

NĀ PUA MAKANI WIND ENERGY PROJECT
Habitat Conservation Plan
FY 2025 Annual Report
(July 1, 2024 – June 30, 2025)



Prepared for:

Nā Pua Makani Power Partners, LLC

Prepared by:



July 2025

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1.0 Introduction

Nā Pua Makani Power Partners, LLC (NPMPP) developed a Habitat Conservation Plan (HCP; Tetra Tech 2016) for the Nā Pua Makani Wind Energy Project (Project) and received a U.S. Fish and Wildlife Service (USFWS) incidental take permit on September 7, 2018 (ITP; TE63452B-0) and the Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) incidental take license on April 30, 2019 (ITL; ITL-21). Covered Species include:

- Hawaiian hoary bat (*Lasiurus semotus*) or 'ōpe'ape'a;
- Newell's shearwater (*Puffinus newelli*) or 'a'o;
- Hawaiian goose (*Branta sandvicensis*) or nēnē;
- Hawaiian duck (*Anas wyvilliana*) or koloa maoli;
- Hawaiian coot (*Fulica alai*) or 'alae ke'oke'o;
- Hawaiian gallinule (*Gallinula chloropus sandvicensis*) or 'alae 'ula;
- Hawaiian stilt (*Himantopus mexicanus knudseni*) or ae'o; and
- Hawaiian short-eared owl (*Asio flammeus sandwichensis*) or pueo.

Project construction began in FY 2019 and continued into FY 2021. Concrete pouring for the first turbine foundation began on April 30, 2019, and coincides with the effective start date of the ITL. Project commissioning began on August 16, 2020, and commercial operations began on December 11, 2020. During commissioning Project components and the interconnection and transmission capabilities of the system are tested before the initiation of full commercial operation.

On behalf of NPMPP, Tetra Tech, Inc. (Tetra Tech) has prepared this report to describe activities relating to the Project HCP for the State of Hawai'i fiscal year (FY) 2025¹ (July 1, 2024 – June 30, 2025) pursuant to the terms and obligations of the approved HCP, ITL, and ITP. The Project has previously submitted annual HCP progress reports to DOFAW and USFWS for FY 2019 through FY 2024 (Tetra Tech 2019a, Tetra Tech 2020a, Tetra Tech 2021, Tetra Tech 2022, Tetra Tech 2023a, Tetra Tech 2024).

¹ Fiscal year references in this report refer to the State of Hawai'i fiscal year, which begins every July 1st and ends every June 30th.

2.0 On-Site HCP-Related Management

2.1 Avoidance and Minimization

NPMPP has worked to minimize risk to wildlife through avoidance and minimization measures outlined in the HCP. In addition, NPMPP has implemented monitoring approaches to document potential impacts to wildlife.

To minimize potential impacts to wildlife, on-site lighting at the operations and maintenance building and substation is directed downward and fitted with non-white light bulbs. Lighting in the vicinity of the turbines is only used when workers are at the site at night. No night work requiring lights that could attract wildlife occurred in FY 2025.

NPMPP implements low wind speed curtailment to reduce potential impacts to Hawaiian hoary bats. Implementation included increasing manufacturer's recommended cut-in speeds to 5 meter per second (m/s) and feathering turbine blades into the wind below 5 m/s. Low wind speed curtailment is instituted annually March – November between sunset and sunrise; in FY 2025 this included implementation July – November 2024 and March – June 2025. In addition to the intended benefit of reducing bat fatalities, low wind speed curtailment reduces risk to Covered Species such as the Newell's shearwaters and Hawaiian short-eared owl, which could transit the Project.

NPMPP installed an NRG ultrasonic acoustic bat deterrent system on Turbines 2, 3, 4, and 6 prior to the initiation of commercial operations to further reduce the collision risk to the Hawaiian hoary bat. These turbines were selected due to their proximity to forest edge and gulch habitat, which have been correlated with increased bat activity.

2.2 Downed Wildlife Monitoring

On August 26, 2020, the Project initiated standardized carcass searches according to the Project's Post-construction Mortality Monitoring (PCMM) Implementation Plan (Tetra Tech 2023b), concurrent with the beginning of periodic turbine testing during the Project commissioning phase (August 16, 2020). While input had not yet been received from USFWS or DOFAW on the PCMM Implementation Plan, there was a need to implement a standardized monitoring approach suitable for yielding robust statistical estimates of take.

Based on subsequent input on the PCMM Implementation Plan from USFWS and DOFAW, NPMPP and Tetra Tech have updated the document incorporating additional information and commitments to address agency questions and concerns through three revisions. Two significant changes to implementation were made because of these updates. In FY 2022, searches in supplemental (agricultural areas) and associated bias correction testing were incorporated into the analysis. In

FY 2023, carcass persistence testing protocols were modified to test carcass persistence in the searched agricultural areas rather than similar, but unsearched, surrogate agricultural areas².

Throughout FY 2025, downed wildlife monitoring at the Project consisted of standardized fatality monitoring according to the Project's PCMM Implementation Plan (Tetra Tech 2023b). A final revision of the plan was submitted in December 2023 addressing a few minor clarifying edits requested by DOFAW (Tetra Tech 2023b). The PCMM Implementation Plan describes how the Project implements the PCMM program provided in the HCP based on the Project construction footprint, current land use patterns, and topography. The elements of the PCMM program used to estimate fatality rates of Covered Species include:

- The specific delineation of:
 - Systematic search areas;
 - Supplemental (agricultural) search areas within active agricultural areas in the vicinity of Turbines 6 – 9, where canine search teams can (at least periodically) safely perform searches;
- Search frequency;
- Bias correction testing protocols (see Sections 2.3 – 2.4); and
- Methods and results for the calculation of the proportion of the carcass distributions searched within individual agricultural plots and systematic search areas.

In FY 2022, based on recommendations from DOFAW and USFWS to increase the search areas around the turbines, NPMPP and Tetra Tech incorporated protocols to augment the systematic search area results with search results from supplemental (agricultural) search areas where consistent and effective searching can take place. This process included extensive outreach to the farmers working adjacent to the Project turbines³, hiring of an additional canine handler, and significant logistical and methodological adjustments to ensure that health and safety requirements are met, landowner and farmer relationships are maintained, and quality data can be collected.

² Testing of carcass persistence trials in searched agricultural areas demonstrated that when the number of trial carcasses was low, search dogs were unlikely to cause damage to tender crops. Therefore, carcass persistence could be measured accurately within the searched agricultural areas. This approach was used throughout FY 2024.

³ To facilitate reporting by farmers of incidental observation of carcasses in the agricultural areas, NPM created and printed an informational flier in Lao language which included photos of HCP-covered and other protected species (i.e., MBTA), messaging to report any carcasses found, and NPM's contact information for reporting found carcasses. Copies of the flier were both posted in the areas where the tenant agricultural workers work and live and distributed as laminated copies to each individual tenant for reference. In addition, the operations manager of the agricultural area who speaks Lao verbally conveyed the same information to each tenant and emphasized the importance of notifying NPM of any carcasses they find.

Under the PCMM Implementation Plan as performed in FY 2025, NPMPP conducted weekly searches with trained canine search teams within systematic search areas (Figure 1). These systematic search areas consist of areas that were cleared and graded during Project construction at each of the Project's eight turbines and can be practicably maintained in low-growing vegetation through mowing due to the low to moderate slopes. In addition, as site conditions allowed, a canine search team performed supplemental searches within active agricultural areas; all such areas that were searched consistently⁴ during any fiscal quarter were incorporated into fatality estimates. Associated bias correction trials (see Sections 2.3 and 2.4) and searches were performed throughout FY 2025 and incorporated consistently searched supplemental search area results into the analysis of the take estimate (Section 2.7).

Supplemental areas are not always searchable (see footnote 4), can be highly variable in terms of the vegetative growth, evolve quickly, and are relatively small. These challenges meant that not all delineated supplemental search areas were used in the statistical analyses. Nevertheless, all delineated supplemental search areas are regularly evaluated and considered for incorporation in future analyses based on their search history. Ultimately, these additional areas provide opportunities for an improved understanding of the carcass distribution at the site and may facilitate the establishment of more robust fatality estimates.

2.3 Carcass Persistence Trials

Eighty, 28-day carcass persistence trials were conducted within the systematic search areas in FY 2025, using black rats (*Rattus rattus*) for Hawaiian hoary bat surrogates and wedge-tailed shearwater (*Ardenna pacifica*) or similar carcasses collected or procured under the Project's Special Purpose Utility Permit (MB79835D-4) and Hawai'i Protected Wildlife Permit (WL23-10 and #240808094610-WILD) as surrogates for the avian Covered Species.

Within supplemental agricultural search areas, an additional 40, 28-day carcass persistence trials were conducted in FY 2025. The probability that a carcass persisted until the next search used in the fatality analysis is reported in Table 1.

⁴ Some supplemental search areas regularly or occasionally have loose dogs which threaten the safety of the canine search team. Similarly, other conditions, such as the periodic application of herbicide or other chemicals, may make searching a supplemental search area unsafe or impractical during a particular week.

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**Nā Pua Makani
Wind Energy Project**

**Figure 1
HCP Implementation
Components
and Infrastructure**

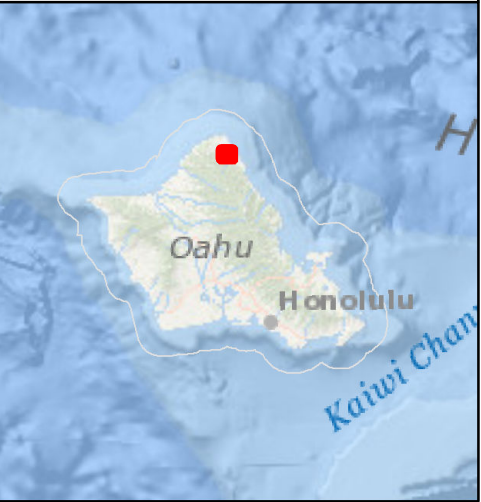
OAHU, HI

-  Turbine with Bat Deterrent
-  Turbine with No Bat Deterrent
-  Met Tower
-  Bat Acoustic Detector
-  50% MBTH Plot
-  75% MBTH Plot
-  Systematic Search Areas
-  Supplemental Search Areas
-  O&M Building
-  HECO Switching Station
-  Substation

Aerial imagery from 2020.



Reference Map



1:8,000 WGS 1984 UTM Zone 4N

0 0.125 0.25 0.5
Miles

NOT FOR CONSTRUCTION

Table 1. Cumulative Searcher Efficiency and Carcass Persistence Trial Results FY 2025

Size	Search Area	Total Trials		Mean (95% Confidence Interval)	
		Searcher Efficiency ¹	Carcass Persistence	Searcher Efficiency (Proportion Detected) ²	Probability of Persistence to the Next Search (r) ³
Bat Surrogate	Systematic (canine)	48	40	0.79 (0.66 – 0.89)	0.76 (0.65 – 0.85)
	Systematic (human only) ⁴	20		0.70 (0.48 – 0.86)	0.76 (0.65 – 0.85)
Medium Bird	Systematic (canine)	45	40	0.98 (0.90 – 1.00)	0.97 (0.95 – 0.99)
	Systematic (human only) ⁴	32		0.94 (0.81 – 0.99)	0.97 (0.95 – 0.99)
Bat Surrogate	Supplemental canine (analysis)	43	20	0.86 (0.74 – 0.94)	0.50 (0.33 – 0.68)
Medium Bird	Supplemental canine (analysis)	55	20	0.98 (0.92 – 1.00)	0.79 (0.60 – 0.91)
1. Available for detection. 2. Estimates and 95 percent confidence interval calculated using Dalthorp et al. (2017) single year module. 3. The estimate of r is reported in lieu of carcass persistence time, as r provides a more informative portrayal of the effect of carcass persistence on fatality estimates, incorporating information from the carcass persistence distribution and the search interval in a single variable. Estimates and confidence interval for r calculated using Dalthorp et al. (2017) single year module. The probability of persistence is based on a 7-day search interval for the supplemental agricultural search areas, but the actual measure varies based on the frequency of searches. 4. Throughout FY 2025 small area around a warehouse in the vicinity of Turbine 7 routinely had loose dogs in the vicinity. The canine handler could not safely search this small discrete area. Testing of searcher efficiency performed by the canine handler without their dog was performed to incorporate this information into the analysis.					

2.4 Searcher Efficiency Trials

Within systematic search areas, a total of 162 searcher efficiency trial carcasses were placed over 20 trial days during FY 2025. Similar to the carcass persistence trials, black rats were used as surrogates for bats, and wedge-tailed shearwaters, Bulwer's petrels (*Bulweria bulwerii*), red-tailed tropicbirds (*Phaethon rubricauda*), or cattle egrets (*Bubulcus ibis*) were used as surrogates for avian Covered Species. Searcher efficiency trials occurred approximately monthly throughout the year. Most trials tested canine search teams in FY 2025; however, un-aided human searches occurred during 67 searches to cover a small area adjacent to a warehouse near Turbine 7 due to searcher safety concerns. This warehouse area routinely had aggressive, loose dogs in the vicinity, making it unsafe to perform searches with a search dog. Therefore, 67 of these 162 searcher efficiency trials were administered to test human-only searcher efficiency.

Of the 162 trials placed, 13 bat surrogates and four bird carcasses were not available for detection.⁵ Within supplemental search areas, an additional 118 searcher efficiency trial carcasses were placed over 13 trial days. Of these, 18 bat surrogates and two bird carcasses were not available for detection. The probability that an available carcass would be detected is reported in Table 1.

2.5 Vegetation Management

Mowing within each of the eight search plots currently occurs every other week, on average. On a weekly basis, NPMPP staff and search contractors evaluate the condition of search plot vegetation, and contractors perform necessary vegetation management around turbines following the completion of scheduled fatality monitoring searches. Canine-safe herbicide is used as needed and only within the systematic search areas immediately around the turbines. This effort maintains vegetation at heights below approximately 8 inches within the systematic search areas at each turbine.

2.6 Scavenger Trapping

NPMPP has contracted scavenger control for the site. Traps are checked approximately every two weeks. Active trapping occurred at all eight turbines and connecting roadways throughout the Project area using 90 DOC250 and 10 Steve Allan traps⁶. Trap distribution has remained consistent throughout the implementation of this program. The scavenger control program documented the removal of 317 mongooses (*Herpestes auropunctatus*), 214 rats (*Rattus* spp.), 12 feral cats (*Felis catus*), 15 house mice (*Mus musculus*), and 52 non-target species (17 giant African snails [*Lissachatina fulica*], 12 cane toads [*Rhinella marina*], 10 spotted doves [*Spilopelia chinensis*], 10 common mynas [*Acridotheres tristis*], two white-rumped shama [*Copsychus malabaricus*], and one feral chicken [*Gallus gallus*] in FY 2025. Based on bi-weekly trapping data capture, rates were relatively stable over time and are reported in Table 2.

Table 2. Scavenger Trapping Results at the Project in FY 2025

Trap Check Date	Mongooses per Trap	Rats per Trap	Cats per Trap	Mice per Trap	Non-Target Species per Trap	Active Traps per Check ¹
07/06/2024	0.08	0.11	0.00	0.00	0.00	91
07/20/2024	0.21	0.13	0.01	0.00	0.01	89
08/04/2024	0.21	0.06	0.02	0.00	0.02	94

⁵ Carcasses not available for detection are those that were not detected by the search team, and upon investigation by the testing proctor, could not be found, indicating the carcass had likely been scavenged prior to the search.

⁶ Scavenger control traps are not deployed in the searchable agricultural areas for safety reasons due to the presence of tenant farmer's children and pets.

Trap Check Date	Mongoose per Trap	Rats per Trap	Cats per Trap	Mice per Trap	Non- Target Species per Trap	Active Traps per Check ¹
08/24/2024	0.16	0.06	0.01	0.00	0.02	90
08/31/2024	0.10	0.09	0.00	0.00	0.00	89
09/15/2024	0.15	0.02	0.00	0.00	0.02	93
09/28/2024	0.14	0.05	0.00	0.00	0.02	92
10/13/2024	0.14	0.08	0.00	0.00	0.01	93
10/26/2024	0.14	0.07	0.00	0.00	0.01	86
11/09/2024	0.08	0.16	0.00	0.00	0.04	89
11/23/2024	0.11	0.17	0.01	0.00	0.02	90
12/08/2024	0.17	0.10	0.00	0.01	0.00	94
12/25/2024	0.22	0.07	0.00	0.01	0.02	91
01/11/2025	0.07	0.16	0.00	0.00	0.02	89
01/19/2025	0.05	0.09	0.01	0.02	0.01	94
02/01/2025	0.10	0.08	0.00	0.00	0.01	84
02/15/2025	0.13	0.15	0.00	0.00	0.04	89
03/02/2025	0.14	0.08	0.00	0.02	0.02	92
03/15/2025	0.08	0.07	0.00	0.00	0.01	90
03/30/2025	0.11	0.08	0.01	0.01	0.04	93
04/12/2025	0.10	0.05	0.00	0.00	0.02	83
04/27/2025	0.23	0.12	0.01	0.06	0.06	83
05/10/2025	0.17	0.09	0.01	0.00	0.01	87
05/25/2025	0.15	0.14	0.01	0.00	0.03	93
06/07/2025	0.18	0.11	0.00	0.03	0.08	89
06/22/2025	0.11	0.02	0.02	0.00	0.00	93
Mean (SD)	0.14 (0.14)	0.09 (0.04)	0.01 (0.01)	0.01 (0.01)	0.02 (0.02)	89.96 (3.23)
1. "Active Traps per Check" represents the number of active traps checked on a given trap check date. Trap numbers were less than 100 when traps were damaged, lost, or malfunctioned.						

2.7 Documented Fatalities and Monitoring Results

All observed downed wildlife were handled and reported in accordance with the USFWS and DOFAW Downed Wildlife Protocol (DOFAW and USFWS 2020). NPMPP documented 69 wildlife incidents in FY 2025 (Appendix 1). Three fatalities of one Covered Species, Hawaiian hoary bat, and one fatality of an endangered species not covered by the HCP, Hawaiian petrel (*Pterodroma sandwichensis*)⁷, were found in FY 2025. Eighteen fatalities of species covered by the Migratory Bird Treaty Act (MBTA) were documented: twelve wedge-tailed shearwaters, three cattle egret (*Bulbucus ibis*), one Pacific golden-plover (*Pluvialis fulva*), one white-tailed tropicbird (*Phaethon lepturus*), and one house finch (*Haemorhous mexicanus*). The other wildlife incidents included 17 common waxbills (*Estrilda astrild*), 15 spotted doves (*Spilopelia chinensis*), seven zebra doves (*Geopelia striata*), two common myna (*Acridotheres tristis*), two red-billed leiothrix (*Leiothrix lutea*), two red-vented bulbuls (*Pycnonotus cafer*), one African silverbill (*Euodice cantans*), and one chestnut munia (*Lonchura atricapilla*). Note that of the four total observed bat fatalities, three occurred at turbines with deterrents and the fourth occurred at a turbine without.

Various factors affect how the number of observed fatalities is scaled to estimate the direct take of Covered Species at the Project. Unobserved fatalities are due to three primary factors:

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

Sections 2.3 and 2.4 describe methods that are used to estimate the effect of the first two factors. To evaluate the contribution of the proportion of the search area searched to the estimate, an agency recommended ballistics model (Hull and Muir 2010) and GIS-delineated search area spatial data were used to estimate the proportion of the carcass distribution searched.

2.7.1 Hawaiian Hoary Bat

2.7.1.1 Estimated Take

Four Hawaiian hoary bat fatalities have been observed at the Project since the Project began testing turbine operations (commissioning) in August 2020. One of the observed bat fatalities (Q1 FY 2022) was identified as female (Pinzari and Bonaccorso 2018) and occurred outside the period when females have dependent young, and no indirect take is associated with that individual. The second observed bat fatality (Q1 FY 2025) was identified as male (S. Shizuru, pers. comm., February 4, 2025); hence, no indirect take is associated with that individual. The third observed bat fatality (Q2 FY 2025) and fourth observed bat fatality (Q3 FY 2025), both for whom genetic sexing results are pending, occurred outside the period when females have dependent young and no indirect take

⁷ The Project has initiated an amendment to the HCP to add Hawaiian petrel as a Covered Species.

is associated with those individuals. The observed Hawaiian hoary bat fatalities by fiscal year are listed in Table 3.

Table 3. Observed Hawaiian Hoary Bat Fatalities at the Project through FY 2025

Fiscal Year	Hawaiian Hoary Bat Observed Direct Take	Hawaiian Hoary Bat Incidental Fatality Observations	Total
2021	0	0	0
2022	1	0	1
2023	0	0	0
2024	0	0	0
2025	3	0	3
Total	4	0	4

On an annual basis, observed take and bias correction factors are applied to estimate the probability of having detected a fatality over the previous year using the Evidence of Absence software program (EoA; Dalthorp et al. 2017), an agency approved analysis tool. This process for the Project is complex, combining systematic search areas searched by canines with the small systematic search area searched by humans only and multiple groups of agricultural search plots with unique search schedules through a multi-class analysis in EoA. This analysis process is illustrated in Appendix 2.

Cumulative take is estimated from three components: (1) observed direct take (ODT) during protocol (standardized) fatality monitoring, (2) unobserved direct take (UDT), and (3) indirect take. EoA is used to assess direct take, using results from bias correction and ODT to generate an upper credible limit (UCL) of direct take (i.e., ODT + UDT). USFWS and DOFAW have requested that estimates of direct take be reported at the 80 percent UCL. Direct take values from this analysis can be interpreted as: there is an 80 percent probability that actual direct take at the Project over the analysis period was less than or equal to the 80 percent UCL. Associated indirect take is estimated based on the sex and age characteristics of bat fatalities found at the Project, and the life history characteristics of (assumed to be representative of) the Hawaiian hoary bat, as described in the Project's approved HCP and current agency guidance (USFWS 2016).

The total cumulative estimated bat take (including indirect take) from the start of Project commissioning (when periodic turbine operation began) through FY 2025 is summarized in Table 4. Input values used in the EoA multi-year analysis are provided in Table 5.

Table 4. Cumulative Take Estimation for Hawaiian Hoary Bat through FY 2025

A: Observed Direct Take Used in Analysis	B: Incidental Observed Take	C: 80% Upper Credible Limit of Estimated Direct Take¹	D: UDT (C – A – B)	E: Estimated Indirect Take (Adult Equivalents)²	Total Estimated Adult Take (C + E)
4	0	10	6	1	11
1. Multi-year EoA analysis (Dalthorp et al. 2017) based on FY 2021 –FY 2025 data. 2. Overall indirect take for the Project is the rounded-up value calculated using the USFWS (2016) methodology as described in the text.					

Table 5. Input Values for Multi-Year Analysis of Hawaiian Hoary Bat Take

Modelling Period	Weight	Search Fatalities	Ba¹	Bb¹	$\hat{g}$	$\hat{g}$ 95% CI
FY 2021	0.87	0	81.18	74.92	0.520	0.442 – 0.598
FY 2022 ²	1.00	1	144.3	115.2	0.556	0.492 – 0.616
FY 2023 ²	1.00	0	152.9	134.2	0.533	0.475 – 0.590
FY 2024 ²	1.00	0	91.06	97.79	0.482	0.411 – 0.553
FY 2025 ²	1.00	3	74.72	78.21	0.489	0.410 – 0.568
1. EoA stores the parameters of the beta distribution to four significant digits; however, model imprecision suggests these results should be reported to a maximum of three digits (Dan Dalthorp, USGS, pers. comm. January 2020). 2. Results from FY 2022 – FY 2025 include results from searches within the systematic search areas and consistently searched supplemental search areas combined into a single estimate through the multi-class module in EoA (Dalthorp et al. 2017).						

The estimated direct take (ODT + UDT) for the four Hawaiian hoary bat fatality found between the start of operation and end of FY 2025 (June 30, 2025) is less than or equal to 10 bats (80 percent UCL). Details of the estimated direct take parameters are in Appendix 3.

Indirect take is estimated to account for the potential loss of future individuals (offspring) that may occur as the result of the loss of an adult female through direct take during the breeding period when females may be pregnant or supporting dependent young. Indirect take for the Project is calculated using the USFWS (2016) guidance as follows:

- **Total Juvenile Take Calculated from Observed Female Take (April 1 – September 15)**
 - 0 (observed females) * 1.8 (pups per female) = 0 juveniles⁸

⁸ As the observed fatalities in FY 2022 (Q2) and FY 2025 (Q2 and Q3) occurred outside the period when females have dependent young, and the FY2025 Q1 fatality was identified as male, no indirect take is associated with those individuals.

- **Total Juvenile Take Calculated from Observed Unknown Sex Take (April 1 – September 15)**
 - $0 \text{ (observed unknown sex)} * 0.5 \text{ (assumed sex ratio)} * 1.8 \text{ (pups per female)} = 0$ juveniles
- **Total Juvenile Take Calculated from Unobserved Take**
 - $6 \text{ (unobserved direct take)} * 0.5 \text{ (assumed sex ratio)} * 0.25 \text{ (proportion of calendar year females could be pregnant or have dependent pups)} * 1.8 \text{ (pups per female)} = 1.35$ juveniles
- **Total Calculated Juvenile Indirect Take = 1.35**
- **Total Adult Equivalent Indirect Take = $0.3 \text{ (juvenile to adult conversion factor)} * 1.35 = 0.405$**

The UCL for cumulative Project take of the Hawaiian hoary bat at the 80 percent credibility level is 11 adult bats ($10 \text{ [estimated direct take]} + 1 \text{ [estimated indirect take]}$). That is, there is an approximately 80 percent probability that actual take at the Project at the end of FY 2025 is less than or equal to 11 bats.

2.7.1.2 Projected Take

Evidence of Absence (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.

NPMPP projected take through the end of the permit term using the fatality monitoring data collected through FY 2025. The objective of this analysis was to evaluate the potential for the Project to exceed the permitted take limit at the 80 percent UCL prior to the end of the permit term (Appendix 3). For this analysis, the detection probability for future years is assumed to be constant at 0.489 (95 percent CI = $[0.410, 0.568]$). As future indirect take is unknown and will potentially vary based on the timing of ODT, it was assumed that the total indirect take for the Project over the permit term would be a maximum of three adult equivalents (10 juveniles based on assumed Hawaiian hoary bat survival rates; USFWS 2016), or 5.8 percent of the permitted take. Currently, the proportion of total take that is attributable to indirect take is 3.9 percent ($0.405 \text{ [adult indirect take]} / 10.405 \text{ [adult direct and indirect take]} = 0.0389$). Assuming three adult bat equivalents are attributed to the Project as indirect take, the permitted direct take under the Project's ITP and ITL would be 48 bats (i.e., $51 \text{ permitted take} - 3 \text{ indirect take} = 48 \text{ direct take}$). Based on the analysis described above and presented in Appendix 3, there is an 83.9 percent chance that the 80 percent UCL of cumulative take will not be exceeded during the permit term.

2.7.2 Other Covered Species

There has been no observed take of the seven other Covered Species (i.e., excluding Hawaiian hoary bat) at the Project. The yearly take for these species by fiscal year is listed in Table 6.

Table 6. Observed Fatalities of Other Covered Species at the Project through FY 2025

Covered Species	FY 2021 – FY 2025	
	Direct	Incidental
Newell's shearwater	0	0
Hawaiian goose	0	0
Hawaiian duck	0	0
Hawaiian stilt	0	0
Hawaiian coot	0	0
Hawaiian gallinule	0	0
Hawaiian short-eared owl	0	0
Total	0	0

2.8 Invasive Species Management Surveys

In FY 2019 NPMPP developed an invasive species management plan to limit the potential impacts of invasive species (Tetra Tech 2019b). Consistent with HCP requirements, NPMPP coordinated with the O'ahu Invasive Species Committee (OISC) to identify and implement measures to minimize the risk of introducing devil weed (*Chromolaena odorata*) to the Project area. Approaches to minimize risk include periodic site inspections by qualified personnel to search for the presence of plants and cleaning of equipment used in the Project area. Surveys covering the Project's disturbance footprint are conducted annually in the fall.

During an invasive plant species survey of the Project in Q2 FY 2025, biologists detected devil weed in the approximately the same distribution as the Q2 FY 2024 surveys (Turbines 3, 4, and 6, as well as along the road between the Mālaekahana and Department of Land and Natural Resources-owned portions of the Project, and on the road between turbines 6 and 7). No new detection areas were documented in FY 2025. Following initial detection of devil weed at the site, NPMPP coordinated with the OISC to verify appropriate control measures for this species within the Project's disturbance footprint and has continued to implement this approach in FY 2025.

Field observations suggest devil weed is established beyond the Project's disturbance footprint. The OISC has reported the presence of a known infestation in the vicinity of the Project prior to Project construction. Based on current data, OISC does not believe eradication of devil weed is possible and requested that NPMPP manage the species to the extent practicable, using best practices identified in the Project's invasive species management plan. NPMPP manages the devil weed within the Project footprint through a combination of hand removal and mowing. Hand pulled specimens are bagged and incinerated. NPMPP continues to monitor and manage known infestations and monitor

for the presence of devil weed in new locations. The canine search team and project biologist follow decontamination protocols to clean field gear following potential exposure to devil weed seed sources. This approach should reduce the risk of further expansion of the colony. To date regular mowing of affected areas within the systematic search areas have kept the plants from forming flowers or seeds.

2.9 Wildlife Education and Incidental Reporting System

NPMPP implemented a Wildlife Education and Incidental Reporting Program for Project staff working at the Project. This training enables staff to identify the Covered Species that may occur at the Project site by providing staff with printed reference materials that include photographs of each of the Covered Species, information on their biology and habitat requirements, threats to the species onsite, and avoidance and minimization measures of the HCP. Project staff are responsible for awareness of wildlife activity onsite, responding to and treating wildlife appropriately, documenting any Project-related wildlife incidents, and reporting any downed wildlife to the on-site manager.

Seventy-three Project personnel, subcontractors, and visitors were trained through this program in FY 2025. Downed wildlife observations found during standardized searches were supplemented by 11 incidental downed wildlife observations reported in FY 2025 by Project personnel trained through the Wildlife Education and Incidental Reporting Program (Appendix 1).

3.0 Mitigation and Related Activities

The Project's mitigation requirements are described in Section 6.0 of the HCP (Tetra Tech 2016).

3.1 Hawaiian Hoary Bat

3.1.1 Poamoho Management Area Research and Management Plans

The mitigation plan for the Hawaiian hoary bat in the HCP includes preparation and implementation of research and management plans targeting actions that will increase the quantity and quality of bat habitat in the Poamoho Management Area and study the effectiveness of habitat restoration activities on improving the availability of bat food resources and increasing bat activity. Several revisions to the associated research and management plans were submitted and reviewed by DOFAW and USFWS between FY 2022 and 2024. In Q3 2024 the ESRC reviewed the plans and recommended revisions requiring further coordination with all stakeholders involved in the management of the Poamoho Management Area (PMA). From the close of Q4 2024 through Q2 2025, NPMPP met with stakeholders and worked on revisions to the mitigation and research plans. In Q3 2025 (January 23, 2025) NPMPP held an in-person meeting with PMA stakeholders including the Ko'olau Mountains Watershed Partnership (KMWP), DOFAW Native Ecosystems Protection & Management staff, DOFAW O'ahu staff, DOFAW HCP staff, USFWS, OISC, NPMPP, and Tetra Tech. Information discussed and received during this meeting was integrated into further revisions to the

mitigation and research plans and revised versions of these plans were provided to DOFAW and USFWS in February of Q3 2025. Further revisions were made in March of Q3 2025 prior to the ESRC meeting held on April 11 of Q4 2025. The ESRC, DOFAW HCP, and USFWS approved the revised bat management and research plans with amendments. NPMPP is making final revisions to these plans to incorporate the recommendations from the ESRC, DOFAW, and USFWS and anticipates submittal of a revised final management and research plans in Q1 FY 2026.

3.1.2 Bat Deterrent Research Plan

The ITL includes a special condition requiring NPMPP to perform research focused on bat deterrence measures with the goal of reducing bat take at wind turbines. NPMPP and Tetra Tech have consulted with DOFAW on their priorities for this research, potential challenges, and possible research approaches over several years. In Q4 of FY 2024, Tetra Tech presented the plan for review by the ESRC. The ESRC recommended the development of a further revised plan that more directly evaluates the efficacy of deterrents and to consider the inclusion of thermal videography. NPMPP revised the deterrent plan to study the efficacy of deterrents through a combination of thermal videography and ultrasonic acoustic recordings to monitor nightly activity, flight, and foraging behavior of bats at four wind turbines at the NPM project site: two turbines equipped with deterrents, two turbines with no deterrents. A revised research plan was submitted to DOFAW in Q3 2025. Comments were received in April of Q4, 2025. Revisions were made and the plan was submitted to DOFAW in late April of Q4, 2025 and in May 2025 of Q4 2025, DOFAW formally approved the bat deterrent research plan in accordance with ITL Special Condition 8. The research plan is anticipated to be implemented during Q1 and Q2 of FY 2026 and results reported in Q3 of FY 2026.

3.1.3 On-Site Acoustic Surveys

The Project commenced commercial operation on December 11, 2020. As part of the HCP the Project commits to performing acoustic monitoring for Hawaiian hoary bat activity for an undefined period during operation (Section 4.2.2 of the HCP, Tetra Tech 2016). Post-construction monitoring for bat activity began in September 2020 and is currently in the 5th monitoring year. Monitoring was conducted at four locations (Turbines 1, 4, 6, and 9; Figure 1) using ground-based recording units. Recording units consisted of a Song Meter SM4BAT-FS ultrasonic acoustic recorder equipped with high frequency microphones (SMM-U2; Wildlife Acoustics, Inc., Maynard, Massachusetts), elevated 3 meters above the ground on poles and powered by 12 v/18 amp-h batteries connected to 10 w/12 v solar panels (ACOPower, Walnut, California). All units were set to record nightly bat activity beginning 1 hour before sunset and end 1 hour after sunrise. Monitoring site locations were selected to provide the best spatial distribution across the Project and representation of the habitats (e.g., mature forest, agriculture, and gulch).

The objective of acoustic monitoring is to better understand the annual, seasonal, and site variation in bat activity at the Project. Analysis of variance (ANOVA) and Tukey's honest significance difference (Tukey's HSD) were used to test for differences in annual detection rates between the FY

2021 and FY 2025 monitoring years. A linear model (LM) was used to test for a change in detection rates across all monitoring years and for differences in mean detection rates between sites. Data were normalized with an Ordered Quantile Normalization transformation using the ‘bestNormalize’ package in R (Peterson 2021). The distribution of residuals from the LM were examined to check for violations of model assumptions. All tests were two-tailed, employed an alpha value of 0.05, and were conducted in R version 4.4.2 (R Core Team 2024). The characterization of Hawaiian hoary bat seasons corresponds approximately to Gorresen et al. (2013).

Bat activity at the Project has been generally low across the five-year monitoring period, but gradual increases in annual detection rates have occurred since monitoring began. During FY 2025 (June 2024 – May 2025), Hawaiian hoary bats were detected on 169 out of 1,280 detector-nights, resulting in a detection rate of 13.2 percent. This represents the highest annual detection rate recorded since monitoring began in FY 2021. Bat detection rates were highest from August through October during the lactation and post-lactation reproductive periods, with a peak (0.34) occurring in the month of September. Following the September peak, bat activity continued to decline throughout the post-lactation reproductive period and remained low through the pre-pregnancy reproductive period. Detection rates increased again in April and May of the pregnancy reproductive period (Figure 2).

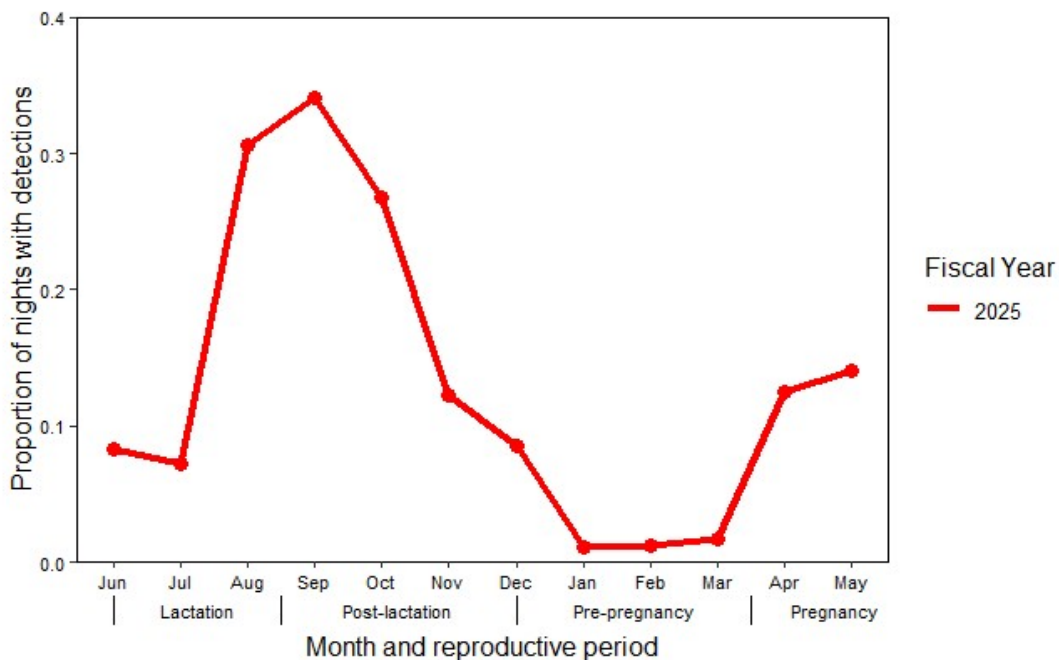


Figure 2. Monthly Bat Acoustic Activity at Nā Pua Makani for FY 2025 with Corresponding Reproductive Periods

The annual detection rate in FY 2025 was higher than all previous years, with notable increases observed since FY 2021 (Table 7). However, this increase was only statistically significant when

comparing FY 2021 to FY 2025 (ANOVA: $F_{4, 52} = 2.95$, $P < 0.029$; Tukey's HSD: $P < 0.024$). Despite the lack of significance between adjacent years, a significant overall increasing trend in detection rates was identified across all monitoring years (LM: $R^2 = 16.84$ percent; $F_{1, 55} = 11.14$, $P < 0.002$), suggesting a gradual increase in bat activity at the site over time (Figure 3). The seasonal patterns observed in FY 2025 were consistent with those documented in previous years (Figure 4).

Table 7. Number of Nights Sampled, Number of Nights with Detections, and Proportion of Nights with Bat Detections at Four Ground-based Detectors Sampled from FY 2021 through FY 2025

Sampling Period	No. of Nights Sampled	No. of Nights with Detections	Proportion of Nights with Detections
FY 2021 (September 2020 - May 2021)	969	26	0.027
FY 2022 (June 2021 - May 2022)	1,357	83	0.061
FY 2023 (June 2022 - May 2023)	1,351	130	0.096
FY 2024 (June 2023 - May 2024)	1,345	140	0.104
FY 2025 (June 2024 - May 2025)	1,280	169	0.132

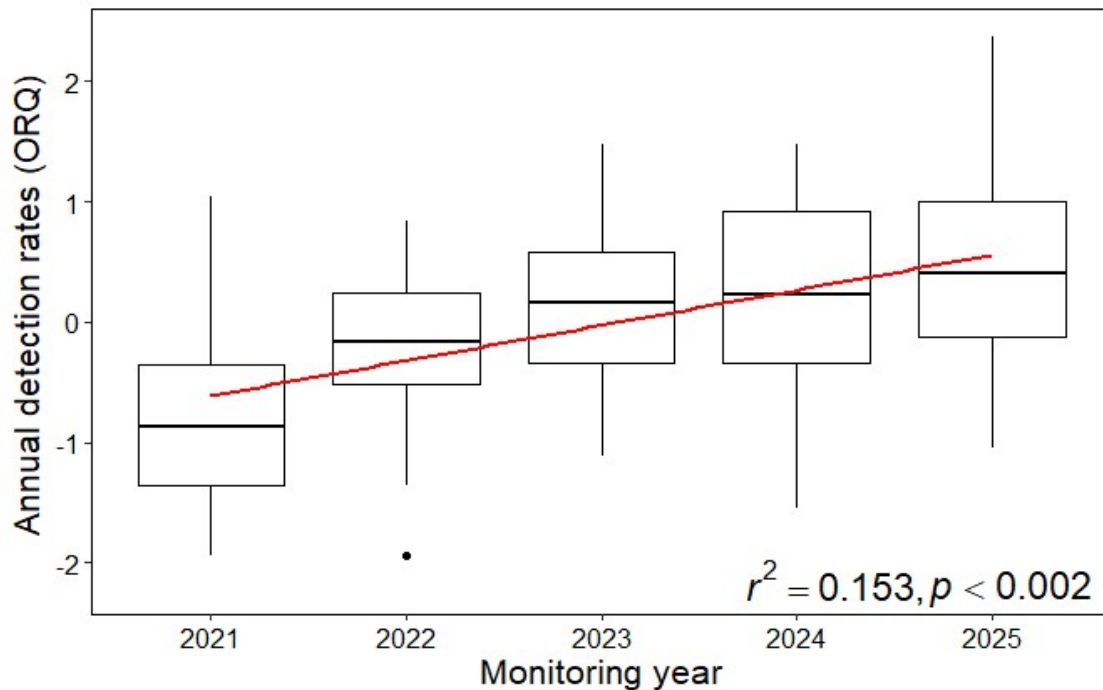


Figure 3. Box-plot with Linear Regression Showing the Increasing Trend in the Annual Detection Rate at the Project between FY 2021 and FY 2025

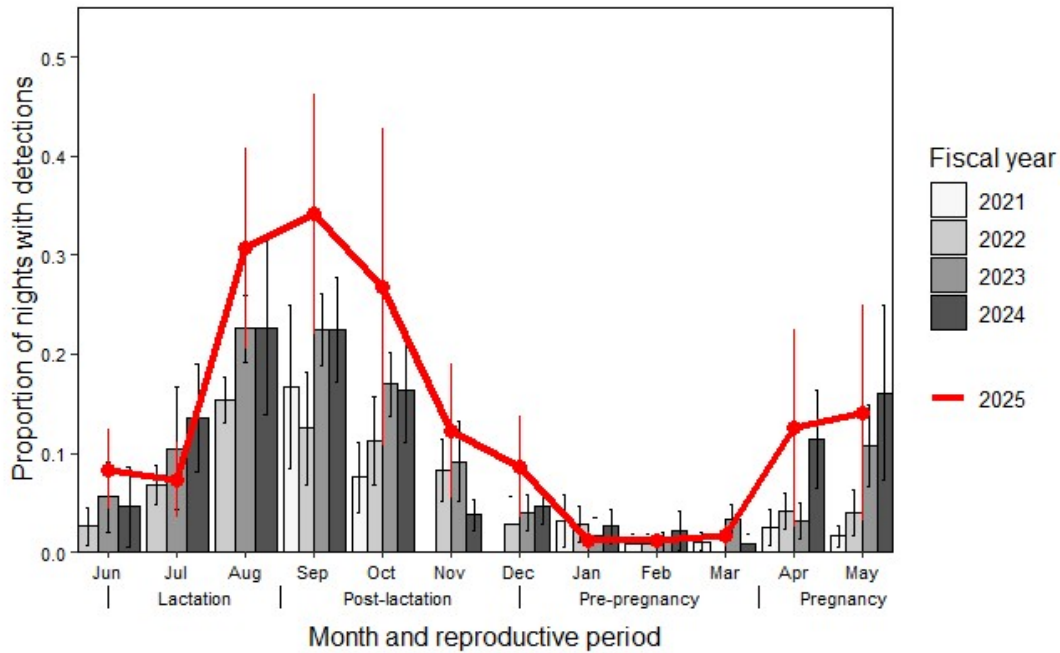


Figure 4. Monthly Bat Acoustic Activity at Nā Pua Makani for FY 2021 and FY 2025 with Corresponding Reproductive Periods

Site-specific trends in detection rates further indicated spatial variability in bat activity. Notably, significant differences were observed during the lactation and post-lactation periods (July–October), when overall activity was higher (LM: $R^2 = 63.9$ percent; $F_{47,131} = 4.93$, $P < 0.001$; Figure 5). In July, WTG-6 had significantly higher detection rates than WTG 9 ($t = 2.10$, $P < 0.039$). In August detection rates were significantly greater at WTG-1 ($t = 2.80$, $P < 0.006$), WTG-4 ($t = 2.82$, $P < 0.006$) and WTG-6 ($t = 4.06$, $P < 0.001$) compared to WTG-9. In September, detections were significantly higher at WTG-1 ($t = 3.42$, $P < 0.001$) and WTG-6 ($t = 3.70$, $P < 0.001$) compared to WTG-9. while in October, detection rates at WTG-4 were greater compared to WTG-9 ($t = 2.90$, $P < 0.005$).

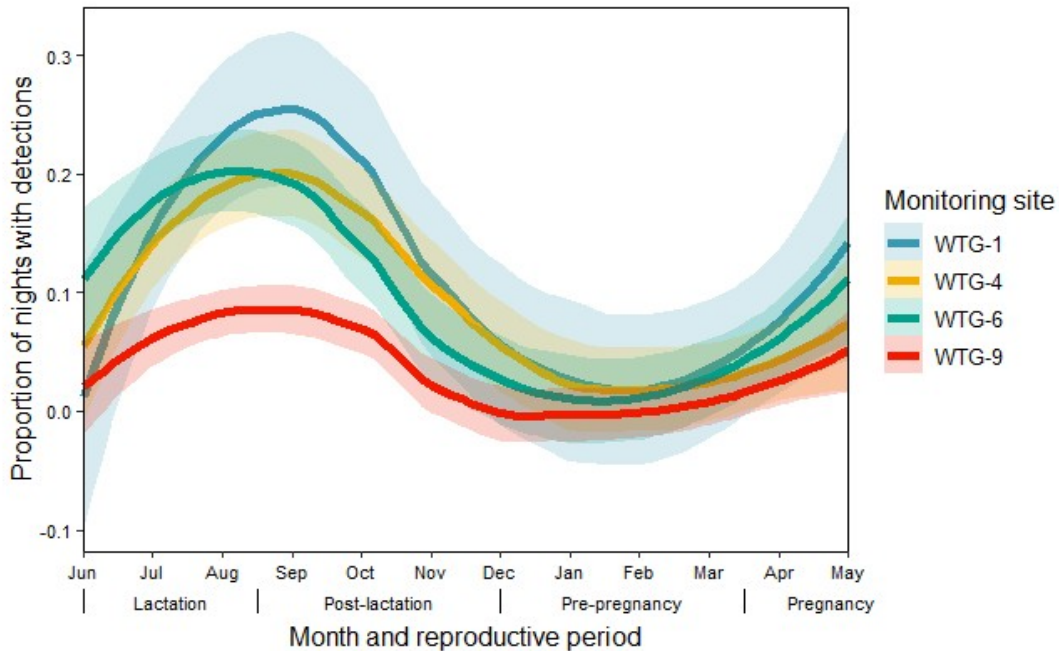


Figure 5. Site-Specific Variation in Mean Detection Rates for Each Month with Corresponding Reproductive Periods.

Note: Trend Lines are fitted with Loess smoothing curve; see Figure 1 for spatial context.

3.2 Newell's Shearwater

NPMPP provided required mitigation funds to the National Fish and Wildlife Foundation (NFWF) on September 22, 2020. During the January 30, 2025 (Q3 2025) annual meeting with USFWS and DOFAW, USFWS provided an update that USFWS is considering potential projects to fund and is working with NFWF to pull together funds for a larger mitigation project using funds contributed by NPMPP and that USFWS will provide an update with they have more information (Jonah Dedrick, pers. comm. January 2025). At the end of FY 2024 USFWS has not provided an update or reported that NFWF has funded programs using the NPMPP funds. NPMPP will report results from the Newell's shearwater mitigation efforts once NFWF identifies and funds an appropriate mitigation project.

3.3 Hawaiian Goose

Based on NPMPP's consultation with DOFAW and USFWS regarding the loss of the Hawaiian goose population on O'ahu prior to the construction and operation of the Project, NPMPP will address new information associated with this species in the HCP major amendment (see Section 4.0).

3.4 Hawaiian Waterbirds

No Hawaiian waterbird take has been documented. A revision to the Project's waterbird mitigation plan was required due to changes in habitat and actions at the mitigation site outside of the control

of NPMPP. A minor revision to the mitigation plan was accepted by USFWS and DOFAW in Q2 FY 2024. In Q3 FY 2024, the MOU was finalized with DOFAW. The first annual payment was submitted to DOFAW in Q4 FY 2024. Implementation of the mitigation plan by DOFAW began in Q2 FY 2025. Per the MOU, DOFAW is required to submit quarterly email updates with data obtained for that quarter within 15 calendar days of the end of each quarter. NPMPP received the first and second quarterly data submittals (periods November 2024 – January 2025 and February 2025 – April 2025, respectively) from DOFAW. The data from the third quarterly report (May 2025 – July 2025) is anticipated from DOFAW on August 15, 2025. Results from Hawaiian Waterbird mitigation efforts performed between November 2024 to October 2025 will be reported in the FY 2026 annual report.

3.5 Hawaiian Short-eared Owl

NPMPP provided required mitigation funds to the Endangered Species Trust Fund on September 18, 2020, and an MOU for use of the funds and reporting requirements was finalized with DOFAW on February 18, 2021. DOFAW used the funds provided by NPMPP to fund a graduate research project on Hawaiian short-eared owl breeding ecology. Appendix 3 in the FY 2023 annual report (Tetra Tech 2023a) is the final report from that study (Price and Wang 2023).

4.0 Adaptive Management

NPMPP has identified several adaptive management actions for the Project and has coordinated closely with USFWS and DOFAW to document needs and ensure agency support for the identified actions. Adaptive management actions identified by NPMPP include:

- Limited deployment of ultrasonic acoustic bat deterrents to test their efficacy at the Project;
- Addressing changed conditions relating to the status of the Hawaiian goose on O‘ahu.

In consultation with USFWS and DOFAW, NPMPP installed ultrasonic acoustic bat deterrents designed by NRG Systems on four Project turbines based on available scientific research and preliminary results from the Kawaiiloa Wind Farm on O‘ahu (Tetra Tech 2019c, Tetra Tech 2020b, Weaver et al. 2019). Deterrents became operational between September 17 and 28, 2020. Each bat deterrent system consists of six deterrent units (DU) and a single deterrent unit controller (DUC). Each DU is deployed at the front of the nacelle top and bottom. The three top mounted DU’s are 45” downwind of the rotor. The three bottom mounted DU’s are 30” downwind of the rotor. Each DU consists of a subarray of six speakers which emit sounds at different frequencies and decibel levels. FAA lights occupy the back of the nacelle approximately 20 feet behind the top mounted DU’s. Each DU consists of six subarray speakers. The DU are connected via cables to the DUC which powers, sets schedules, and communicates the status of the system.

The deterrent system is monitored to ensure components are operating according to the manufacturer’s recommendations. The effective area covered by each of the 6 deterrent units overlap, ensuring redundancy in the system in the event of a component failure. Components are

replaced as soon as practicable after they fall below the manufacturer’s standards, and replacement components are stored on site to ensure availability. During FY 2025, the deterrent units operated within manufacturer’s recommendations 91 percent of the time. Additional information on NRG’s bat deterrent system is provided on their website (NRG Systems 2025).

USFWS, DOFAW, and NPMPP have agreed that because the Hawaiian goose was extirpated from O’ahu prior to the construction and operation of the Project, the Project currently poses no risk to the Hawaiian goose. NPMPP continues to work with USFWS and DOFAW to address this changed circumstance in the Project’s HCP major amendment.

5.0 Agency Meetings, Consultations, and Site Visits

NPMPP and Tetra Tech communicated actively with USFWS, and DOFAW throughout FY 2025 through in-person meetings, conference calls, and e-mail communications related to the Project’s HCP. The purposes of these communications included required semi-annual meetings, and planning associated with avoidance and minimization measures, monitoring, and mitigation. A summary of agency coordination is provided in Table 8.

Table 8. Summary of Key Agency Coordination and Communication in FY 2025

Date	Description	Participants/Recipients
07/01/2024	USFWS provided Hawaiian hoary bat fatality records for Hawai’i windfarms to assist with fall distribution analysis in response to ESRC recommendation to evaluate new literature and establish best available science regarding fall distribution	NPMPP, Tetra Tech, USFWS
07/10/2024	USFWS provided information on potential petrel mitigation sites for HCP Amendment	NPMPP, Tetra Tech, USFWS
08/08/2024	DOFAW asked for more updates on Deterrent Research Plan. NPMPP/Tetra Tech responded that options are being investigated and would respond in the next few months	DOFAW, Tetra Tech, NPMPP
08/08/2024	Protected Wildlife Permit Renewal Submitted	NPMPP, Tetra Tech, DOFAW
08/12/2024	Meeting to discuss Hawaiian petrel mitigation options	DOFAW, USFWS, Tetra Tech, NPMPP
08/20/2024	Tetra Tech site visit to Poamoho with the Ko’olau Mountain Watershed Partnership (KMWP) regarding bat mitigation plans	Tetra Tech, KMWP
09/03/2024 and 09/04/2024	Agencies provided comments on FY 2024 Annual Report	DOFAW, USFWS, Tetra Tech, NPMPP
10/21/2024	Tetra Tech and NPMPP site visit to NPMPP’s Hāmākua Marsh Wildlife Sanctuary Waterbird Mitigation Site for work kickoff meeting with DOFAW.	DOFAW, Tetra Tech, NPMPP

Date	Description	Participants/Recipients
10/29/2024	NPMPP Revised FY 2024 Annual Report submittal	DOFAW, USFWS, Tetra Tech, NPMPP
11/27/2024	DOFAW Protected Wildlife Permit Renewal Fully Executed	USFWS, Tetra Tech, NPMPP
1/14/2025	Evidence of Absence (EoA) Meeting (requested by USFWS to discuss questions from their modeler)	NPMPP, Tetra Tech, DOFAW, USFWS
1/14/2025	2024 Annual report submitted for Protected Wildlife Permit	NPMPP, Tetra Tech, DOFAW
1/15/2025	2024 Annual report submitted for Special Purpose Utility Permit	NPMPP, Tetra Tech, USFWS
1/23/2025	In-person Bat Mitigation Workshop (Tier 1 Mitigation and Research Plans)	NPMPP, Tetra Tech, USFWS, DOFAW
2/6/2025	Planning for Agency Site Visit to Project in April 2025	NPMPP, Tetra Tech, USFWS, DOFAW
3/6/2025	ESRC Annual Review Meeting	DOFAW, Tetra Tech, NPMPP
3/18/2025 (email from J. Adams)	DOFAW/USFWS discussed potential sites for Hawaiian petrel mitigation projects	DOFAW, USFWS, Tetra Tech, NPMPP
4/2/2025	Agency Site Visit to Project site	DOFAW, USFWS, Tetra Tech, NPMPP
4/11/2025	ESRC Review and Vote on the NPMPP Hawaiian Hoary Bat Tier 1 Mitigation Habitat Management Plan for the Poamoho Management Area and Hawaiian Hoary Bat Tier 1 Mitigation Research Plan; ESRC approved both plans with amendments.	DOFAW, ESRC, Tetra Tech, NPMPP
5/5/2025	Bat Deterrent Research Plan review	DOFAW, Tetra Tech, NPMPP
6/4/2025	Hawaiian Petrel take estimate update	DOFAW, USFWS, Tetra Tech, NPMPP
6/13/2025	NPMPP Poamoho Bat Mitigation Plan – Poamoho Implementation Meeting	DOFAW HCP, DOFAW NEPM, DOFAW O'ahu, USFWS, Tetra Tech, NPMPP

6.0 Expenditures

Total HCP-related expenditures for the Project in FY 2025 were \$715,890. A summary of expenditures by category is provided in Table 9.

Table 9. HCP-related Expenditures at the Project in FY 2025

Category	Amount
Permit Compliance	\$81,735
Fatality Monitoring	\$137,555
Scavenger Trapping	\$27,939

Category	Amount
Acoustic Monitoring for Bats	\$21,130
Vegetation Management	\$77,752
Bat Deterrent Study	\$67,904
Bat Mitigation Planning	\$93,412
Waterbird Mitigation	\$199,320
HCP Amendment Planning	\$31,175
Total Cost for FY 2025	\$737,923

7.0 FY 2025 HCP Implementation Work Plan

NPMPP's FY 2025 HCP implementation work plan is provided as Table 10.

Table 10. FY 2025 HCP Implementation Work Plan

Program	Component	FY 2025			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
PCMM	Fatality Searches	Weekly searches throughout FY			
	Bias Correction Trials	Monthly searcher efficiency and carcass persistence trials	Monthly searcher efficiency and carcass persistence trials	Monthly searcher efficiency and carcass persistence trials	Monthly searcher efficiency and carcass persistence trials
	Scavenger Control	Trap checks every ~2 weeks, quarterly evaluation to assess changes in schedule			
	Vegetation Management	Occurs shortly after completion of searches, search areas evaluated weekly and managed as needed			
	Invasive Species Surveys		Survey Project area		
		Manage devil weed consistent with protocols			
Bat Acoustic Monitoring	Data downloads and Equipment Checks	Download data and equipment check monthly			
Bat Deterrents	Maintenance	Maintain operational deterrents on 4 turbines			
	Research Study	Revise and submit research plan for ESRC review and DOFAW approval	DOFAW approval/Implementation		
Mitigation	Hawaiian Goose	To be addressed in HCP major amendment			
	Waterbirds	Implementation			
	Newell's Shearwater	Coordinate with USFWS regarding mitigation progress and reporting			
	Hawaiian Hoary Bat	Revise and submit research and management plans for ESRC review and USFWS and DOFAW approval			
	Hawaiian Short-eared Owl	Complete			
Reporting	Wildlife Incidents	As required per DOFAW and USFWS 2020 protocol			
	Regular Reporting	FY 2024 annual report	Agency coordination	Agency Annual Meeting ESRC annual review	Agency coordination

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APPENDIX 1. OBSERVED FATALITIES, LOCATIONS, AND DETECTION METHOD IN FY 2025 AT THE PROJECT

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Species	Date	Turbine Number or Location ¹	Distance to the Turbine (meters)	Detection Method ²
<i>Phaethon lepturus</i> (white-tailed tropicbird)	07/10/2024	8	58	Search
<i>Spilopelia chinensis</i> (spotted dove)	07/20/2024	6	1.5	Incidental
<i>Spilopelia chinensis</i> (spotted dove)	07/26/2024	9	2.5	Incidental
<i>Pycnonotus cafer</i> (red-vented bulbul)	08/02/2024	6	2	Search
<i>Geopelia striata</i> (zebra dove)	08/11/2024	6	4	Incidental
<i>Spilopelia chinensis</i> (spotted dove)	08/11/2024	8	1	Incidental
<i>Bubulcus ibis</i> (cattle egret)	08/14/2024	7	59	Search
<i>Lasiurus semotus</i> (Hawaiian hoary bat)	08/21/2024	2	47	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater)	08/28/2024	7	36	Search
<i>Geopelia striata</i> (zebra dove)	09/11/2024	7	9	Search
<i>Spilopelia chinensis</i> (spotted dove)	09/28/2024	2	3	Incidental
<i>Spilopelia chinensis</i> (spotted dove)	10/05/2024	1	1	Incidental
<i>Pterodroma sandwichensis</i> (Hawaiian petrel)	11/04/2024	7	91	Search
<i>Acridotheres tristis</i> (common myna)	11/11/2024	9	1	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater)	11/11/2024	7	59	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater) ²	11/18/2024	8	86	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater) ²	11/18/2024	6	45	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater) ²	11/18/2024	7	112	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater)	11/22/2024	8	273	Incidental
<i>Acridotheres tristis</i> (common myna)	11/25/2024	2	144	Search

Species	Date	Turbine Number or Location ¹	Distance to the Turbine (meters)	Detection Method ²
<i>Estrilda astrild</i> (common waxbill)	11/25/2024	3	1	Search
<i>Estrilda astrild</i> (common waxbill)	11/25/2024	3	1	Search
<i>Estrilda astrild</i> (common waxbill)	12/09/2024	2	223	Search
<i>Estrilda astrild</i> (common waxbill)	12/16/2024	2	3	Search
<i>Estrilda astrild</i> (common waxbill)	12/16/2024	2	2.5	Search
<i>Estrilda astrild</i> (common waxbill)	12/16/2024	2	2	Search
<i>Ardena pacifica</i> (wedge-tailed shearwater)	12/16/2024	9	53	Search
<i>Bubulcus ibis</i> (cattle egret)	12/23/2024	7	69	Search
<i>Estrilda astrild</i> (common waxbill)	12/23/2024	1	24	Search
<i>Spilopelia chinensis</i> (spotted dove)	12/23/2024	7	100	Search
<i>Lasiurus semotus</i> (Hawaiian hoary bat)	12/30/2024	9	1	Search
<i>Estrilda astrild</i> (common waxbill)	12/30/2024	1	1	Search
<i>Estrilda astrild</i> (common waxbill)	12/30/2024	3	5	Search
<i>Spilopelia chinensis</i> (spotted dove)	01/05/2025	6	15	Incidental
<i>Geopelia striata</i> (zebra dove)	01/06/2025	3	1	Search
<i>Estrilda astrild</i> (common waxbill)	01/13/2025	2	6	Search
<i>Pycnonotus cafer</i> (red-vented bulbul)	01/13/2025	8	22	Search
<i>Haemorhous mexicanus</i> (house finch)	01/13/2025	3	2	Search
<i>Lonchura atricapilla</i> (chestnut munia)	01/18/2025	3	1	Incidental
<i>Estrilda astrild</i> (common waxbill)	01/21/2025	3	2	Search

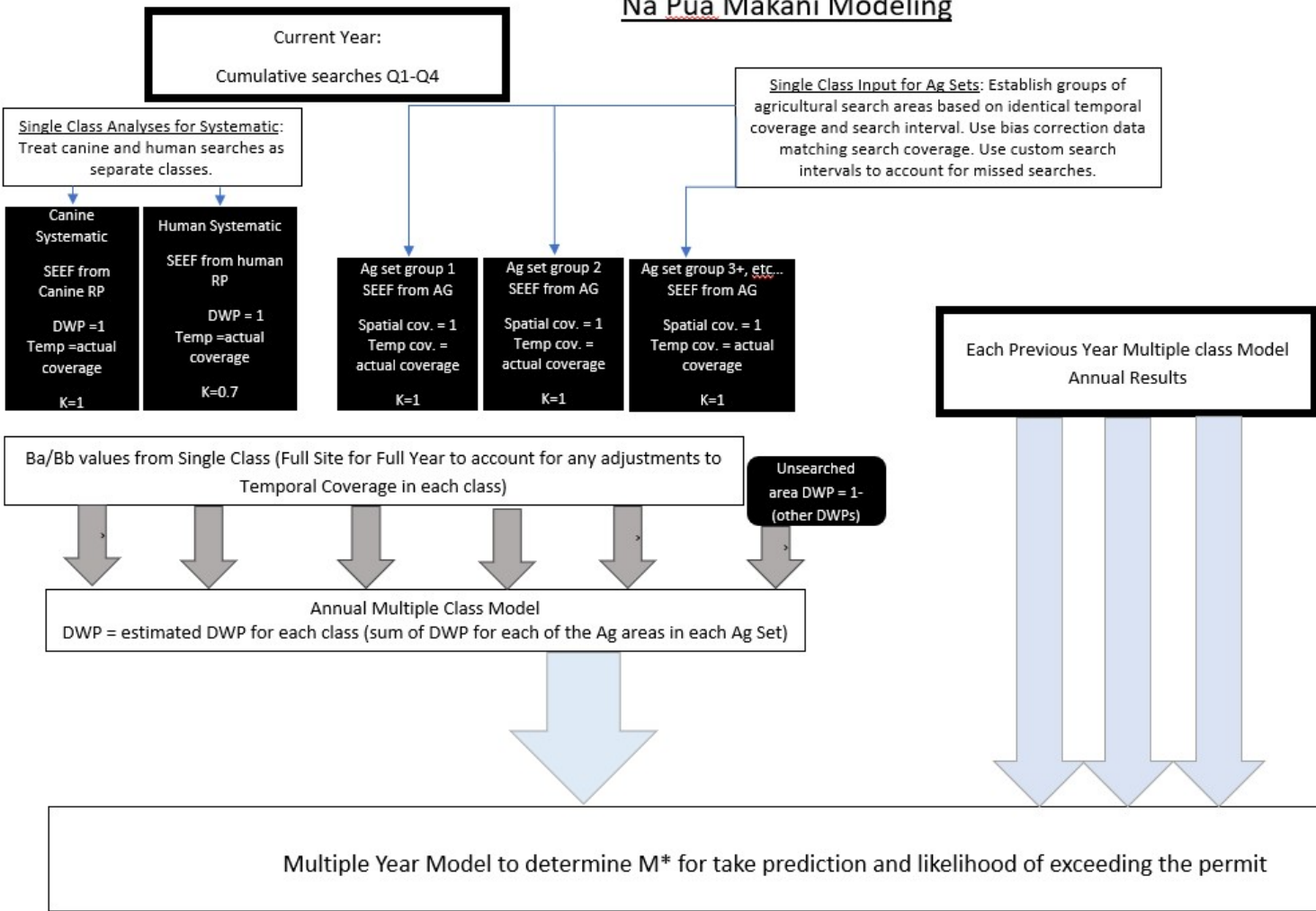
Species	Date	Turbine Number or Location ¹	Distance to the Turbine (meters)	Detection Method ²
<i>Lasiurus semotus</i> (Hawaiian hoary bat)	01/28/2025	4	1	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater)	01/28/2025	7	49	Search
<i>Pluvialis fulva</i> (Pacific golden-plover)	01/31/2025	7	1	Incidental
<i>Estrilda astrild</i> (common waxbill)	02/03/2025	1	4	Search
<i>Leiothrix lutea</i> (red-billed leiothrix)	02/09/2025	3	1	Search
<i>Geopelia striata</i> (zebra dove)	02/10/2025	9	131	Search
<i>Spilopelia chinensis</i> (spotted dove)	02/10/2025	9	35	Search
<i>Spilopelia chinensis</i> (spotted dove)	03/05/2025	6	2	Incidental
<i>Geopelia striata</i> (zebra dove)	03/10/2025	2	130	Search
<i>Estrilda astrild</i> (common waxbill)	03/10/2025	7	99	Search
<i>Spilopelia chinensis</i> (spotted dove)	03/14/2025	8	4	Incidental
<i>Spilopelia chinensis</i> (spotted dove)	04/02/2025	9	2	Incidental
<i>Spilopelia chinensis</i> (spotted dove)	04/05/2025	1	2	Incidental
<i>Estrilda astrild</i> (common waxbill)	04/14/2025	4	91	Search
<i>Spilopelia chinensis</i> (spotted dove)	04/14/2025	9	2	Search
<i>Spilopelia chinensis</i> (spotted dove)	04/21/2025	8	2	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater)	05/05/2025	7	40	Search
<i>Spilopelia chinensis</i> (spotted dove)	05/05/2025	2	30	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater)	05/10/2025	7	28	Incidental
<i>Geopelia striata</i> (zebra dove)	05/12/2025	6	37	Search

Species	Date	Turbine Number or Location ¹	Distance to the Turbine (meters)	Detection Method ²
<i>Ardena pacifica</i> (wedge-tailed shearwater)	05/12/2025	7	99	Search
<i>Ardena pacifica</i> (wedge-tailed shearwater)	05/17/2025	1	27	Incidental
<i>Bubulcus ibis</i> (cattle egret)	06/02/2025	9	5	Incidental
<i>Geopelia striata</i> (zebra dove)	06/02/2025	9	1	Search
<i>Estrilda astrild</i> (common waxbill)	06/09/2025	3	3	Search
<i>Leiothrix lutea</i> (red-billed leiothrix)	06/16/2025	7	148	Search
<i>Estrilda astrild</i> (common waxbill)	06/16/2025	2	6	Search
<i>Estrilda astrild</i> (common waxbill)	06/16/2025	2	15	Search
<i>Euodice cantans</i> (African silverbill)	06/30/2025	8	171	Search
1. Incidental detections are downed wildlife incidents detected outside of the systematic search effort, including detections outside of the defined systematic search areas but found during a search effort as well as detections of fatalities within search areas by non-searchers. 2. Found without apparent injuries and transported to wildlife rehabilitation facility, but later euthanized due to injuries subsequently diagnosed after drop off.				

APPENDIX 2. EVIDENCE OF ABSENCE ANALYSIS FLOWCHART FOR THE PROJECT

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Nā Pua Makani Modeling



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**APPENDIX 3. DALTHORP ET AL. (2017) FATALITY ESTIMATION
DATA FOR HAWAIIAN HOARY BATS THROUGH FY 2025 AT THE
PROJECT**

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Figure 1. Dalthorp et al. (2017) Multi-year Analysis Input

MY_bats_FY2020-25.rds - EoA, v2.0.7 - Multiple Years Module

Edit Help

Past monitoring and operations data

Year	p	X	Ba	Bb	g	95% CI
2021	0.871	0	81.18	74.92	0.5201	[0.442, 0.598]
2022	1	1	144.3	115.2	0.5561	[0.495, 0.616]
2023	1	0	152.9	134.2	0.5326	[0.475, 0.59]
2024	1	0	91.06	97.79	0.4822	[0.411, 0.553]
2025	1	3	74.72	78.21	0.4886	[0.41, 0.568]

Future monitoring and operations parameters

Year	p	g	g_lwr	g_upr
1	1	0.489	0.4099	0.5676
2	1	0.489	0.4099	0.5676
3	1	0.489	0.4099	0.5676
4	1	0.489	0.4099	0.5676
5	1	0.489	0.4099	0.5676
6	1	0.489	0.4099	0.5676
7	1	0.489	0.4099	0.5676
8	1	0.489	0.4099	0.5676
9	1	0.489	0.4099	0.5676
10	1	0.489	0.4099	0.5676
11	1	0.489	0.4099	0.5676
12	1	0.489	0.4099	0.5676
13	1	0.489	0.4099	0.5676
14	1	0.489	0.4099	0.5676
15	1	0.489	0.4099	0.5676

Options

Fatalities

☒ Estimate M Credibility level (1 - α) 0.8

☐ Total mortality ☒ One-sided CI (M*) ☐ Two-sided CI

Project parameters

Total years in project 20

Mortality threshold (T) 48

☐ Track past mortality

☒ Projection of future mortality and estimates

Future monitoring and operations

☒ g and p unchanged from most recent year

☐ g and p constant, different from most recent year

g 0.314 95% CI: 0.288 0.339 p 1

☐ g and p vary among future years

Average Rate

☐ Estimate average annual fatality rate (λ)

Annual rate threshold (τ) 2

☐ Credibility level for CI (1 - α) 0.9

☒ Short-term rate ($\lambda > \tau$) Term: 3 α 0.01

☐ Reversion test ($\lambda < p \tau$) p 0.6 α 0.1

Actions

Calculate Close

Figure 2. Dalthorp et al. (2017) Projection Results Figure Output

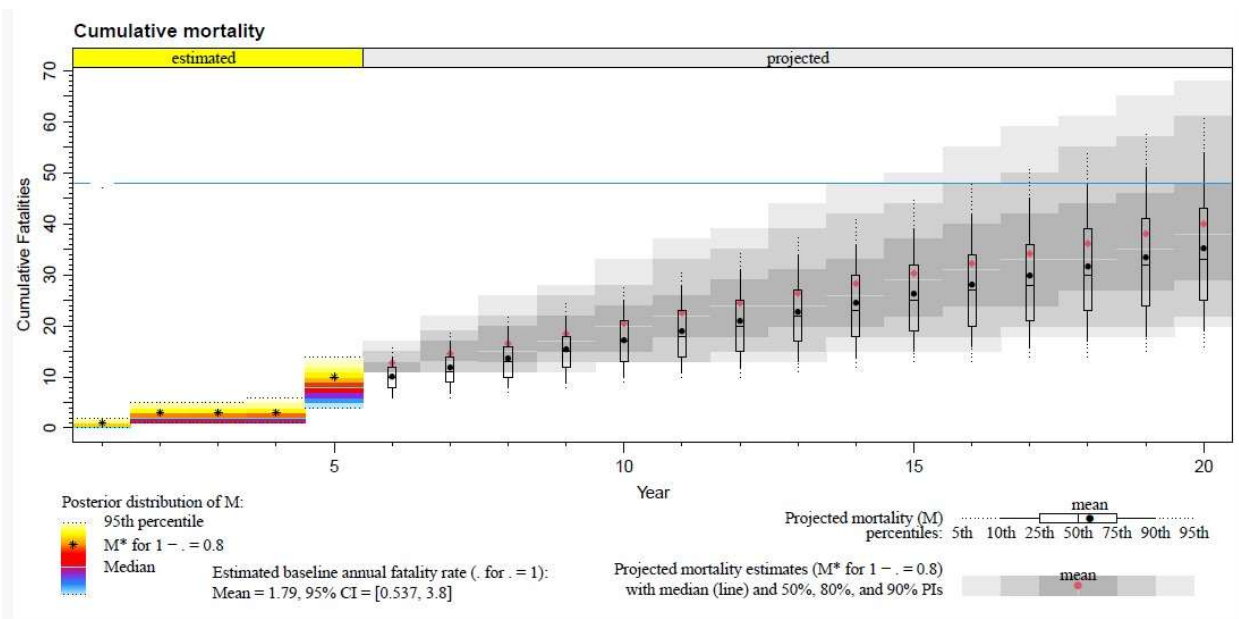


Figure 3. Dalthorp et al. (2017) Projection Text Results Output Page 1 of 2

```

=====
Summary statistics from posterior predictive distributions for 10000 simulated projects
-----
Estimated annual baseline fatality rate (lambda for rho = 1): mean = 1.79, 95% CI = [0.537, 3.8]

Projected fatalities and fatality estimates...
p(M > Tau within 20 years) = 0.1606 [exceedance]
p(M* > Tau within 20 years) = 0.2399 [triggering]
M* based on credibility level 1 - alpha = 0.8

Among projects with triggering (23.99%), mean(M) = 43.70 at time of triggering, with median = 43 and IQR = [39, 48]
Among projects with no triggering (76.01%), mean(M) = 29.58 at end of 20 years, with median = 29 and IQR = [23, 36]

Years of operations without triggering:
Mean = 19.29, with median = 20 and IQR = [20, 20]

-----
Summary statistics for projection years
-----

```

Yr	Mean M	M*	quantiles of M								quantiles of M*							
			0.05	0.10	0.25	0.50	0.75	0.90	0.95	0.05	0.10	0.25	0.50	0.75	0.90	0.95		
1	10.1	12.8	5	6	8	10	12	14	16	11	11	11	13	13	15	17		
2	11.9	14.6	6	7	9	11	14	17	19	11	11	13	13	17	19	22		
3	13.7	16.6	7	8	10	13	16	20	22	11	11	13	15	20	22	24		
4	15.4	18.5	8	9	12	15	18	22	25	11	13	15	17	22	26	28		
5	17.2	20.4	9	10	13	17	21	25	28	13	13	15	20	24	28	33		
6	19.1	22.5	10	11	14	18	23	28	31	13	13	18	22	26	33	37		
7	20.9	24.5	10	12	15	20	25	31	35	13	15	18	22	29	35	39		
8	22.6	26.4	11	13	17	22	27	34	38	13	15	20	24	31	39	44		
9	24.4	28.3	12	14	18	23	30	37	41	15	18	22	26	35	42	48		
10	26.2	30.4	13	15	19	25	32	40	44	15	18	22	29	37	46	50		
11	28.0	32.3	13	16	20	27	34	42	48	15	18	24	31	40	48	55		
12	29.8	34.2	14	17	22	28	36	45	51	18	20	24	33	42	50	59		
13	31.6	36.2	15	18	23	30	39	48	55	18	20	27	33	44	55	61		
14	33.4	38.1	16	18	24	31	41	51	58	18	22	27	35	46	57	65		
15	35.2	40.0	16	19	25	33	43	54	61	20	22	29	38	48	61	70		

```

=====
Governing parameters: Tau = 48, alpha = 0.2

Data for 5 years of monitoring:
  yr  x    g    glwr  gwpr  rho  M*
2021 0 0.5201 0.4403 0.5998 0.871 1
2022 1 0.5561 0.4945 0.6176 1 3
2023 0 0.5326 0.4738 0.5914 1 3
2024 0 0.4822 0.4097 0.5547 1 3
2025 3 0.4886 0.4080 0.5692 1 10

Parameters for future monitoring and operations:
Number of years: 15
g = 0.4886, 95% CI [0.408, 0.5692]
Relative weight (rho): 1
=====

```

Figure 3 (continued). Dalthorp et al. (2017) Projection Text Results Output Page 2 of 2

```

*****
Summary statistics for mortality estimates through 5 years
-----
Results
Totals through 5 years

M* = 10 for 1 - alpha = 0.8, i.e., P(M <= 10) >= 80%
Estimated overall detection probability: g = 0.516, 95% CI = [0.485, 0.547]
Ba = 512.69, Bb = 481.32
Estimated baseline fatality rate (for rho = 1): lambda = 1.794, 95% CI = [0.537, 3.8]

Cumulative Mortality Estimates
Year      M*   median  95% CI   mean(lambda) 95% CI
2021      1     0      [0, 2]   0.9699 [0.0009283, 4.888]
2022      3     2      [1, 5]   2.7900 [0.2002, 8.714]
2023      3     2      [1, 5]   2.7990 [0.201, 8.733]
2024      3     2      [1, 6]   2.8730 [0.2064, 8.964]
2025     10     8      [4, 14]  8.7370 [2.616, 18.5]

Annual Mortality Estimates
Year      M*   median  95% CI   mean(lambda) 95% CI
2021      1     0      [0, 2]   0.9699 [0.0009283, 4.888]
2022      3     2      [1, 5]   2.7100 [0.1942, 8.473]
2023      1     0      [0, 2]   0.9430 [0.0009389, 4.745]
2024      1     0      [0, 3]   1.0460 [0.00104, 5.269]
2025      9     6      [3, 12]  7.2380 [1.726, 16.76]

Test of assumed relative weights (rho) and potential bias           Fitted rho
Assumed rho      95% CI
0.871 [0.003, 1.756]
1 [0.107, 2.732]
1 [0.002, 1.644]
1 [0.002, 1.800]
1 [0.945, 4.225]

p = 0.08118 for likelihood ratio test of H0: assumed rho = true rho
Quick test of relative bias: 0.985

=====
Input
Year (or period) rel_wt X Ba Bb ghat 95% CI
2021 0.871 0 81.18 74.92 0.520 [0.442, 0.598]
2022 1.000 1 144.3 115.2 0.556 [0.495, 0.616]
2023 1.000 0 152.9 134.2 0.533 [0.475, 0.590]
2024 1.000 0 91.06 97.79 0.482 [0.411, 0.553]
2025 1.000 3 74.72 78.21 0.489 [0.410, 0.568]

```