD2 bat detectors (Titley Electronics, Brendale, QLD, Australia). In October 2019 (FY 2020) the Pali brush fires burned across most of the Project destroying six SM2 units (WTGs 1, 2, 3, 5, 13 and 14). For the remainder of the FY 2020 (October 2019 to June 2020) only two sites were monitored for acoustic bat activity. In order to continue with the objectives of the monitoring program and address gaps in the spatial coverage of SM2's introduced by the brush fire; the monitoring regime was redesigned in July 2020 with the deployment of five SM2's (Figure 1). Similar to other years, each SM2 is equipped with one SMX-U1 ultrasonic microphone (Wildlife Acoustics, Maynard, MA, USA) positioned horizontally, facing southwest (away from the prevailing NE trade winds), 6.5 meters above ground level. Because of differences in the equipment used, data collected in FY 2021 is only comparable to data collected between FY 2014 (October 2013) and FY 2020.

The objective of bat acoustic monitoring is to understand better the annual and seasonal variations in bat activity at the Project. Analysis of variance (ANOVA) was used to test for differences in interannual detection rates from FY 2015 through FY 2021. A linear model (LM) was used to test for a change in detection rates across all sampling years, FY 2015 to FY 2021. The sampling periods for FY 2014 and FY 2020 are not consistent with the sampling periods for all the other monitoring years. In FY 2014, acoustic monitoring was not conducted during the months of July through September, a period with consistently high activity.

In FY 2020, only the months of July through September, prior to the Pali brush fires, included all sampling locations for that year and represent 85 percent (n = 100) of all acoustic detections recorded. For visual comparison of monthly detections rates between years all available data are provided in the figures. For direct comparison of annual detection rates between FY 2021 and FY 2020 only the sampling months of July through September are included. For the statistical analyses (ANOVA and LM) FY 2014 and FY 2020 have been excluded. All data were normalized using an

Ordered Quantile normalization transformation (ORQ). The distribution of residuals from the LM were examined to check for violations of model assumptions. All tests were 2-tailed, employed an alpha value of 0.05, and were conducted in the R version 4.05 (R Core Team 2017). The characterization of Hawaiian hoary bat seasons corresponds approximately to Starcevich et al. (2019).

In FY 2021, Hawaiian hoary bats were detected on 232 nights out of 1,671 detector-nights sampled (13.9 percent; Table 3). Detection rates were highest between the months of September and October during the post-lactation reproductive period, with the peak in detection rates (0.438 detections per detector night) occurring during the month of October (Figure 2). A second smaller peak in detection rates (0.148 detections per detector night) was observed at the end of the post-lactation reproductive period during the month of December, followed by a decline in January. Detection rates steadily increased again beginning in February of the pre-pregnancy reproductive period with a third peak in detection rates (0.169 detections per detector night) occurring in May of the pregnancy reproductive period, followed by a decline in June[2] (Figure 2). The temporal pattern and scale of the detection rates in FY 2021 was similar to the general temporal pattern of detection rates observed in previous years (Figure 3).

Table 3. Number of Nights Sampled, Number of Nights with Detections and Proportion of Nights with Bat Detections Between FY 2014 and FY 2021

Dates	No. of Nights Sampled	No. of Nights with Detections	Proportion of Nights with Detection(s)
FY 2014 (October 2013 – June 2014)[1]	2,183	85	0.039
FY 2015 (July 2014 – June 2015)[1]	2,864	204	0.071
FY 2016 (July 2015 – June 2016)[1]	2,038	110	0.054
FY 2017 (July 2016 – June 2017)[1]	2,217	166	0.075
FY 2018 (July 2017 – June 2018)[1]	2,103	386	0.183
FY 2019 (July 2018 – June 2019)[1]	2,549	211	0.083
FY 2020 (July 2019 – June 2020)[2]	1,146	117	0.102
FY 2021 (July 2020 – June 2021)[3]	1,671	232	0.139

1. Number of detectors = 8.
2. Detectors reduced from 8 to 2 in October 2019 due to Pali brush fires.
3. Number of detectors = 5.

[2] Corresponding reproductive periods defined by Gorresen et al. 2003.

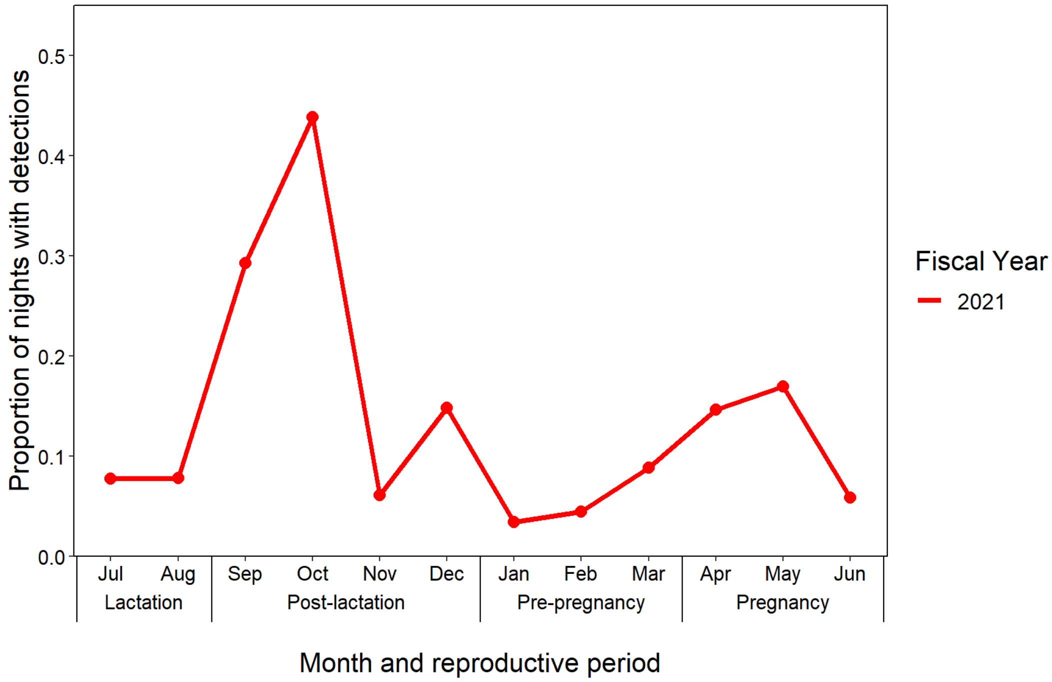

Figure 2. Monthly Detection Rates at KWP II in FY 2021 with Corresponding Reproductive Periods

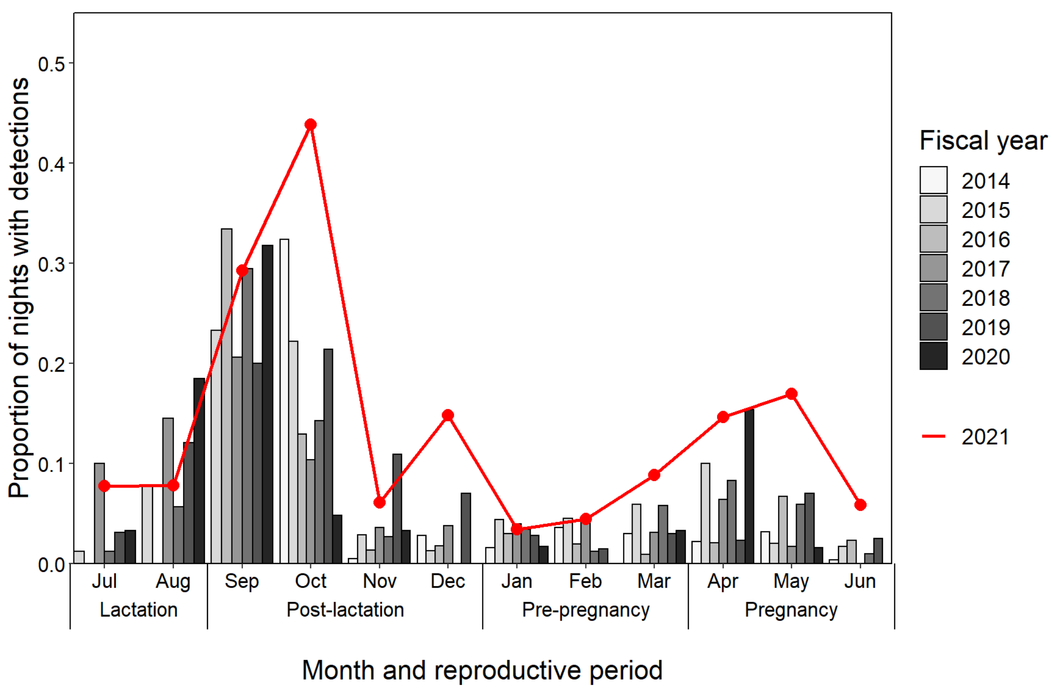

Figure 3. Monthly Bat Detection Rates at KWP II for FY 2014 to FY 2021 with Corresponding Reproductive Periods

The annual detection rate in FY 2021, for the period July through September (adjusted to account for the Pali brush fires of FY 2020), was marginally lower than the annual detection rate for the same sampling period in FY 2020. Between July and September of FY 2021 Hawaiian hoary bats were detected on 65 nights out of 449 (14.5 percent) detector-nights sampled compared to 16.0 percent in FY 2020 (Tetra Tech 2019). Annual detection rates varied between all monitoring years (Table 3); however, only differences between FY 2016 and FY 2021 were significant (ANOVA: $F_{5,66}$ = 2.56, P < 0.037; Tukey's HSD: P < 0.016). Across all monitoring years (FY 2015 to FY 2021) there is a slightly increasing trend in the annual detection rate, although not significant (LM: R^2 = 9.2 percent; $F_{1,70}$ = 0.7.12, P < 0.009, Figure 4).

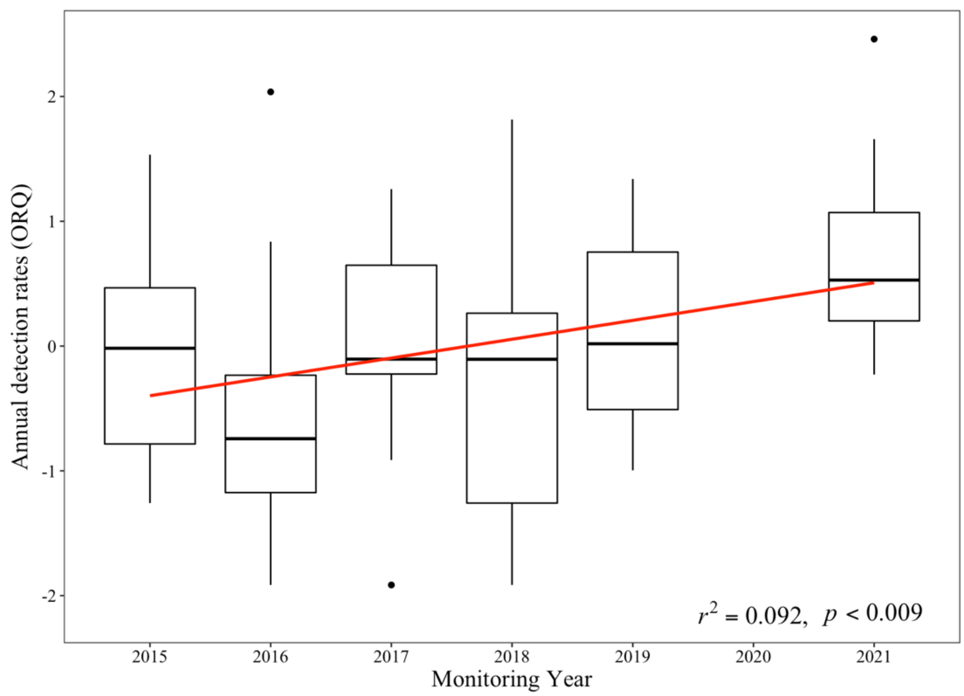

Figure 4. Box-plot with Linear Regression Showing the Increasing Trend in the Annual Detection Rates at KWP II between FY 2015 and FY 2021

9.2 Hawaiian Goose

The Project provided funds to DOFAW in FY 2017 to begin predator control at Maui-based release pens locations with high Hawaiian goose activity or nesting on Maui. The funding provided for the implementation of predator control, fence maintenance, vegetation management and monitoring of a Hawaiian goose release pen at Piʻiholo Ranch in FY 2017, FY 2018, and part of FY 2019. The Project also provided funding for a technician at the Haleakalā Ranch pen from October 2018 through February 2019. In May 2020, the Project provided $112,682 to DOFAW for Piʻiholo Ranch funding. DOFAW was unable to process these funds due to internal limitations. Additionally, the future status of the Piʻiholo Ranch release pen is currently unknown due to owner transfer of the property anticipated in calendar year 2021. Thus, no funding credit was available in FY 2021. DOFAW provided these details to KWP II on June 16, 2021. DOFAW is working with KWP II to plan for adaptively managing the Hawaiian goose mitigation program.

Several potential benefits can be accrued based on the effects of these actions including production of fledglings and increases in adult survival rates. In July 2020, DOFAW provided a letter describing proposed mitigation credit for fledgling production attributable to the Project; however, KWP II believes that the proposed accounting approach for mitigation credit undervalues the benefits the Project's mitigation efforts have produced and is working with USFWS and DOFAW to develop consensus. Once consensus is reached, KWP II will assess accrued lost productivity and incorporate that information into an overall assessment of the Hawaiian goose mitigation status for the Project. As previously mentioned, KWP II hopes to incorporate this analysis in a subsequent draft of the FY 2021 annual report.

9.3 Seabirds

KWP II is committed to seabird protection and recovery on Maui and within Maui Nui. Although results at the Makamakaʻole Seabird Mitigation Site (Makamaka'ole) have suggested the potential for the site to support reproduction of Newell's shearwaters, the Project is not on-track for fulfilling the Project's Hawaiian petrel mitigation needs. KWP II is actively working with USFWS and DOFAW to adaptively managed Hawaiian petrel mitigation to achieve the goals laid out in the HCP by funding Hawaiian petrel mitigation on Lānaʻi.

9.3.1 Hawaiian Petrel and Newell's Shearwater – Makamakaʻole

Mitigation efforts at Makamaka'ole have been ongoing since construction of the two breeding site enclosures (predator fence exclosures) was completed on September 5, 2013. Mitigation efforts at Makamaka'ole involve predator monitoring and trapping, artificial burrow checks and monitoring using game cameras, seabird social attraction using decoys and sound systems, and ongoing maintenance of both enclosures. In July 2021, KWP II provided to agencies an accounting of differences between the initial agency assessment and what Tetra Tech believes are appropriate measures of burrow activity to be used in the calculation of increased Newell's shearwater adult survival based on available evidence. Hawaiian petrel occupancy of the site has not been confirmed since 2017; however, monitoring results indicate annual increases in burrow attendance and breeding attempts by Newell's shearwaters since the first evidence of site occupation in 2016. Results from the 2020 breeding season, which concluded in FY 2021, added to the multi-year trove of (photographic) evidence that burrow attendance by species other than Newell's shearwaters at this site is rare (Appendix 6).

Seabird breeding activity is assessed using game cameras, burrow scoping, checking for removal or displacement of toothpicks placed at burrow entrances, as well as checks for evidence of visitation including guano, feathers, and scent presence around burrows. During the 2020 breeding season, 26 burrows in Enclosure A showed evidence of activity over the monitoring period with 18 burrows showing consistent occupancy (exceeding two months) with Newell's shearwater activity.

In Enclosure B, 17 burrows had primarily Newell’s shearwater and limited Bulwer’s petrel (*Bulweria bulwerii*) activity with four burrows demonstrating consistent Newell’s shearwater breeding activity. A total of seven (nonviable) eggs were recovered from six nest boxes, and there was no evidence of chicks (Appendix 6).

In FY 2021, continued mitigation efforts at Makamakaʻole were contracted to Maui Nui Seabird Recovery Project (MNSRP) through the 2021 breeding season. USFWS and DOFAW reviewed an updated protocol prior to the 2021 breeding season, which included adjustments incorporated based on seabird experts who reviewed the status of the mitigation site after the 2020 breeding season. This protocol is currently being implemented at the site. Updates from previous years include replacement of nesting substrate in consultation with seabird experts, Maui Natural Area Reserve System and Maui Forest Reserve, data collection consistent with Raine et al (2020), an adjusted social attraction regime, and barn owl control as needed (Appendix 7). Project staff regularly are visiting the enclosures with MNSRP to ensure consistent oversight.

MNSRP staff continue to update and maintain perimeter fencing. Approximately bi-weekly visits to Enclosures A and B are ongoing, checking burrows and game cameras for activity, completing vegetation management including clearing the outside perimeter and inside pathways and conducting predator control. Site visits through June 2021 suggest Newell’s shearwater activity is consistent with or greater than observed in the 2020 breeding season, and at least one pair of Newell’s shearwaters is incubating an egg.

9.3.2 Lānaʻi Hawaiian Petrel Protection Project

Hawaiian petrels have not been observed occupying the Makamaka’ole mitigation site since 2017. Therefore, KWP II has worked with USFWS an DOFAW to adaptively manage mitigation efforts for this species to ensure that its mitigation obligations are met.

For the 2018 Hawaiian petrel breeding season, the Kaheawa Wind Power I project worked with USFWS and DOFAW to adaptively manage Hawaiian petrel mitigation efforts in an interim fashion. As a result of this adaptive management, Kaheawa Wind Power I, LLC provided funding to Pūlama Lānaʻi to supplement Hawaiian petrel breeding colony protection efforts on Lānaʻi. The success of this program and on-going difficulties in attracting petrels to Makamaka’ole suggested that both KWP projects could benefit the Hawaiian petrel and make progress on mitigation obligations by continuing support for the Lānaʻi petrel breeding program.

In FY 2021, the two KWP projects with concurrence from USFWS and DOFAW, adaptively managed their seabird mitigation programs by providing funding to Pūlama Lānaʻi in the amount of $104,657 for the 2021 breeding season. This effort includes predator control as well as burrow monitoring and evaluation in the densely occupied Hawaiian petrel nesting area (Greater Hi’i). Results from the 2021 breeding season will be reported in the FY 2022 annual report.

9.3.3 Newell's Shearwater Survey – East Maui

Surveys of East Maui for potential additional mitigation sites was funded and completed in September 2015 (KWP II 2016). These surveys evaluated potential colony locations, estimated the numbers of birds present, assessed predator activity, and provided for management feasibility assessment.

10.0 Adaptive Management

In accordance with the HCP, LWSC was implemented from the start of Project operations at wind speeds of up to 5 meters per second at all WTGs for the months of April through November. LWSC is expected to reduce bat take as explained in the HCP. This curtailment period was extended to begin mid-February and continue through December 15, 2014 in response to bat fatalities documented at the Project on March 13, 2013 and February 26, 2014, and at the Kaheawa Wind I Project on December 14, 2013. On June 6, 2014 the Project offered an adaptive management proposal to the USFWS and DOFAW to increase take minimization for bats and on July 29, 2014 the LWSC was raised to 5.5 m/s between February 15 and December 15 from sunset to sunrise. The Project continues site-wide bat activity assessment after the required initial three-year period identified in the original HCP; the approved HCP Amendment commits to monitoring during Project operations (Section 9.2).

The Project has previously implemented a variety of actions to minimize risk to the Hawaiian goose which continued in FY 2021. Safety measures to avoid interactions between Hawaiian goose and canine search teams have been identified and are implemented as needed. Scavenger trapping efforts implemented at the Project to improve persistence of carcasses during fatality monitoring have likely reduced the risk of predation of the Hawaiian goose. KWP II has identified additional practicable actions to minimize the threats to the Hawaiian goose based on current projections of take. KWP II presented Hawaiian goose take minimization opportunities currently being explored to agencies during the FY 2021 semi-annual meeting in May 2021 and is planning for coordination with technical experts on vegetation management opportunities. KWP II will continue to work with USFWS, DOFAW, and technical experts in FY 2022 to further reduce risk to the species.

11.0 Agency Meetings, Consultations, and Visits

KWP II communicated actively with USFWS and DOFAW throughout FY 2021 through in-person meetings, conference calls, submittal of quarterly reports, and e-mail communications related to the Project's HCP. The purpose of these communications included required semi-annual HCP implementation meetings and focused discussions regarding mitigation funding, adjustments to all current mitigation programs, and mitigation credits for the Hawaiian goose and seabird mitigation programs. All meetings in FY 2021 were via teleconference. A summary of agency coordination follows in Table 4.

Table 4. Summary of Agency Coordination and Communication in FY 2021

Date	Communication	Participants
September 29, 2020	Submittal of the final KWP II HCP FY 2020 annual report	Submitted to DOFAW, USFWS by Tetra Tech
October 20, 2020	Annual HCP Implementation review meeting	KWP II, Tetra Tech, USFWS, DOFAW
November 2, 2020	Submittal of FY2021 Q1 report	Submitted to DOFAW, USFWS by Tetra Tech
December 2, 2020	Makamakaʻole informational meeting with seabird experts	KWP II, Tetra Tech, DOFAW, USFWS, Dr. Andre Raine, Dr. Lindsay Young, Jay Penniman, Dr. Eric VanderWerf,
January 6, 2021	Follow up to the Makamakaʻole informational meeting for contextualizing data for seabird mitigation credit.	KWP II, Tetra Tech, USFWS, DOFAW
January 19, 2021	USGS research as bat mitigation update	KWP II, Tetra Tech, USGS, USFWS, DOFAW
January 28, 2021	Annual HCP Implementation review by ESRC	KWP II, Tetra Tech, ESRC
January 29, 2021	Submittal of FY 2021 Q2 report	Submitted to DOFAW, USFWS by Tetra Tech
February 11, 2021	Makamakaʻole data collection planning for 2021 breeding season	KWP II, Tetra Tech, USFWS, DOFAW
February 19, 2021	Lānaʻi Hawaiian petrel mitigation planning for 2021 breeding season	KWP II, Tetra Tech, USFWS, DOFAW
February 25, 2021	Submittal of Makamaka'ole report and supplemental data for agency review	Submitted to DOFAW, USFWS by Tetra Tech
March 15, 2021	Submittal of USGS Research Summary adaptive management plan	Submitted to DOFAW, USFWS by Tetra Tech
March 23, 2021	Submittal of adaptive management proposal for Hawaiian petrel mitigation work on Lānaʻi	Submitted to DOFAW, USFWS by Tetra Tech.
April 27, 2021	Submittal of FY 2021 Q3 report	Submitted to DOFAW, USFWS by Tetra Tech
May 5, 2021	Semi-annual HCP Implementation review meeting	KWP II, Tetra Tech, USFWS, DOFAW
June 16, 2021	Hawaiian goose release pen update	KWP II, Tetra Tech, DOFAW
June 28, 2021	Submittal of Brookfield's Hawaiian goose mitigation counter proposal memo requesting a more comprehensive approach to Hawaiian goose mitigation credit.	Submitted to DOFAW, USFWS by Tetra Tech
June 30, 2021	Submittal of Makamakaʻole game camera footage and summary data.	Submitted to DOFAW, USFWS by Tetra Tech

12.0 Expenditures

Total HCP-related expenditures for the Project in FY 2021 were $650,555 (Table 5).

Table 5. HCP-related Expenditures at the Project in FY 2021

Category	Amount
Permit Compliance	$41,000
Fatality Monitoring	$47,000
Acoustic Monitoring for Bats	$18,500
Vegetation Management and Scavenger Trapping	$11,600
Equipment and Supplies	$1,700
Staff Labor[1]	-
Makamakaʻole Mitigation Project[2]	$107,916
Lānaʻi Hawaiian Petrel Mitigation Project[2]	$104,657
Pi'iholo Release Pen[3]	$112,682
Tier 3 Bat Research Project	$205,500
Total Cost for FY 2021	**$650,555**

1. Staff labor costs are included in the overall costs for each category.
2. Makamaka'ole and the Lānaʻi petrel mitigation project are co-funded by KWP I and KWP II.
3. Funding provided in May 2020; however, in June 2021, DOFAW informed KWP II that processing and hiring delays resulted in no use of funds in FY 2021.

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Appendix 1. Dalthorp et al. (2017) Fatality Estimation for Hawaiian Hoary Bat and Hawaiian Goose at the Project through FY 2021

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Appendix 1a. Dalthorp et al. (2017) Fatality Estimation for Hawaiian hoary bat at the Project through FY 2021

Modelling Parameter		Modelling Period								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9 (current)**
FY		2013	2014	2015	2016	2017	2018	2019	2020	2021
LWSC		5.0 m/s	5.0 m/s	5.5 m/s	5.5 m/s	5.5 m/s	5.5 m/s	5.5 m/s	5.5 m/s	5.5 m/s
Date Range	Begin	7/1/2012	7/1/2013	7/1/2014	7/1/2015	7/1/2016	7/1/2017	7/1/2018	7/1/2019	7/1/2020
	End	6/30/2013	6/30/2014	6/30/2015	6/30/2016	6/30/2017	6/30/2018	6/30/2019	6/30/2020	6/30/2021
Period length		364	364	364	364	364	364	364	362	364
% of Year		1	1	1	1	1	1	1	1	1
Search Interval (days)		7	7	7	7	7	7	7	7.1	7
Number of Searches in Modelling period		52	52	52	52	52	52	52	51	52
Observed fatality (X)		1	2	0	0	0	0	0	0	0
K		0.7	0.7	0.7	1[1]	1[1]	1[1]	1[1]	1[1]	1[1]
DWP		1	1	1	0.56[2]	0.56[2]	0.56[2]	0.56[2]	0.56[2]	0.56[2]
G	**G**	0.443	0.359	0.336	0.362	0.442	0.375	0.368	0.476	0.409
	min	0.241	0.235	0.187	0.27	0.374	0.287	0.289	0.437	0.333
	max	0.656	0.493	0.503	0.46	0.511	0.467	0.45	0.516	0.486
B	**Ba**	9.080	18.50	10.95	35.09	87.96	41.22	50.35	289.1	63.53
	Bb	11.41	33.02	21.68	61.84	111.1	68.77	86.64	318.1	92.00
M*[3]		5	12	12	12	11	12	12	11	11

1. Searches performed by canine teams.
2. Search area reduced to graded portions of and roads within 70 m radius from turbine.
3. Cumulative value representing estimate of total direct take from the start of operations through the identified monitoring period at the 80 percent UCL.

Appendix 1b. Dalthorp et al. (2017) Fatality Estimation for Hawaiian goose at the Project through FY 2021

Modelling parameter		Modelling Period								
		1	2	3	4	5	6	7	8	9 (current)
FY		2013	2014	2015	2016	2017	2018	2019	2020	2021
Date Range	Begin	7/1/2012	7/1/2013	7/1/2014	7/1/2015	7/1/2016	7/1/2017	7/1/2018	7/1/2019	7/1/2020
	End	6/30/2013	6/30/2014	6/30/2015	6/30/2016	6/30/2017	6/30/2018	6/30/2019	6/30/2020	6/30/2021
Period length (days)		364	364	364	365	364	364	364	362	364
% of Year		1	1	1	1	1	1	1	1	1
Search Interval (days)		7	7	7	7	7	7	7	7.1	7
Number of Searches in Modelling period		52	52	52	52	52	52	52	51	52
Observed fatality (X)		1	0	2	1	0	1	0	3	0
K		1	1	1	1	1	1	1	1	1
DWP		0.7	0.7	0.7	0.372[1]	0.372[1]	0.372[1]	0.372[1]	0.372[1]	0.372[1]
g	g	0.654	0.653	0.681	0.358	0.361	0.360	0.361	0.347	0.361
	min	0.503	0.474	0.583	0.288	0.294	0.285	0.295	0.319	0.338
	max	0.791	0.812	0.771	0.431	0.43	0.437	0.429	0.375	0.384
B	Ba	26.32	18.94	62.8	61.66	68.06	54.62	70.09	380.2	633.1
	Bb	13.91	10.05	29.46	110.5	120.7	97.27	124.2	717.0	1120
M*[2]		3	3	6	9	10	13	13	21	22

1. Search area reduced to graded portions of and roads within 70 m radius from turbine.

2. Cumulative value representing estimate of total direct take from the start of operations through the identified monitoring period at the 80 percent UCL.

Appendix 2. Indirect Take for the Hawaiian Hoary Bat and Hawaiian Goose at the Project in FY 2021

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Appendix 2a. Indirect Take for the Hawaiian Hoary Bat at the Project in FY 2021

Parameter	Description	Fiscal Year									
		2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
A	Observed Breeding Female Take	0	0	0	0	0	0	0	0	0	**0**
B	Indirect Take from Observed Breeding Female Take (A x 1.8)	0	0	0	0	0	0	0	0	0	**0**
C	Observed Breeding Unknown Sex Take	0	0	0	0	0	0	0	0	0	**0**
D	Indirect Take from Observed Breeding Unknown Sex Take (C * 0.5 * 1.8)	0	0	0	0	0	0	0	0	0	**0**
E	All Observed Take (Search and Incidental)	1	2	0	0	0	0	1	0	0	**4**
F	Estimated Take Multiplier (11/4=2.75)	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
G	Estimated Direct Take (E x F)	2.75	5.50	0.00	0.00	0.00	0.00	2.75	0.00	0.00	**11**
H	Unobserved Direct Take (G - E)	1.75	3.50	0.00	0.00	0.00	0.00	1.75	0.00	0.00	**7**
I	Indirect Take Calculated from Unobserved Take (H * 0.5 * 0.25 * 1.8)	0.39	0.79	0.00	0.00	0.00	0.00	0.39	0.00	0.00	**1.58**
Total Indirect Take (B + D + I; juveniles)											**1.58**
Total Indirect Take (B + D + I)*0.3 (adults)											**0.47**

Appendix 2b. Indirect Take for the Hawaiian Goose at the Project in FY 2021

Parameter	Description[1]	Fiscal Year									
		2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
A	Observed Take	1	0	2	1	0	4	1	3	0	12
B	Estimated Take Multiplier (22/12=1.83)	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	--
C	Estimated Direct Take (A x B)	1.83	0.00	3.67	1.83	0.00	7.33	1.83	5.50	0.00	22.0
D	Observed Indirect Take Multiplier (Season Defined)	0.04	0.00	0.09	0.09	0.00	0.09	0.09	0.09	0.00	--
E	Observed Indirect Take (A x D)	0.04	0.00	0.18	0.09	0.00	0.36	0.09	0.27	0.00	1.03
F	Unobserved Direct Take (C - A)	0.83	0.00	1.67	0.83	0.00	3.33	0.83	2.50	0.00	10.00
G	Unobserved Indirect Take (F x 0.06)	0.05	0.00	0.10	0.05	0.00	0.29	0.05	0.15	0.00	0.60
Total Direct Take from Collisions with WTGs (C)											**22**
Total Indirect Take (fledglings; E + G)											**1.63**
Total Indirect Take (adults; [E + G] x 0.512)											**0.83**

1. KWP II is in discussion with DOFAW and USFWS regarding mitigation credit; this table will be amended to include mitigation and lost productivity calculations once consensus is reached.

Appendix 3. Hawaiian Hoary Bat and Hawaiian Goose and 20-year Projected Take at the Project in FY 2021

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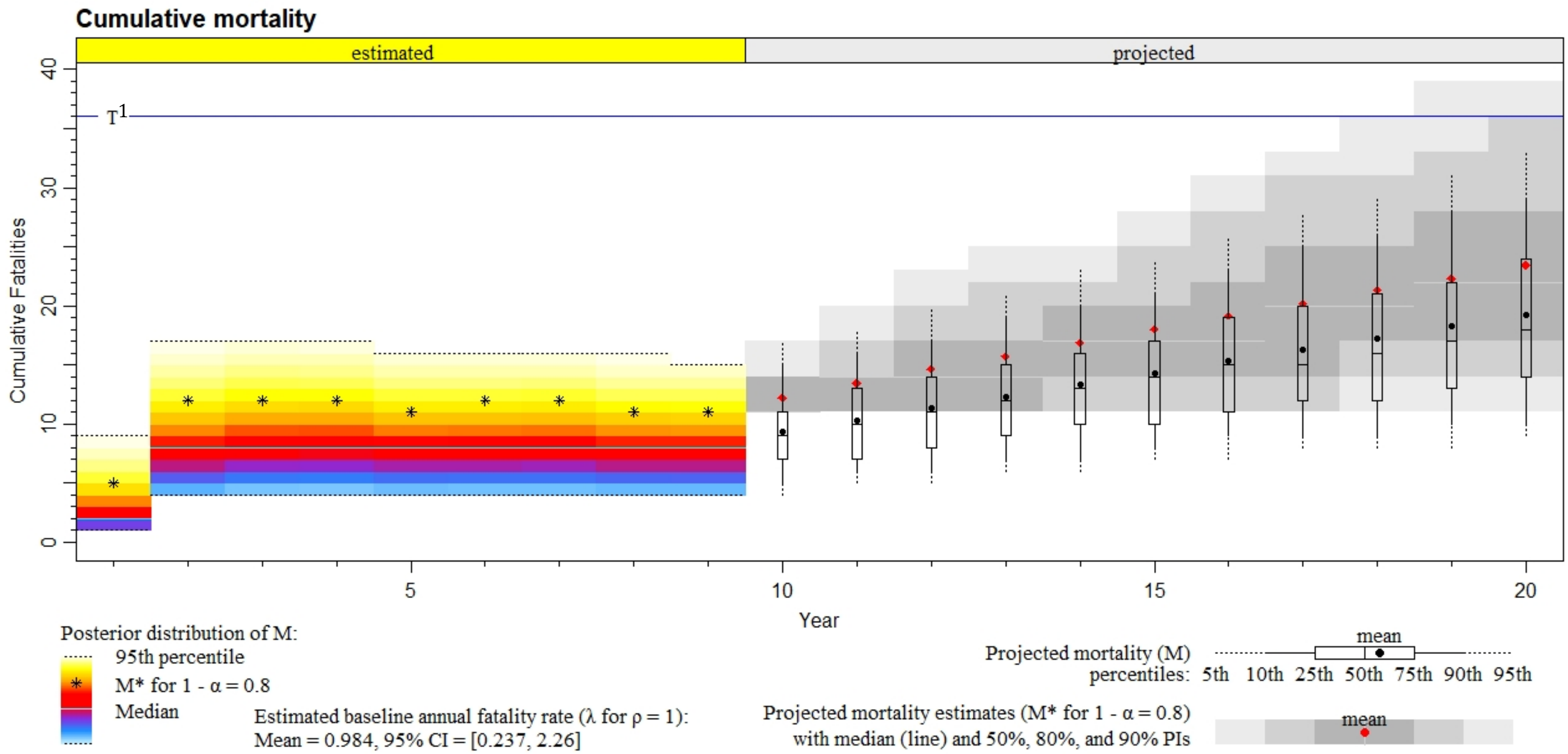
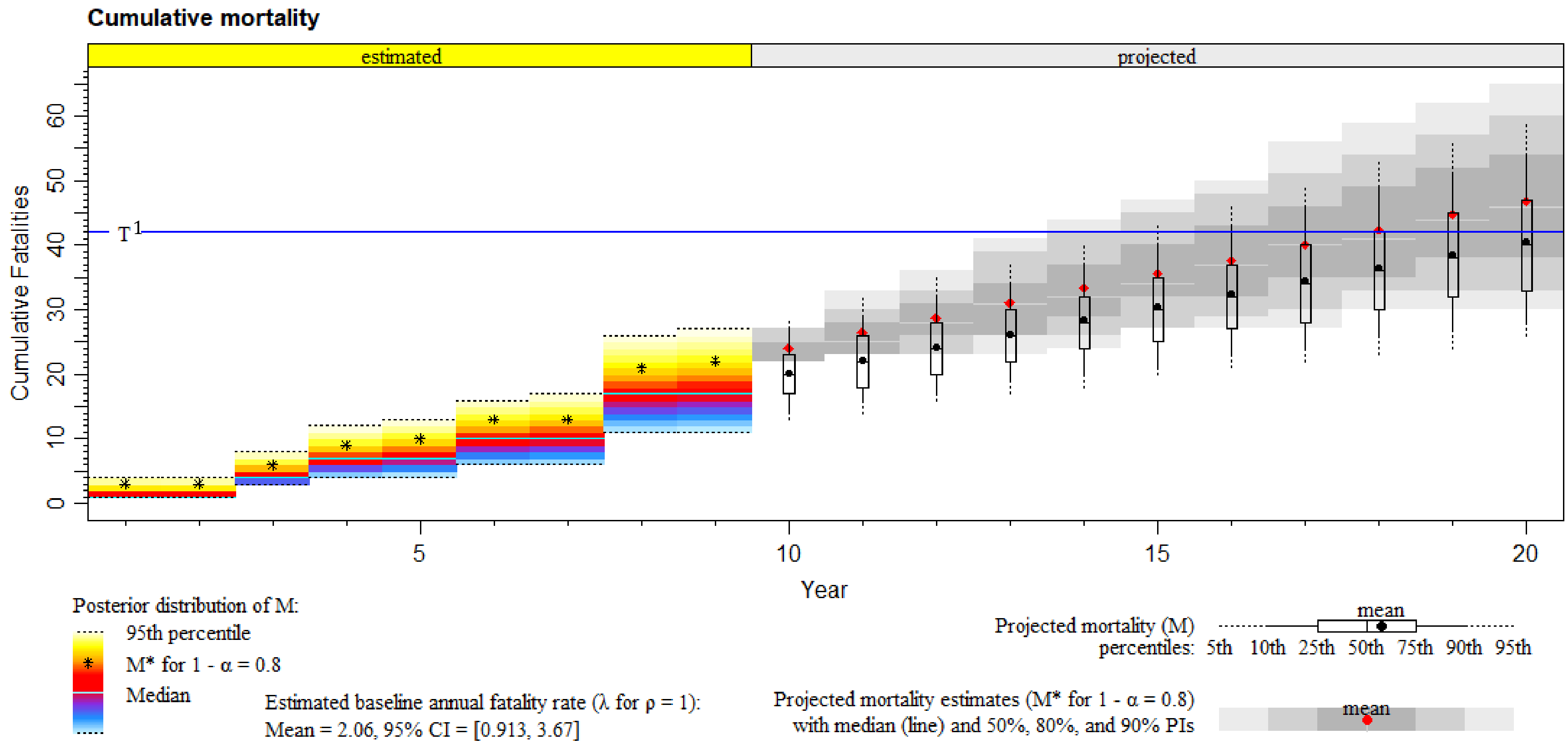
Appendix 3a. Projected Cumulative Mortality for the Hawaiian Hoary Bat at the Project



1. Permitted take for the Hawaiian hoary bat at the Project is 38 under the HCP. Take, however, as calculated from EoA only includes direct take. To account for indirect take in this figure, an approximate take threshold (T) of 36 is shown, representing authorized bat take (38) minus 2 adult equivalents of indirect take (5.3percent of the requested authorized limit). Currently, the proportion of total take that is attributable to indirect take is 4.1 percent.

Appendix 3b. Projected Cumulative Mortality for the Hawaiian Goose at the Project



1. Permitted take for the Hawaiian goose at the Project 44; however, take as calculated from EoA only includes direct take. To account for indirect take in this figure, an approximate take threshold (T) of 42 is shown, representing requested authorized Hawaiian goose take (44) minus 2 adult equivalents of indirect take (4.5 percent of the requested authorized limit). Currently, the proportion of total take that is attributable to indirect take is 3.6 percent.

Appendix 4. Documented Fatalities at the Project during FY 2021

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Species	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)
Francolinus pondicerianus (gray francolin)	9/9/2020	12	1	34
Francolinus francolinus (black francolin)	9/30/2020	7	1	94
Bubulcus ibis (cattle egret)[1]	11/11/2020	13	20	297
Spilopelia chinensis (spotted dove)	3/17/2021	11	1	70
Spilopelia chinensis (spotted dove)	6/16/2021	2	1	24
Francolinus francolinus (black francolin)	6/30/2021	8	1	302
1. MBTA protected species.				

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Appendix 5. USGS Hawai‘i Island Hawaiian Hoary Bat Ecological Research Project Annual Report

Hawaiian Hoary Bat Conservation Biology: Movements, Roosting Behavior, and Diet

Agreement # 17WSTAAZB005541

Annual Report

Summary of Research Activities through July 2021

29 July 2021

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The Hawaiian Hoary Bat Conservation Biology project is designed to advance understanding of key aspects of endangered Hawaiian hoary bat (*Lasiurus semotus*) ecology and population biology. Key components of the study include:

- Roost fidelity and characterization
- Maternal roost ecology and mother-pup behavior
- Habitat use
- Diet analysis using molecular techniques
- Insect prey selection and availability
- Insect prey-host plant associations
- Movements throughout the annual cycle
- Banking of tissue and fur collection for genetic and pesticide studies (outside scope of this study)

Study preparation and design

This USGS-led study is being conducted in collaboration with several researchers with the University of Hawai'i at Hilo – Hawai'i Cooperative Studies Unit.

Land and special use access permits were granted by: Hawai'i DLNR Division of Forestry and Wildlife - Forest Reserve System, Natural Area Reserve System, and Land Division; USDA Forest Service – Hawai'i Experimental Tropical Forest; The Nature Conservancy; USFWS – Hakalau Forest National Wildlife Refuge; Department of Hawaiian Home Lands. Additionally, numerous private landowners have provided access to properties. Sampling permits were granted for bat handling and sampling and for insect collections: USFWS Recovery Permit (TE003483-33); Hawai'i Protected Wildlife Permit (WL19-52); Hawai'i Native Invertebrate Research Permit (I2444); University of Hawai'i System IACUC (04-039-17). The USDA Forest Service - Institute for Pacific Islands Forestry and the University of Hawai'i College of Tropical Agriculture and Human Services granted permission to station automated telemetry receiver stations on their properties.

Field data collection commenced in May 2018 and will be completed in August 2021. During the first 2.5 years of field work, the sampling area spanned much of the east side of Hawai'i Island (Figure 1). Eight fixed sampling sites were selected for regularly scheduled bat mist netting and insect collections; these sites were sampled three times per year (approximately 4-month interval between visits) for two years (Jan 2019 – Jan 2021). Four fixed sites were located at high elevation (above 1000 m asl) and four at low elevation (below 600 m asl). The fixed sample sites included native and exotic forests, orchards, pastures, and mixed habitats. Sampling cycles were divided by breeding cycle phase: non-reproductive (December-March), pregnancy/pupping (April-July), post-lactation/fledging (August-November). Additional bat mist netting efforts during this time were conducted at sites that spanned a range of habitat types in east Hawai'i. During the final 7-months of field work (February-August 2021) mist netting efforts were focused in (1) native-dominant forest habitats, (2) leeward dryland forest (a habitat type not previously sampled), and (3) sites where reproductive females had been captured in previous years.

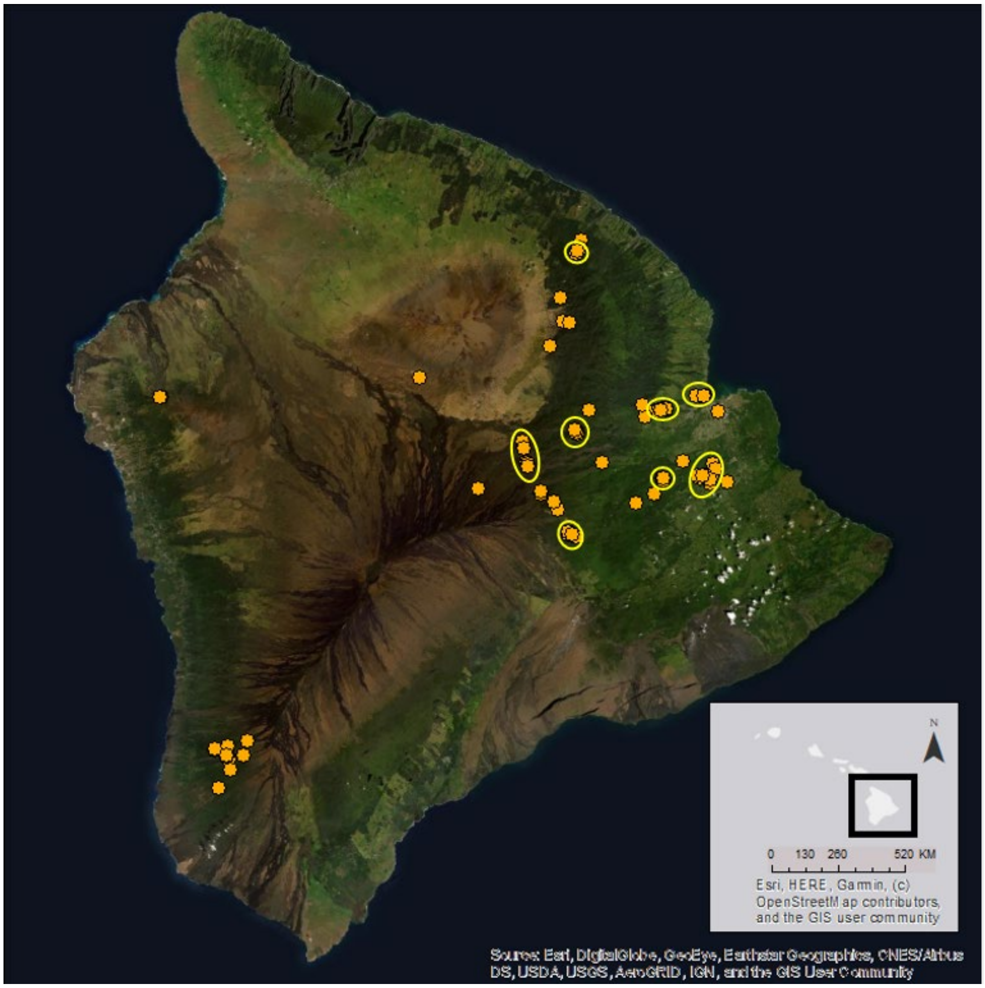

Figure 1. Mist net sites on the island of Hawaiʻi. Fixed sampling sites are circled in yellow.

Effect of Covid-19 pandemic on study

Bat capture efforts were paused mid-March through early June 2020 due to the Covid-19 pandemic. During this time a number of field and lab tasks, that could be conducted without the handling of bats and while maintaining social distancing, continued relatively uninterrupted and data processing continued. After careful evaluation of conditions on the island of Hawaiʻi, implementation of enhanced sanitation protocols, acquisition of personal protective equipment, and personnel training in the proper use of N95 respirators, bat captures resumed in early June 2020.

Capture effort

Bat mist netting was conducted during 221 nights from 14 May 2018 to 23 June 2021 (2018: 37, 2019: 87, 2020: 60, 2021: 37); bats were captured on 57 of these nights (Figure 2). One hundred thirty-five individuals were captured and from all individuals tissue and hair samples were collected and morphometric measurements and reproductive status recorded. All bats were marked with unique color-coded bands. Radio-telemetry tags were affixed to 122 individuals. Additionally, nine individuals were captured twice, one individual was caught three times, and seven of these recaptures were radio-tagged twice.

Figure 2. Mist nest being set up to capture Hawaiian hoary bats (top) and captured bat (bottom).

Roost ecology

Roost ecology studies were a primary focus during the three years of field data collection. Once individuals were captured and radio-tagged, efforts to track the individuals to a day roost tree(s) commenced within one day. Dense forest vegetation and a limited road network creates extremely difficult conditions for tracking individuals to their day roost resulting in significant effort devoted to this work. Radio telemetry (Figure 3) was used to track a total of 32 bats to a day roost tree occupied for at least one day; an additional 51 bats were tracked to at least one day roost located within a forest stand (Figure 4). Ten individuals were tracked to more than one day roost tree. Three maternity roost trees were confirmed in 2019, five in 2020, and three in 2021; from each of these roosts the number of pups was evaluated by repeat observations at each maternity roost (Figure 5). Active maternity roosts have been monitored on a nightly basis using acoustic and thermal video recordings to obtain information on roost fidelity, the time of roost emergence/return, the within-night frequency and duration of foraging flights, time to pup fledging, and presence of potential predators (Figure 5). All historical maternity roosts are visited weekly during the maternity season to monitor for activity. Regular monitoring of select non-maternity roosts is also being conducted to check for returning individuals to document fidelity and identify opportunities for video monitoring (Figure 6). Where possible, roost fidelity of bats with active radio tags was monitored using an automated receiver station near the roost (Figure 3). Data from these systems have been collected and downloaded at 37 tree or stand-level roosts since May 2019, when the system was first used. Roost monitoring and data collection at active roosts will continue through September 2021.

Roost trees are identified to species and characteristics are measured (e.g., height, dbh, percent canopy cover, etc.). Roost tree metrics have been collected at 50 trees. Stand-level characteristics (e.g., stand height, dominant tree, understory, etc.) for an additional 64 locations (114 total) were derived from a combination of satellite and airborne imagery and ground measurements. Trees used by roosting bats were comprised of non-native plantation species, invasive species, and native *Metrosideros polymorpha* and *Diospyros sandwicensis*. Preliminary tree and stand metric results collected through 2019 and associated metadata are publicly available through the USGS ScienceBase Catalog, https://doi.org/10.5066/P9R95UYT (Montoya-Aiona et al. 2019). A metadata viewer is available for download: https://github.com/usgs/fort-pymdwizard/releases.

Figure 3. Radio telemetry effort to located day roost tree (left). Automated receiver station used to measure roost fidelity (middle). Thermal imager used for searches for roosting bats (right).

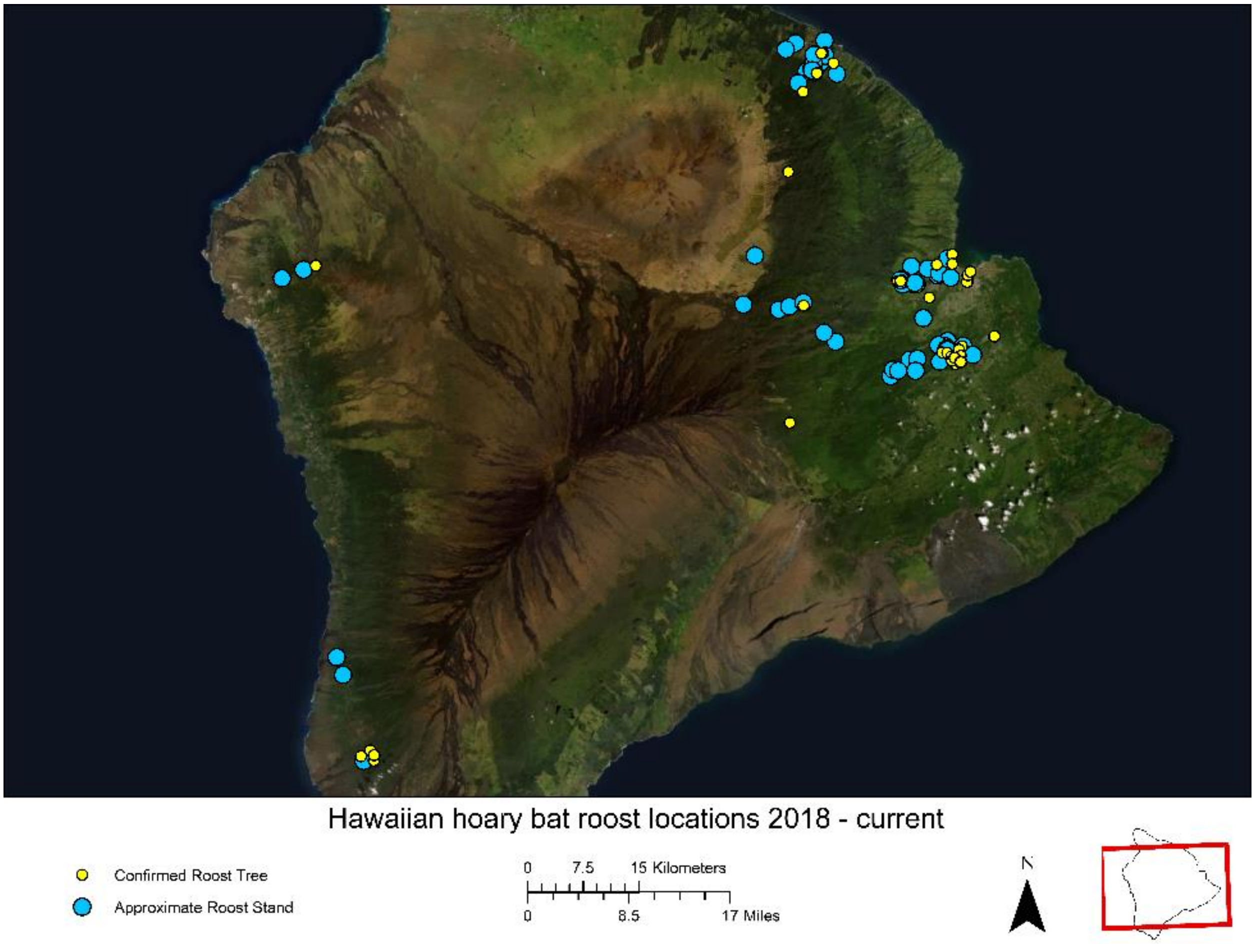

Figure 4. Confirmed and approximate Hawaiian hoary bat roost locations, 2018 – July 2021.

Figure 5. Thermal video camera deployment at maternity roost (top left). A mother Hawaiian hoary bat with two pups observed during maternity roost monitoring (top right). Thermal video monitoring of bat roost behavior (bottom).

Figure 6. Example of a mother-pup Hawaiian hoary bats at roost (left). Adult male Hawaiian hoary bat observed during roost fidelity monitoring (right).

Diet studies

Studies of diet are focused on three primary lines of research: prey selection (comparison of availability with what is in fecal samples and comparison between sexes), seasonal and elevational comparisons, and host-plant associations with diet species.

Insect collection commenced in February 2019 and continued for two years ending in January 2021. Nocturnal flying insects were collected using light traps (Figure 7) run at each fixed collection site concurrently with mist netting. Insect collection was conducted during two nights in each sampling cycle (i.e., 16 nights total per cycle). Collected insects are being categorized by size class and identified to the highest possible taxonomic classification; this lab work is underway and nearly complete (Figure 7). Additionally, DNA extracted from potential prey items were submitted for genetic barcoding to establish a reference library of potential bat prey items. Additional prey items will be submitted for barcoding during September-October 2021.

To identify bat prey, genetic meta-barcoding of guano samples is being conducted, and a bioinformatics approach used to match bat prey items with the reference library (above) and public databases (see Pinzari et al. 2019). A total of 85 guano samples have been collected from captured bats to date. Samples were processed and submitted for sequencing in November 2019 and February 2021. 74 samples were submitted, 69 of which yielded usable data. Remaining samples will be processed and submitted for meta-barcoding in September 2021.

Collection of caterpillars from vegetation at the fixed sampling sites was conducted March–May 2020 (Figure 8). A combination of rearing caterpillars to adult form and genetic barcoding of the caterpillars will be used to link the collections with bat diet. Host plants of bat prey are being identified using these collections and are examined further with in-depth literature searches and the cataloging of insect host plants in Hawaiʻi.

Figure 7. Insect collection using UV light trap (left). Potential bat prey collected and identified (middle). Hawaiian hoary bat guano sample being prepared for genetic meta-barcoding (right).

Figure 8. Caterpillar collection from vegetation to identify host plants of potential Hawaiian hoary bat prey (left). Caterpillars collected with host plant material (middle and right).

Movements

The automated telemetry system did not serve to provide data on bat movements on the landscape (see Technical issues section below). However, additional movement information has been documented when possible, including site fidelity and seasonality of re-captured bats (*n* = 10), the distance between multiple roosts used by individual bats (*n* = 10), and the distance between capture and roost locations (*n* = 114; Figure 9). Additionally, the activity budget (i.e., flight bout duration and frequency) of individual bats at roosts monitored by thermal video as part of the current study and bat telemetry location data obtained between 2004 and 2010 is being examined for its use in inferring the spatial extent of nightly movements.

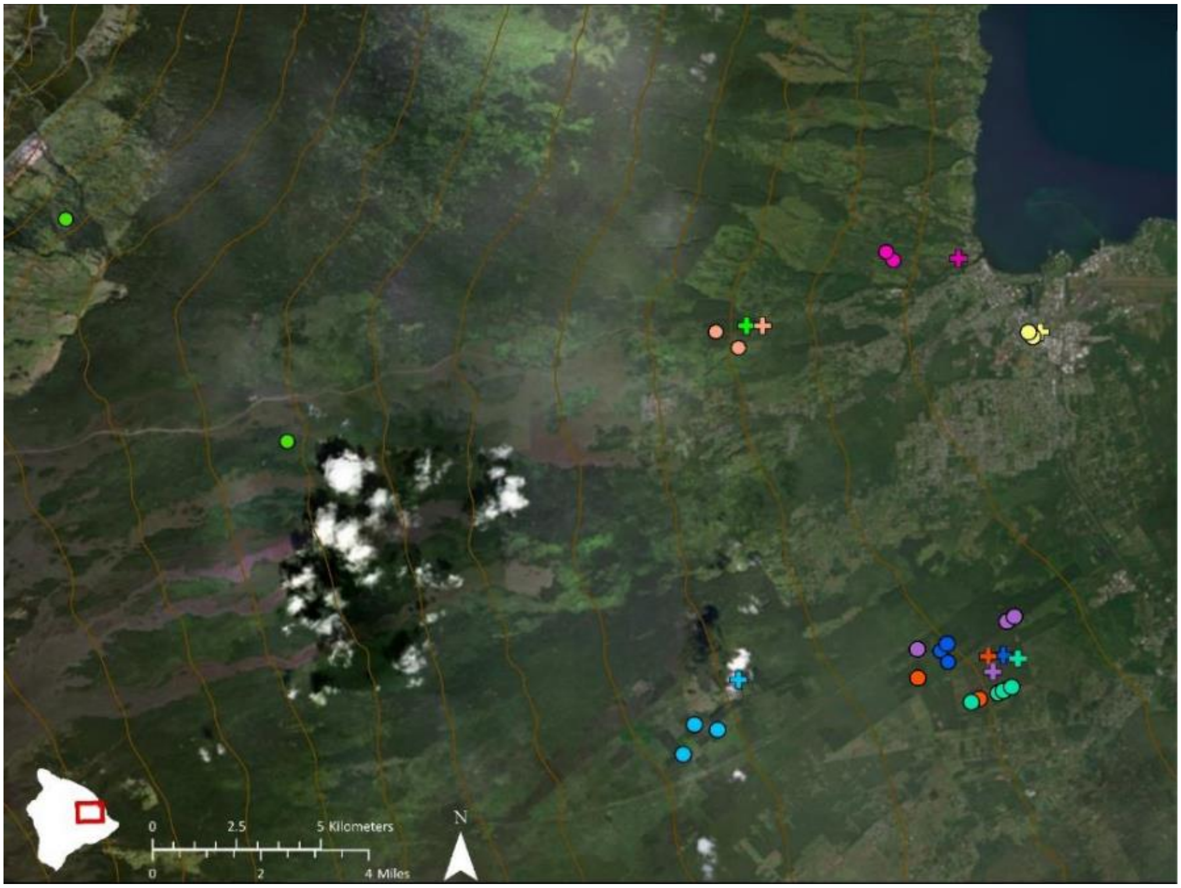

Figure 9. Example of net sites (cross symbols) relative to roost locations (circles) for captured bats (grouped by color) (data as of March 2020).

Technical issues

An automated telemetry system comprised of a network of six stations was established across a broad section of the Wailuku watershed. Each station consisted of a 20 to 30 ft mast with six radially arranged antennas and a radio receiver with cellular connectivity allowing for real-time coverage with live data feeds. However, technical issues with the system precluded its use in recording telemetered bat movement. The issues primarily entailed the high levels of ambient electromagnetic noise present in the region from which transmitter (i.e., radio-tag) signals could not be reliably discerned, persistent software bugs and power failure problems related to overheating of the receiver components. Bat flight behavior, specifically low altitude and within-forest movement, may also have contributed to limiting the reception range of transmitters in many parts of the landscape.

Given the technical difficulties collecting movement data with the automated system, there was a need to adaptively manage the research project to maximize the benefits of this project to the management of Hawaiian hoary bats. The following adjustments were proposed and implemented during 2021:

1) Expanded sampling area for roost and diet studies into additional habitat/forest types that represent a broader range of the landscape in Hawaiʻi to improve inference for planning

restoration and mitigation areas on other islands. The study area described in the Statement of Work was limited to the east side of Hawaiʻi Island dominated by rain forests and wet shrublands; we expanded sampling areas into mesic and dry forests with a broader range of dominant tree and shrub species.

2) Focused efforts to collect roost and diet (guano collection) sampling at higher elevation and native dominated forest sites where samples were underrepresented due to the difficulty of obtaining samples in these areas.

3) Continued sustained high intensity monitoring at roosts, including maternity roosts. In lieu of shifting efforts to facilitate tracking work, we maintained and expanded roost research efforts that yielded quality datasets (e.g., video monitoring, visual checks).

4) Analysis of hand-held and automated telemetry data collected to find and monitor roosts to better understand Hawaiian hoary bat movements on the landscape. From continued high intensity roost searching efforts and expansion of these efforts into additional habitats, we expanded datasets to calculate distances and elevational differences between capture locations and roost sites and analyze time spent away from the roost.

Future research efforts

We will conclude field work and data collection in August–September 2021. Analysis of data collected over the 3-year period of field work and report writing is on-going and planned through remainder of 2021 and early 2022.

References

Montoya-Aiona, K. M., F. A. Calderon, S. P. Casler, K. N. Courtot, P. M. Gorresen, and J. P. S. Hoeh. 2020. Hawaii Island, Hawaiian hoary bat roosting ecology and detection 2018-2019. U.S. Geological Survey data release, https://doi.org/10.5066/P9R95UYT.

Pinzari, C., T. Zinn, R. W. Peck, D. Gross, K. Montoya-Aiona, K. Brinck, P. M. Gorresen, and F. Bonaccorso. 2019. Hawaiian hoary bat (*Lasiurus cinereus semotus*) activity, diet, and prey availability at the Waihou Mitigation Area, Maui. Hawai`i Cooperative Studies Unit Technical Report HCSU-TR090, University of Hawai'i at Hilo, Hilo, Hawaiʻi. Available: http://hdl.handle.net/10790/4638.

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Appendix 6. Makamakaʻole Seabird Mitigation Area 2020 Annual Report

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Makamaka'ole Threatened and Endangered Seabird Mitigation Project: Exclosures and Artificial Burrows Annual Summary Report

Reporting Period: May 2020 – December 2020
Monitored and Reported by Maui Nui Seabird Recovery Project for Brookfield Renewables and Tetra Tech

Overall Summary: The Makamaka'ole seabird mitigation site consists of 2 predator-proof exclosures, each housing 50 artificial seabird burrows with nest boxes. Social attraction mechanisms including seabird models and nighttime auditory playback are in place to attract Newell's shearwaters (*Puffinus newelli,* NESH) in exclosure A, and Hawaiian petrels (*Pterodroma sandwichensis*, HAPE) in exclosure B. MNSRP performed assessment of the exclosures at Makamaka'ole and began monitoring in May 2020. The brackets holding the metal cap of the exclosures had rusted to the point of failure, resulting in severe compromise of the structures as wind ripped off sections of the cap in multiple locations. This created post flex, hogging out holes and necessitating brace construction throughout the impacted sections of fence. Maintenance and repairs progressed for all structural components of both exclosures throughout the year and are ongoing.
The playback system for auditory attraction was activated on May 22, 2020. By that time, NESH were already attending the nest boxes in both exclosures, and one Bulwer's petrel (*Bulweria bulwerii,* BUPE) was noted in exclosure B. NESH activity continued through the end of October. A total of 7 eggs (nonviable) were recovered from 6 nest boxes, and there was no evidence of chicks. Based on weekly burrow monitoring and a final check inside each nest box on Nov. 23, the annual burrow visitation rate is 43%.
Traps were deployed inside and outside the exclosures in June and July 2020. A total of 7 rats and 7 mice were captured inside. Outside; 12 rats, 1 mouse, and 22 mongooses were removed. Tracking tunnels show a low level of rodent activity inside the exclosures, mainly mice.

Vegetation Control: Prior to any exclosure repair could begin, extensive vegetation removal was needed along the inside and outside of the fence. Vegetation was overgrown as a result of infrequent site visits and monitoring activities in the months prior to MNSRP's assessment. Weed-whacking of the overgrowth continued over several visits. Controlling the vegetation requires regular upkeep to maintain open access to predator traps, artificial burrows, decoys and other enclosure infrastructure. It is not possible to keep aware of all the needs for fence repair and possible compromise if the vegetation is uncontrolled.

Exclosure Fence – Status and Activities:
All damaged hood sections were removed from both exclosures. Degraded posts, braces, and mesh panels were removed and replaced, and installation of new hood sections began. Replacing the rusted mesh and brackets and repairing sections of skirt continues. Repair at exclosure A is dependent on the stabilization of the slope with a retaining wall and steps, which is ongoing work by MNSRP. Work on the exclosure structure slowed at the end of the year due to inclement weather and reduced staff availability.

Sound Playback System – Status and Activities: The sound playback system was active from May 22 through September 17. Established burrows were already active and clustered around speaker locations before the system was active this season, suggesting that the birds were returning from previous years. The continuous calling that was broadcast each night throughout the season may have caused stress to the already established NESH, especially in exclosure A. Aggressive behaviors among birds were noted from game camera footage. See figure 1 for active burrows and speaker locations.

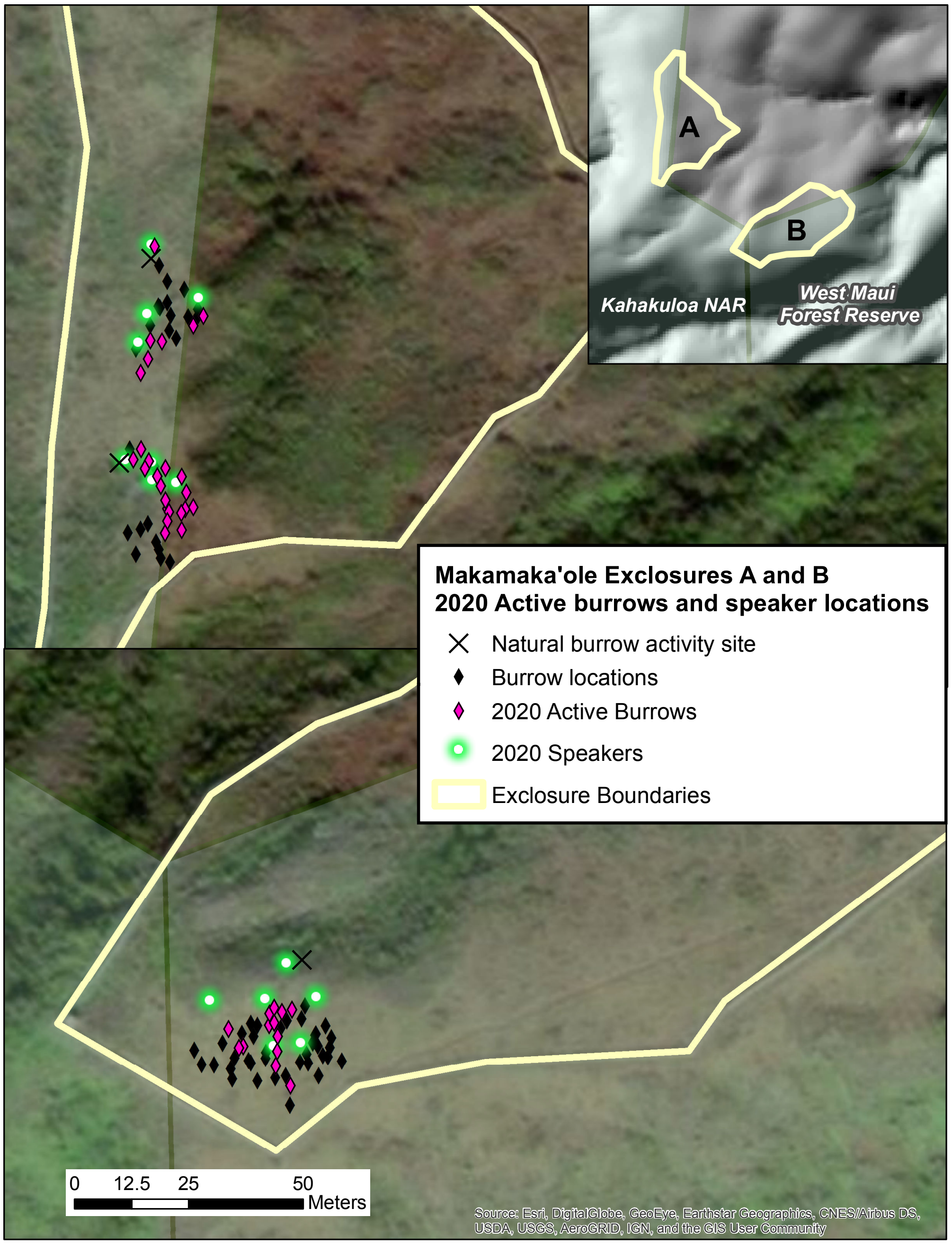


Figure 1. Natural and artificial burrow and speaker locations in exclosures A and B.

Artificial Burrow Checks:
Seabird activity was assessed weekly at each burrow by checking for removal or displacement of toothpicks erected at the entrance, searching for guano and feathers, and by noting bird scent. Data collection for burrow activity began on 5/22. During regular checks, 2 eggs were discovered rolled out at burrow 22A on June 18, and 1 egg was recovered from burrow 50B on August 8. Burrow scoping was attempted but inconclusive for egg/chick identification in several of the active burrows. On August 31, active nest boxes were open to assess breeding activity. Four broken eggs were recovered from inside burrows 14A, 25A, 43A, and 22B. In addition, a desiccated carcass of a Band-rumped storm petrel (*Oceanodroma castro*, BANP) was recovered from inside 22A. Six adult NESH were banded and returned to the nest boxes; 2 pairs (14A and 26A) and 1 each from 20A and 48A.

On September 17, Spencer Engler and search dog “Mochi” from Aloha Environmental Services performed a search for any bird activity outside the nest boxes. Bird sign was noted at 2 natural nest scrapes in exclosure A and 1 in B near the speakers and colony area (see Figure 1). Burrow scoping at the natural sites revealed no eggs or birds present.

All nest boxes were opened on November 23 to check for bird activity, and to assess the condition of the boxes. In total, 26 artificial burrows in A and 17 artificial burrows in B showed some sign of activity over the monitoring period. Of those, 18 in A and 4 in B were consistently active, with bird sign (displaced toothpicks, guano, feathers) on at least 4 consecutive visits (i.e., for at least one month). A summary of burrow activity by exclosure is presented in Table 1, and details for active burrows are shown in Table 2.

Game cameras were deployed and moved among active burrows in both exclosures to capture bird activity. Only NESH and one BUPE (burrow 50B) were documented as visiting the burrows. A NESH was active at the scrape site in B. Much of the game camera footage is overexposed, but NESH were positively identified at 15 burrows in A (11, 12, 14, 17, 18, 20, 21, 22, 24, 25, 26, 28, 29, 43, and 48) and 2 in B (22 and 50). Bird activity outside the burrow entrances was highest in June. During that time footage from several of the burrows reveals 2 – 3 birds outside at the same time.

Table 1. 2020 activity summary for all nest boxes.

Burrow	Bird Sign at opening (11/23/20)	Activity over the season	Burrow	Bird Sign at opening (11/23/20)	Activity over the season
A1	No sign	No activity	B1	No sign	No activity
A2	No sign	No activity	B2	No sign	No activity
A3	No sign	No activity	B3	No sign	No activity
A4	Minimal vegetation, one moldy feather	No activity	B4	No sign	No activity
A5	Some sticks - maybe rodent?	No activity	B5	No sign	No activity
A6	Minimal vegetation but no other sign	No activity	B6	No sign	No activity
A7	Some sticks, minor duff	No activity	B7	No sign	No activity

A8	A few feathers and some vegetation	Entered, feathers, guano	B8	No sign	No activity
A9	Feathers, toothpicks, sticks, duff, and guano	Entered, guano	B9	No sign	Entered
A10	No sign	No activity	B10	Feathers	No activity
A11	Feathers, toothpicks, duff in nest cup	Entered, feathers, guano	B11	No sign	No activity
A12	Feathers and vegetation in nest bowl; toothpicks inside	Entered, guano, odor	B12	No sign	No activity
A13	Feathers, toothpicks, duff in nest	Entered, feathers, guano	B13	No sign	Entered, guano
A14	Copious toothpicks, feathers, and vegetation; egg membrane	Entered, feathers, guano, odor	B14	No sign	No activity
A15	One feather, much grass in nest cup	Entered, guano	B15	One feather and minimal vegetation	Entered
A16	Feathers, no nest	Entered, guano	B16	No sign	No activity
A17	Four feathers, no nest	Entered, feathers, guano	B17	No sign	Entered
A18	No sign	Entered, guano	B18	Nest material, 1 toothpick	No activity
A19	No sign	Entered, guano	B19	Minimal vegetation	No activity
A20	Feathers, toothpicks, nest material	Entered, feathers, guano	B20	Feathers	No activity
A21	Feathers, some nest material	Entered, feathers, guano	B21	Lots of sign - vegetation and feathers	Entered, feathers
A22	Feathers, nest material, toothpicks, nest bowl	Entered, feathers, guano	B22	Nest material, feathers, toothpicks	Entered, feathers, guano
A23	No sign	No activity	B23	A couple feathers but no other sign	Entered
A24	Feathers, toothpicks, nest material	Entered, feathers, guano	B24	Feathers	Entered, feathers, guano
A25	Nest material, toothpicks, feathers	Entered, feathers, guano	B25	Feathers and vegetation	Entered
A26	Nest bowl with grass and toothpicks	Entered, feathers, guano	B26	Feather	Entered
A27	No sign	No activity	B27	Some feathers, no other sign	Entered, guano
A28	Feathers, toothpick, nest bowl	Entered, guano	B28	No sign	Entered, feathers, guano
A29	Feathers, nest material and bowl, toothpicks	Entered, feathers, guano	B29	Toothpicks, feathers (collected)	Entered, guano
A30	No sign	No activity	B30	Two feathers, some vegetation	No activity

A31	No sign	No activity	B31	No sign	No activity
A32	Feathers, nest material (grass)	Entered, feathers, guano	B32	No sign	No activity
A33	Nest material (grass), feathers, toothpicks	Entered, guano	B33	No sign	No activity
A34	Some plant material; no other sign	No activity	B34	Minor grass inside	No activity
A35	No sign	No activity	B35	1 feather, couple pieces of grass	No activity
A36	No sign	No activity	B36	1 small feather	No activity
A37	Some plant material; no other sign	No activity	B37	3 small white body feathers	Entered
A38	No sign	No activity	B38	Few small feathers	Entered, feathers, guano
A39	One body feather, old guano	No activity	B39	No sign	No activity
A40	A few feathers, no other sign	No activity	B40	Some leaves	No activity
A41	A few feathers and grass pieces	Entered, guano	B41	1 feather, no other sign	No activity
A42	Feathers, toothpicks, grass/nest material, cobwebs	No activity	B42	Duff, toothpicks, nest cup (no feathers)	No activity
A43	Feathers, nest material, toothpicks, eggshell (1/2 intact with rocks) - collected	Entered, feathers, guano	B43	2 feathers, small amount of nest material	Entered
A44	One body feather, no other sign	No activity	B44	Minor grass	Entered, feathers
A45	No sign	No activity	B45	3 feathers - collected	No activity
A46	No sign	Entered	B46	No sign	No activity
A47	No sign	No activity	B47	No sign	No activity
A48	Body feathers, toothpicks, small duff	Entered, feathers, guano	B48	No sign	No activity
A49	Some grass, no other sign	No activity	B49	No sign	No activity
A50	Nest bowl with grass and toothpicks	Entered	B50	Feathers, toothpicks, duff, nest cup	Entered, feathers, guano

Table 2. 2020 summary of burrow boxes with seabird activity.

Burrow	**Consistent activity?**	**Dates of noted activity at burrow checks**	**Species on game cam**	**Visitation summary**
A8	yes	9/11/20-10/14/20		Entered with feathers, guano throughout active period. Feathers and duff in box.
A9	no	9/11/20-9/17/20		Entered twice, guano present once. Feathers and duff in box.

A11	yes	5/28/20-10/23/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box.
A12	yes	6/18/20-10/23/20	NESH	Entered with guano throughout active period. Feathers and duff in box.
A13	yes	6/18/20-10/14/20		Entered with feathers, guano throughout active period. Feathers and duff in box.
A14	yes	6/4/20-11/19/20	NESH	Entered with feathers and guano throughout active period. Feathers, duff, and egg membrane in box. Two adults banded 8/31/20.
A15	no	6/18/20		Entered once with guano. One feather and grass in box.
A16	no	9/11/20-9/17/20		Entered twice, guano present once. Feathers in box.
A17	yes	6/18/20-10/1/20	NESH	Entered with feathers, guano throughout active period. Feathers in box.
A18	yes	5/28/20-10/1/20	NESH	Entered with guano throughout active period.
A19	no	6/4/20, 6/18/20		Entered with guano twice.
A20	yes	5/28/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box. One adult banded 8/31/20.
A21	yes	5/28/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box.
A22	yes	5/28/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box. Two eggs roll out 6/18/20.
A24	yes	5/28/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box.
A25	yes	5/28/20-10/1/20	NESH	Entered with feathers, guano throughout active period. Feathers, duff, egg shell and membrane in box.
A26	yes	5/28/20-10/23/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box. Two adults banded 8/31/20.
A28	yes	7/21/20-10/14/20	NESH	Entered with guano throughout active period. Feathers and duff in box.
A29	yes	7/15/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box.
A32	no	7/21/20-7/29/20, 8/19/20, 9/17/20		Entered four times, twice with guano.
A33	yes	7/15/20-10/14/20		Entered with guano throughout active period. Feathers and duff in box.
A41	no	6/9/20, 6/30/20		Entered once, guano present once. Few feathers and grass in box.
A42	no	none		Considered active by the amount of nesting material in box. Visitation prior to 5/22/20?
A43	yes	5/28/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers,duff, egg shell and membrane in box.

A48	yes	5/28/20-10/14/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box. One adult banded 8/31/20.
A50	no	6/30/20-7/7/20		Entered twice. Duff in box.
B13	no	6/4/20-6/18/20		Entered once, guano three times.
B15	no	8/31/20		Entered once. One feather and duff in box.
B21	no	8/19/20-8/31/20		Entered with feathers twice. Feathers and duff in box.
B22	yes	5/28/20-11/19/20	NESH	Entered with feathers, guano throughout active period. Feathers and duff in box.
B23	no	8/19/20-8/31/20		Entered twice. Few feathers in box.
B24	yes	6/4/20, 8/5/20-10/1/20		Entered with feathers, guano throughout active period. Feathers in box.
B25	no	8/31/20, 9/17/20		Entered twice. Feathers and duff in box.
B26	no	8/5/20		Entered once. Feather in box.
B27	no	9/17/20		Entered with guano once. Few feathers in box.
B28	no	8/31/20-9/11/20		Entered with feathers and guano twice.
B29	no	8/5/20, 8/19/20-8/31/20, 9/17/20		Entered with guano on four separate occasions. Few feathers in box.
B37	no	8/31/20		Entered once. Few feathers in box.
B38	yes	7/29/20-9/17/20		Entered with feathers, guano throughout active period. Feathers in box.
B42	no	none		Considered active by the amount of nesting material in box. Visitation prior to 5/22/20?
B43	no	8/19/20, 9/11/20		Entered twice, two feathers and some duff in box.
B44	no	8/12/20		Entered with feathers once. Some grass in box.
B50	yes	5/28/20-11/19/20	NESH, BUPE	Entered with feathers, guano throughout active period. Feathers and duff in box. Egg roll out on 8/5/20.

Seabird Monitoring: No acoustic or visual night surveys were conducted this season.

Predator Removal: DOC200 traps (10 inside and 22 outside) and snap traps (18 inside and 20 outside) are deployed at the exclosures. Baits typically used are eggs for DOC200s and peanut butter for snap traps, although cat food kibble and dehydrated banana were also used. Mongooses were only captured outside the exclosures (n=22). A total of 7 rats and 7 mice were captured inside. An additional 12 rats and 1 mouse were removed outside. Overall catch rate was 49 total catches for 12,205 trap nights (0.004). The average catch rate was greater outside (0.004 vs 0.002 inside) and at exclosure A (0.004 vs 0.003 at B). See Table 3 for trapping summary.

Bait stations within the exclosures were all located and baited with ramik bars in July 2020. They are checked every 3 – 4 weeks for depletion, and moldy bait is replaced. The rate of depletion was much greater in exclosure B compared to exclosure A after initial deployment (100% vs 7% in August), but has since leveled off. The estimated overall bait consumption is 27% in A and 61% in B.

Table 3. Summary of trap nights and catches, inside and outside exclosures.

Exclosure	Placement	Trap Type	Trap Nights	Mongoose catch	Rat catch	Mouse catch	Total catch	**Catch rate**
A	Outside	DOC200	2003	13	2		15	**0.007**
	Outside	Snap trap	2173		6		6	**0.003**
	Inside	DOC200	847				0	**0.000**
	Inside	Snap trap	1782		4	7	11	**0.006**
B	Outside	DOC200	1993	8	4		12	**0.006**
	Outside	Snap trap	1338	1			1	**0.001**
	Inside	DOC200	795		2	1	3	**0.004**
	Inside	Snap trap	1274		1		1	**0.001**
Total			**12205**	**22**	**19**	**8**	**49**	**0.004**

Predator Tracking: Tracking cards baited with peanut butter were used to assess rodent and mongoose activity within the exclosures. They were deployed in 10 tracking tunnels within each exclosure on August 11 and again on October 10. The cards were pulled and checked for rodent activity after 24 hours, and re-deployed and checked for mongoose activity after 72 hours. There were no mongoose detections. Two cards in exclosure B showed rat activity in August. After 24 hours, 50% of the tracking cards in each exclosure had mouse tracks in August. In October, 50% in exclosure A and 30% in exclosure B had mouse activity.

Recommendations:

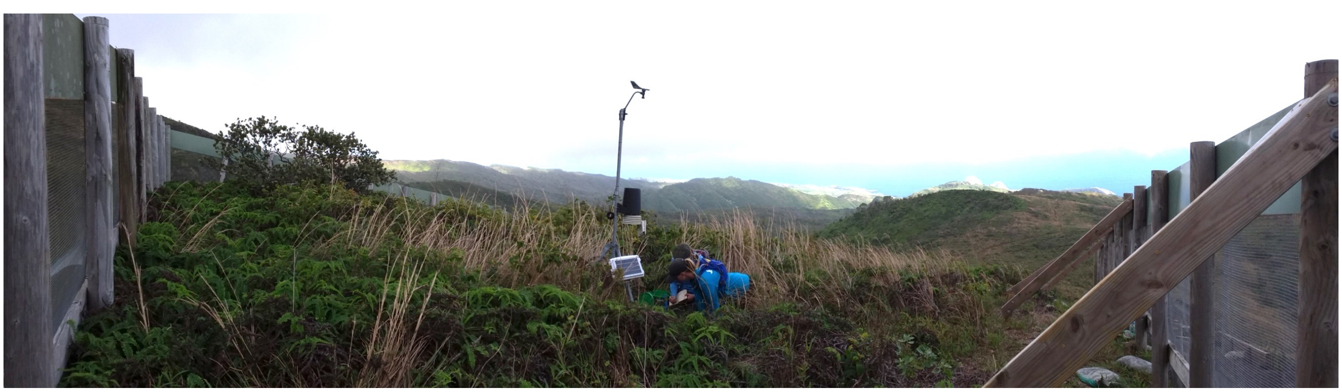
1. The most reliable game cameras for the close proximity and nature of the environment are the Reconyx HP2X. More cameras are needed to get as complete and accurate coverage of all active burrows as possible.
2. For the 2021 seabird breeding season, the call playback system in enclosure A, for NESH, should not be used. Evidence of established NESH site fidelity was provided inadvertently by no management of the enclosures until May of 2020 when the broadcast system was turned on. Documented NESH intra-species aggression may have been caused by the conflicting soundscape created by non-stop broadcast, at high volume, of aerial flight calls in the vicinity of breeding burrows. This aggressive behavior may also account for the eggs ejected from burrows and broken eggs.
3. For the 2021 seabird breeding season, the call playback system in enclosure B, for HAPE, should be modified by moving a speaker to the observation deck to provide elevation above the colony area. The aerial calls being broadcast should be played on the type of schedule that calls are made in a natural colony; shortly after sunset for 3 – 4 hours. After that speakers in the colony area should be programmed with HAPE ground calls. Additional speakers, already in inventory, should be deployed within the colony area.
4. Night surveys to more clearly document species attendance and behavior should be performed, especially in the early months of the breeding season. These surveys further the mitigation benefit by providing information about the flight behaviors of the HAPE

and targeting them for recruitment to the exclosure. Maui Nui Seabird Recovery Project has acquired an infrared illuminator and power supply (not Brookfield Renewables inventory) that will illuminate the entirety of the exclosure areas and the surrounding terrain visible from the observation deck in enclosure B. The project is willing to use this tool, with night vision goggles, to document where birds are coming to ground and the species composition of aerial display assemblages.

5. Nest box substrate should be modified to eliminate the sharp-edged rocks and large round river rocks (These may be responsible for egg breakage in previous years) from the nest bowl surface. This will require collection of the duff, vegetation, and other material present that may hold the odor of birds that have been in attendance in past years. This material will be bagged while the existing substrate is removed, drainage rocks placed, deeply enough to allow water to drain but not protrude to the nesting surface, and sand added to create a suitable nesting substrate. Odor holding material will then be returned to the nest box.
6. Predator control continue year-round, inside and outside of enclosures.
7. Vegetation control continue year-round.
8. Fence repair, stabilization, and maintenance continue year-round.

Makamaka‘ole exclosure photo point panoramas; January 12, 2021

Exclosure A, entrance, photo point makai west



Exclosure A, photo point mauka west


Exclosure A, photo point makai east


Exclosure B, entrance, photo point makai east


Exclosure B, photo point mauka east


Exclosure B, platform, photo point mauka west

Supplemental data files available for agency review:

1. *iForm data files*
   - Makamakaole trapping
   - Makamakaole burrow checks
2. Burrow status and observations notes summary
3. *GIS shapefiles*
   - Updated exclosure boundaries
   - Updated speaker locations
   - Updated bait station locations
   - Updated trap locations
4. *Images*
   - Reconyx vs Moultrie burrow entrances and bird images
   - Burrow substrate images
5. *Game camera addendum report*

Appendix 7. Planned Methods to Address Makamaka‘ole Management Recommendations in 2021 Seabird Breeding Season

TETRA TECH

MEMO

To:	Lasha-Lynn Salbosa, USFWS Paul Radley, DOFAW
From:	Tetra Tech, Inc.
Date:	March 15, 2021
Correspondence #	TTCES-PTLD-2021-025
Subject:	Planned Methods to Address Makamakaʻole Management Recommendations in 2021 Seabird Breeding Season

Plan Overview

The Maui Nui Seabird Recovery Project (MNSRP) will continue managing Brookfield's mitigation efforts at Makamakaʻole in 2021, incorporating recommendations from the agency and independent expert informational meeting and Makamakaʻole project review (Informational Meeting) held via teleconference on December 2, 2020. The primary goals for the 2021 breeding season are to:

- Support continued increased visitation and breeding attempts by Newell's shearwaters at the colony
- Improve artificial burrow conditions to increase the potential for successful Newell's shearwater reproduction
- Modify the social attraction techniques to increase the probability of visitation by Hawaiian petrels and decrease the risk of inter- and intra-species antagonistic behaviors

Recommendations follow in italics with planned approach provided in bold.

Recommendations and Planned Activity

1. *Field Cameras*
    a. *Make sure these are set preferably at the hybrid option to capture both stills and video. Contact Pacific Rim for further ideas.*
    b. *Reconxy cameras are expensive. Bushnells are cheaper and Pacific Rim has found success in using them, since they are cheaper it is possible to get better coverage across the colony.*
    c. *Camera placing and settings are crucial. These are the best tools for confirming the presence of fledgling chicks.*

Plan: Brookfield understands the value of cameras in documenting activity at the colony and will purchase additional cameras to improve documentation. The MNSRP will consult with outside experts as necessary to troubleshoot issues and ensure game camera documentation meets needs.

2. *Burrow Monitoring Frequency*
    a. *Need to conduct multiple burrow checks as the breeding season progresses. Makamaka'ole field site manager/workers should contact Kaua'i Endangered Seabird Recovery Project (KESRP) and Pacific Rim to help develop a more refined monitoring schedule.*

Plan: MNSRP will monitor burrows for activity at approximately 2-week intervals, using burrow inspections or game cameras to identify newly occupied burrows. Game cameras will be deployed at active burrows to document the frequency of visits.

3. *Monitoring Data*
    a. *Monitoring Parameters*
        i. *Number of active burrows visited*
        ii. *Number of active nests*
        iii. *Number of fledglings*
    b. *Monitoring methods should clearly define what determines an active nest versus an active burrow that's being visited; and what indicates the presence of a fledgling and what does not. Monitoring frequency for any particular burrow may change depending on burrow status.*

Plan: MNSRP will provide supporting data consistent with reporting from the 2020 breeding season (MNSRP 2021) and will report summary statistics of key monitoring parameters consistent with those described in Raine et al. (2020).

4. *Substrate in Artificial Burrows*
    a. *Existing gravel and river rocks are much too hard of a surface and will only cause eggs to break.*
    b. *Collect any nest material present to preserve scent and replace substrate with gravel for drainage covered with sand. Makamakaole site managers should contact Pacific Rim for further details on what has worked in the past.*

Plan: MNSRP has coordinated with the Maui Natural Area Reserve System manager (Dr. Fern Duvall) and the Department of Land and Natural Resources Maui Forest Reserve manager (Lance DeSilva) to get approval for replacement of substrate in artificial burrows. MNSRP has replaced the top 2 inches of the 3/4 minus gravel with about 2 inches of sand within 94 artificial burrows as of March 3, 2021 and anticipates completing replacement in the final 6 burrows prior to the return of seabirds to Makamaka'ole. MNSRP used sand that was fresh,

washed, and free of weed seed. Nest material was collected using nitrile gloves, bagged, and then replaced in the burrow after the substrate replacement was completed.

5. *Social Attraction Playback Calls*
    a. *Discontinue playback calls for Newell's shearwater, since a colony has been established and their natural calls can be used.*
    b. *Makamaka`ole site managers to contact KESRP to obtain copies of Hawaiian petrel playback recordings of various behaviors to increase likelihood of Hawaiian petrel visitation.*
    c. *Move speakers to non-occupied burrows.*
    d. *Keep in mind, it is extremely rare to get aggressive behavior between species (HAPE and NESH), given the close proximity of colonies at other locations.*

Plan: MNSRP plans to adjust the social attraction element of the Makamakaʻole colony management in 2021 consistent with recommendations from the Informational Meeting. In 2021, it is expected that Newell's shearwater playbacks will not be used and new Hawaiian petrel recordings that incorporate petrel ground calls and flight calls will be incorporated into the playbacks at exclosure B. Although not expected, should burrow monitoring suggest a reduced level of visitation by Newell's shearwater in 2021 to exclosure A, Brookfield may reinstate Newell's shearwater playbacks in exclosure A to support the continued expansion of the Newell's shearwater colony. MNSRP has already acquired Hawaiian petrel playback recordings from KESRP which include ground calling petrels as well as petrel flight calls. A new speaker will be deployed at the observation platform in exclosure B to broadcast the aerial flight calls, while ground calls will be played in proximity to burrows.

6. *Barn Owl Control*
    a. *Recommend being very vigilant on barn owl control now.*
    b. *Inspect site for likelihood of pueo as that might determine what control tools can be used if and when barn owls are observed.*
    c. *Recommend the use of pole traps. These do not injure the owl; it holds the target animal until it can be dispatched the next day.*

Plan: MNSRP has a barn owl depredation permit through its affiliation with the University of Hawaii, and will implement control measures if evidence of barn owl predation is observed at Makamakaʻole. Regular site visits throughout the breeding season, should allow for prompt detection of barn owl predation. MNSRP staff have extensive experience identifying and responding to barn owl depredation at seabird colonies. Based on habitat and observations, it can be assumed that both pueo and barn owls are present in the vicinity. So, pole traps or

another suitable method that minimizes risk to non-target animals would be employed to manage barn owls.

References

MNSRP (Maui Nui Seabird Recovery Project). 2021. Makamakaʻole threatened and endangered seabird mitigation project: exclosures and artificial burrows annual summary report and supplemental data.

Raine, A. F., J. Rothe, S. Rossiter, and S. Driskill. 2020. Kauaʻi Endangered Seabird Recovery Project: monitoring of endangered seabirds. September 2020.

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