

**Attachment 6**

**Tier 4 Bat Mitigation Monitoring: Interim Monitoring Summary  
for February 2020–March 2025**

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Tier 4 Bat Mitigation Monitoring:  
Interim Monitoring Summary for  
February 2020 – March 2025

Auwahi Wind Energy LLC  
Maui, Hawaii

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# 1 INTRODUCTION

Auwahi Wind Energy LLC (Auwahi Wind) established a Tier 4 Mitigation Site (Mitigation Site) to mitigate the take of Hawaiian hoary bat (*Lasiurus semotus*; ‘ōpe‘ape‘a) at their Auwahi Wind Energy Facility in Maui, Hawaii. Within the Mitigation Site, Auwahi Wind is implementing management actions to improve habitat conditions for ‘ōpe‘ape‘a and will monitor bat activity within the Mitigation Site over a period of 12 years to assess the success of the management activities. Consistent with the monitoring timeline presented in Auwahi Wind’s Habitat Conservation Plan (HCP; Tetra Tech 2019), baseline monitoring was considered Year 0, with successive years of monitoring spanning years 1–11. The primary objective of monitoring is to document changes in ‘ōpe‘ape‘a activity over time using designated call metrics (call abundance and call nightly detection) to assess the impact of management actions on bat activity within the Mitigation Site. In spring 2020, Auwahi Wind deployed acoustic detectors to begin baseline (Year 0) monitoring of ‘ōpe‘ape‘a activity in and adjacent the Mitigation Site (Figure 1.1). Acoustic monitoring has been ongoing since 2020 and this interim report provides a summary of the cumulative acoustic dataset collected and analyzed for the period spanning February 26, 2020, to March 30, 2025.

Mitigation measures, including the installation of two new ponds and planting of hedgerows, have been partially implemented and are ongoing but will take time to mature to a point likely to have a significant impact on bat use. For instance, the ponds that were newly constructed approximately halfway through Year 1 were constructed with liners that will take time to silt in and create habitat for insects. As such, these ponds initially provided new water sources for drinking but were unlikely to provide a significant amount of insect activity compared to the other pond (near site AW237) that was constructed many years ago and is fully vegetated and has a bottom of silt and organic matter. Acoustic data is being collected at one of the two newly constructed ponds (Pond1) and will ideally track the stages of pond maturation and provide insight into how long such features need to be in place prior to providing the desired net benefit to bats.

Similarly, planted hedgerows are only 3–4 years of age and are generally in the range of 10–20 feet tall. At this point, they are likely providing some relief from strong winds that may enhance foraging opportunities but may still be too young to provide roost sites. Detectors associated with the hedgerows were still classified as pasture sites in this data summary; however, the intent is to reclassify these as hedgerow sites once mitigation activities have matured to a point that it appears to be influencing bat activity. If they are already reaching that point of maturity, it may be reflected in the most current data. These should be evaluated again and reclassified if deemed appropriate prior to the next data review. At that time, it may be possible to begin assessing changes in bat activity metrics at specific locations that have transitioned from one feature type (e.g., pasture) to another (e.g., hedgerow).

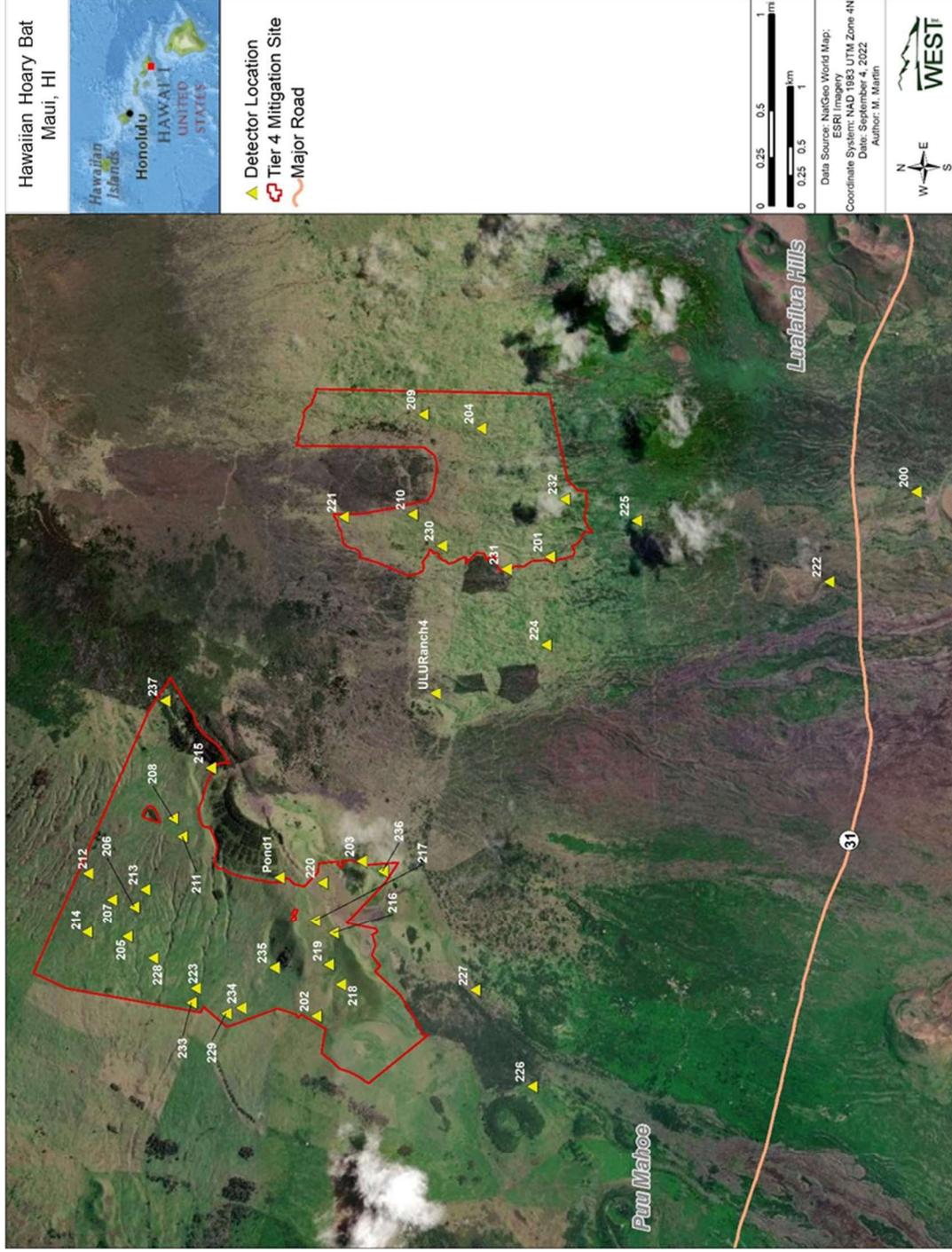


Figure 1.1. Location of Auwahi Wind Energy's Hawaiian hoary bat Tier 4 Mitigation Site and acoustic bat detector locations, Maui, Hawaii.

## 2 ENVIRONMENTAL SETTING

The Mitigation Site consists of two parcels of Ulupalakua ranch lands totaling 1,752 acres on the leeward slopes of Haleakala, Maui, Hawaii (Figure 1.1). The Mitigation Site sits at mid- to upper elevations ranging from approximately 3,600–5,000 feet and is protected by a Hawaiian Islands Land Trust bat conservation easement. The two sites consist primarily of open grasslands used for cattle grazing (i.e., pasture), with a few small forest patches; otherwise, trees are rare in the western parcel and widely dispersed in the eastern parcel (Figure 1.1). Perennial water is scarce within the Mitigation Site, with primary water sources consisting of Waihou Spring, a few stock ponds, seasonal water troughs for cattle, and small intermittent streams.

## 3 METHODS

Thirty-eight SM4Bat full spectrum bat detectors with SMM-U2 microphones (Wildlife Acoustics, Inc., Maynard, Massachusetts) were deployed across the Mitigation Site (32 detectors) and at control sites (six detectors) in spring 2020. The detectors were configured to operate from one hour before sunset to one hour after sunrise. Detectors recorded at a sample rate of 192 kilohertz (kHz); minimum signal duration of 1.5 milliseconds; minimum frequency threshold was set at 10 kHz; and a trigger level of 12 db was used. In fall 2021, two additional acoustic detectors (Pond1 and ULURanch4) were added to the monitoring effort (Figure 1.1); however, ULURanch4 suffered equipment issues that compromised the data and has been excluded from the analysis and metrics reported on herein. Equipment was replaced as needed in response to identified problems; however, detector (SM4Bat) and microphone (SMM-U2) types remained consistent throughout the study. Sampling locations throughout the Mitigation Site were selected using a spatially balanced (Generalized Random Tessellation Sampling; Stevens and Olsen 2004) design based on a grid of 100- x 100-meter grid cells. Within selected grid cells, there was leeway to place detectors according to the habitat subtype requirements of Auwahi Wind's HCP (Tetra Tech 2019). Detectors were subset into three habitat feature subtypes for future management activities within the Mitigation Site: pasture, hedgerow, and water trough/pond. Detectors were also placed outside of the Mitigation Site and distributed among similar habitat features (i.e., pasture, trough, and hedgerow) to serve as controls when assessing trends in bat activity within the Mitigation Site following mitigation activities. The Pond1 detector was added to the sample at a newly constructed pond along the eastern edge of the Mitigation Site in 2021, part way through Year 1 of monitoring.

A baseline habitat condition was identified for each detector station. The baseline (i.e., Year 0) conditions for the 39 sampling stations included 25 pasture, 12 trough/pond locations (10 troughs and two ponds), and two hedgerows (Appendix A). As mitigation activities are completed and hedgerows are installed and mature, it is anticipated that pasture stations located within 30 feet of installed features will transition to hedgerow stations and allow for comparisons of activity rates over time. The Pond1 detector was added in fall 2021 at a newly created pond site that was not sampled prior to pond development. Additional details on the sampling design and mitigation requirements can be found in Auwahi Wind's HCP (Tetra Tech 2019).

Auwahi Wind provided all acoustic monitoring equipment and associated accessories (e.g., microphones, solar panels, and batteries) and managed all aspects of the field study, including

the ongoing maintenance of the detectors and data retrieval. Once collected in the field, Auwahi Wind transferred the raw data to Western EcoSystems Technology, Inc. (WEST), for quality assurance, quality control, and analysis. Once data was received from Auwahi Wind, WEST reviewed and verified its completeness and conducted a quality check of the summary and acoustic files, providing feedback to Auwahi on potential equipment issues to ensure detectors and microphones were maintained and functioning properly. Full spectrum data were then processed and converted to zero-cross data using the software package Kaleidoscope Pro (version 5.1.0; Wildlife Acoustics, Inc.), reducing the overall file sizes for storage and further analysis. During the conversion process, Kaleidoscope Pro filtered zero-cross files suspected to be noise into a folder separate from the other zero-cross files. Once converted and filtered, all zero-cross files, including suspect noise files, were reviewed as digital sonograms and labeled by a bat biologist using the program Analook (Titley Scientific). This process was used to confirm the presence of sufficient echolocation pulses (a minimum of two) to qualify as a bat call, determine consistency with the call parameters of ‘ōpe‘ape‘a (both call frequency and pattern), and to classify the call type (i.e., searching/location calls or feeding buzzes). To ensure consistent organization and comparability of data across years and studies, data handling procedures were consistent with those used during the first three years of monitoring.

Once all call files were reviewed and bat presence verified, the call data were used to calculate the bat use metrics required in the HCP and requested by Auwahi Wind:

1. Call abundance = total bat calls/total active detector nights (a detector-night was defined as one detector operating for one night);
2. Call nightly detection = total nights with bat calls/total active detector nights; and
3. Activity minutes per night = total number of minutes during an active detector-night with at least one bat call.

A second set of metrics was generated based on feeding buzzes only, with a feeding buzz defined as the tightly spaced series of sequential echolocation pulses used to home in on prey and indicative of active feeding:

1. Feeding buzz abundance = total feeding buzzes/total active detector nights; and
2. Feeding buzz nightly detection = total nights with feeding buzzes/total active detector nights.

Call abundance and nightly detection for all calls and feeding buzzes are the metrics identified in the HCP (Tetra Tech 2019) for monitoring purposes. Activity minutes per night was not included as a required monitoring metric in the HCP but has been included herein based on additional discussion and a request from the Hawaii Endangered Species Recovery Committee. Data are summarized for the entirety of the monitoring period (i.e., cumulative dataset) and by year for comparison purposes. Years were defined as years 0–4, with Year 0 being the initial year of monitoring. Data from Year 3 (the 4th year of monitoring) are presented but are not used in comparisons due to the sparseness of the Year 3 dataset.

## 4 RESULTS AND DISCUSSION

Bat calls were recorded at all 39 detectors during the February 26, 2020, through March 30, 2025, sampling period. Sampling effort exceeded 51,000 detector nights during the period and more than 684,000 bat calls were recorded. However, due primarily to rapidly escalating microphone failures in late 2022 that continued through much of 2023, many recorded detector nights resulted in very low or zero bat detections towards the end of Year 2 and throughout Year 3 (Table 4.1; Appendix A). Due to availability issues from the supplier, microphones were not readily available and were not swapped out entirely until early 2024. Given the data quality issues, annual data from years 2, 3, and 4 are only presented for the detectors that appeared to be properly recording bat calls and were functional for a majority of the sampling period (greater than 50% of the sampling days each year). While all detectors were included for Year 0 and Year 1, only 24 detectors were included in Year 2, four detectors in Year 3, and 27 detectors in Year 4 (Table 4.1). Data for Year 3 are included in tables and appendices but are not included in figures or annual comparisons given the paucity of data.

Table 4.1. Results for all bat detections during acoustic surveys conducted at 39 stations associated with Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025.

Year	# of Detectors <sup>a</sup>	# of Bat Calls	Detector Nights with Bat Calls	Total Detector Nights	Mean Call Abundance (Bat Calls/Detector Nights) <sup>b</sup>	Mean Nightly Detection (Nights Bats Detected/Total Detector Nights) <sup>b</sup>	Average Bat Minutes/Detector-night <sup>b</sup>
<b>All Calls</b>							
0	38	155,173	10,814	14,281	11.22	0.76	7.46
1	39	193,664	9,629	13,401	13.99	0.72	8.95
2	24	105,052	4,320	7,216	12.81	0.60	8.16
3	4	5,564	890	1,464	3.80	0.61	3.48
4	27	224,670	6,140	8,333	28.46	0.74	15.58
<b>Feeding Buzz Calls</b>							
0	38	214	166	14,281	0.02	0.01	NA
1	39	789	546	13,401	0.06	0.04	NA
2	24	473	346	7,216	0.06	0.05	NA
3	4	78	75	1,464	0.05	0.05	NA
4	27	4,425	1,053	8,333	0.63	0.13	NA

<sup>a</sup> Only includes detectors which appeared fully functional during the period. Detectors that were non-functional and/or had microphone issues were excluded.

<sup>b</sup> Average of individual detectors.

Mean call abundance, averaged across all functional detectors each year, varied across the monitoring years. Excluding Year 3, mean call abundance was similar and lower in years 0–2 (11.22–13.99 calls/detector-night) compared to Year 4 (28.46; Table 4.1). Mean nightly detection was lowest in Year 2 (60% of nights) and highest in years 0 and 4 (76% and 74%, respectively; Table 4.1). Like mean call abundance, the average number of minutes per night with bat activity was similar and lower in years 0–2 (7.46–8.95 minutes/detector-night) compared to Year 4 (15.58; Table 4.1).

Mean feeding buzz abundance followed a similar pattern to all calls and was lower in years 0–2 (0.02–0.06) compared to Year 4 (0.63; Table 4.1). Similarly, mean feeding buzz nightly detection was lower in years 0–2 (0.01–0.05) compared to Year 4 (0.13; Table 4.1).

#### 4.1 Call Abundance

##### 4.1.1 All Call Abundance

Call abundance varied widely among detectors and across years and habitat feature types (Table 4.2, Figure 4.1; Appendix A). Among habitat feature types, call abundance was on average lowest at troughs, followed by pastures, hedgerows, and ponds (Table 4.2). However, it must be noted that AW215, classified as a pasture site, was a substantial outlier within the pasture group. With this data point removed, mean call abundance at pasture sites was similar to that at trough sites (Table 4.2).

Mean call abundance was slightly higher at pasture and hedgerow sites in years 1 and 2 and much higher in Year 4 compared to Year 0 (Figure 4.1). Mean call abundance at troughs was higher in Year 1 and Year 4 than Year 0 but lower in Year 2 (Figure 4.1). This may be due to a steep decline in the sample size as only three trough detectors had good quality data in Year 2 compared to 10 trough detectors in years 0 and 1 and seven in Year 4, although the decline in Year 2 and rebound in Year 4 was relatively consistent across the operational detectors (Table 4.2).

Activity at the pond sites was influenced by a only as single pond in Year 0, with the construction of a second pond during Year 1; therefore, Year 0 pond data are based on the one existing pond feature, whereas pond data from years 1, 2, and 4 are an average of the two ponds, one of which was newly constructed and had much low activity rates than the existing pond in years 1 and 2. However, activity at the new pond (Pond1) increased substantially in Year 4, and along with an increase in activity at the other Pond (AW237), resulted in an increase in mean call abundance compared to Year 0 (Figure 4.1, Table 4.2).

Table 4.2. Call abundance and nightly detection for all Hawaiian hoary bat calls recorded during acoustic surveys associated with Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025.

Station	Associated Habitat Feature	Call Abundance (Bat Calls/Detector-night)				Nightly Detection (Nights Bats Detected/Total Detector Nights)			
		Year 0	Year 1	Year 2	Year 4	Year 0	Year 1	Year 2	Year 4
AW201	Pasture	1.57	2.98	NA	4.02	0.48	0.59	NA	0.73
AW202	Pasture	4.61	6.06	NA	7.55	0.72	0.63	NA	0.85
AW203	Pasture	6.89	3.63	3.80	NA	0.84	0.48	0.40	NA
AW204	Pasture	2.35	2.87	NA	3.10	0.71	0.63	NA	0.77
AW209	Pasture	2.27	4.16	NA	0.66	0.73	0.85	NA	0.18
AW210	Pasture	2.51	4.29	2.79	NA	0.72	0.80	0.53	NA
AW211	Pasture	4.57	6.54	NA	7.46	0.87	0.65	NA	0.84
AW212	Pasture	3.39	6.10	4.47	NA	0.80	0.84	0.84	NA
AW213	Pasture	5.49	7.19	5.01	7.05	0.88	0.86	0.86	0.76
AW214	Pasture	4.40	7.03	5.40	6.50	0.81	0.88	0.85	0.87
AW215	Pasture	101.96	183.36	117.49	145.32	0.97	0.98	0.94	0.93

Table 4.2. Call abundance and nightly detection for all Hawaiian hoary bat calls recorded during acoustic surveys associated with Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025.

Station	Associated Habitat Feature	Call Abundance (Bat Calls/Detector-night)				Nightly Detection (Nights Bats Detected/Total Detector Nights)			
		Year 0	Year 1	Year 2	Year 4	Year 0	Year 1	Year 2	Year 4
AW216	Pasture	7.69	11.04	8.87	11.78	0.90	0.89	0.81	0.87
AW217	Pasture	6.05	8.83	5.08	10.86	0.82	0.87	0.62	0.91
AW218	Pasture	4.67	0.97	3.89	1.74	0.65	0.38	0.79	0.38
AW219	Pasture	3.04	1.95	1.15	NA	0.62	0.58	0.44	NA
AW220	Pasture	8.79	9.92	4.54	11.81	0.91	0.90	0.49	0.90
AW221	Pasture	3.74	6.03	3.91	5.38	0.85	0.91	0.62	0.81
AW222 <sup>c</sup>	Pasture	0.81	0.66	NA	0.84	0.39	0.30	NA	0.41
AW223	Pasture	3.94	3.50	NA	4.67	0.77	0.69	NA	0.68
AW224 <sup>c</sup>	Pasture	2.30	2.65	1.00	NA	0.64	0.63	0.33	NA
AW225 <sup>c</sup>	Pasture	1.91	1.72	NA	NA	0.57	0.50	NA	NA
AW228	Pasture	3.51	5.93	0.62	NA	0.70	0.72	0.39	NA
AW229	Pasture	5.15	1.01	0.61	7.73	0.82	0.48	0.25	0.80
AW230	Pasture	2.54	3.36	3.25	NA	0.72	0.82	0.72	NA
AW232	Pasture	2.41	3.53	4.19	NA	0.64	0.70	0.52	NA
Avg <sup>a,d</sup>	Pasture	7.86 (3.94 <sup>b</sup> )	11.81 (4.66 <sup>b</sup> )	10.36 (3.66 <sup>b</sup> )	14.78 (6.08 <sup>b</sup> )	0.74 (0.73 <sup>b</sup> )	0.70 (0.69 <sup>b</sup> )	0.61 (0.59 <sup>b</sup> )	0.73 (0.72 <sup>b</sup> )
AW226 <sup>c</sup>	Hedgerow	12.71	16.30	13.20	26.32	0.95	0.87	0.77	0.93
AW227 <sup>c</sup>	Hedgerow	10.81	13.19	15.59	16.09	0.92	0.84	0.68	0.75
Avg <sup>a,d</sup>	Hedgerow	11.76	14.75	14.40	21.21	0.94	0.85	0.73	0.84
AW237	Pond	165.06	153.56	93.27	416.13	0.94	0.95	0.70	0.94
Pond1	Pond	NA	10.68	3.51	30.05	NA	0.79	0.51	0.92
Avg <sup>a,d</sup>	Pond	165.06	82.12	48.39	223.09	0.94	0.87	0.60	0.93
AW200 <sup>c</sup>	Trough	0.93	1.20	NA	0.51	0.43	0.43	NA	0.29
AW205	Trough	4.10	6.27	NA	6.33	0.83	0.81	NA	0.83
AW206	Trough	5.19	6.64	NA	4.37	0.87	0.85	NA	0.44
AW207	Trough	4.36	7.18	1.83	6.98	0.87	0.87	0.33	0.79
AW208	Trough	3.96	11.32	NA	6.56	0.74	0.95	NA	0.78
AW231	Trough	2.57	1.63	NA	NA	0.65	0.37	NA	NA
AW233	Trough	4.69	3.85	NA	NA	0.80	0.40	NA	NA
AW234	Trough	4.62	5.10	3.33	5.53	0.72	0.73	0.76	0.80
AW235	Trough	5.84	5.71	NA	NA	0.73	0.72	NA	NA
AW236	Trough	5.05	7.60	0.67	13.01	0.80	0.78	0.22	0.77
Avg <sup>a,d</sup>	Trough	4.13	5.65	1.94	6.18	0.74	0.69	0.44	0.67

<sup>a</sup>. Average of individual detectors.

<sup>b</sup>. Average excluding AW215 outlier.

<sup>c</sup>. Detector located outside the Mitigation Site.

<sup>d</sup>. Averages may not equal totals shown due to rounding.

Note: Stations with <50% of sample nights or that were malfunctioning (e.g., bad microphones) were excluded (NA).

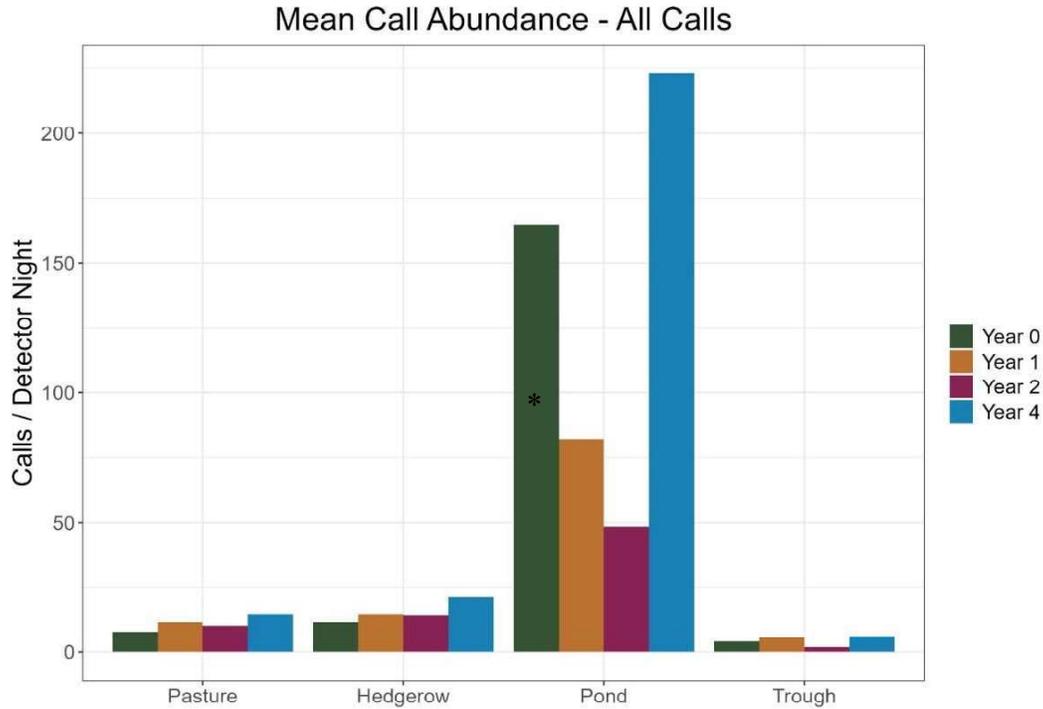


Figure 4.1. Mean number of bat calls per detector-night for all acoustic detectors, by habitat feature type and year, in Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii.

\* Year 0 had only one pond. One new pond site was added part way through Year 1, significantly influencing the mean for ponds.

Note: Year 3 was omitted due to paucity of data.

#### 4.1.2 Feeding Buzz Abundance

Mean feeding buzz abundance was higher at all four feature types in Year 4 compared to all prior years (Figure 4.2). Feeding buzz abundance varied among detectors and across years and habitat feature types but averaged less than 0.5 feeding buzzes/detector-night at all feature types in years 0–2 (Figure 4.2). Feeding buzz abundance increased at all feature types in Year 4, although increases were more substantial at hedgerows and ponds relative to pastures and troughs (Table 4.3, Figure 4.2; Appendix B). Although feeding buzz abundance increased across the Mitigation Site in general, feeding buzz abundance at the pond sites was particularly noticeable, increasing from less than one feeding buzz per night to an average of 6.5 feeding buzzes per night (Figure 4.2, Table 4.3). Among habitat feature types, buzz call abundance was on average lowest at troughs, followed by pastures, hedgerows, and ponds (Table 4.3, Figure 4.2). It must be noted again however, that AW215 was a substantial outlier within the pasture group, and with this data point removed, mean call abundance at pasture sites was similar to that at trough sites (Table 4.3).

Table 4.3. Feeding buzz abundance and feeding buzz nightly detection for Hawaiian hoary bats recorded during acoustic surveys associated with Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025.

Station	Associated Habitat Feature	Buzz Call Abundance (Bat Calls/Detector-night)				Buzz Nightly Detection (Nights Bats Detected/ Total Detector Nights)			
		Year 0	Year 1	Year 2	Year 4	Year 0	Year 1	Year 2	Year 4
AW201	Pasture	0	0.01	NA	0.07	0	0.01	NA	0.07
AW202	Pasture	0	0.01	NA	0.05	0	0.01	NA	0.05
AW203	Pasture	0.01	0.02	0.03	NA	0.01	0.02	0.03	NA
AW204	Pasture	<0.01	0.02	NA	0.10	<0.01	0.02	NA	0.09
AW209	Pasture	0.02	0.03	NA	0	0.02	0.03	NA	0
AW210	Pasture	<0.01	0.05	0.05	NA	<0.01	0.05	0.04	NA
AW211	Pasture	<0.01	0.02	NA	0.08	<0.01	0.02	NA	0.08
AW212	Pasture	0	0.02	0.02	NA	0	0.02	0.02	NA
AW213	Pasture	<0.01	0.04	0.04	0.09	<0.01	0.03	0.04	0.08
AW214	Pasture	0	0.04	0.03	0.10	0	0.03	0.03	0.08
AW215	Pasture	0.18	0.35	0.34	1.38	0.12	0.20	0.19	0.40
AW216	Pasture	0.01	0.08	0.08	0.10	0.01	0.07	0.07	0.09
AW217	Pasture	0.02	0.04	0.04	0.11	0.02	0.04	0.04	0.10
AW218	Pasture	0.02	<0.01	0.02	0.02	0.02	<0.01	0.02	0.02
AW219	Pasture	<0.01	0.01	0.01	NA	<0.01	0.01	0.01	NA
AW220	Pasture	0.03	0.09	0.06	0.20	0.03	0.07	0.05	0.15
AW221	Pasture	<0.01	0.03	0.03	0.15	<0.01	0.03	0.03	0.11
AW222 <sup>c</sup>	Pasture	0	<0.01	NA	0.02	0	<0.01	NA	0.02
AW223	Pasture	<0.01	0.01	NA	0.04	<0.01	0.01	NA	0.04
AW224 <sup>c</sup>	Pasture	0	0.02	0	NA	0	0.02	0	NA
AW225 <sup>c</sup>	Pasture	0	0.02	NA	NA	0	0.02	NA	NA
AW228	Pasture	0	0.03	0.01	NA	0	0.03	0.01	NA
AW229	Pasture	0	<0.01	0	0.08	0	<0.01	0	0.07
AW230	Pasture	<0.01	0.02	0.02	NA	<0.01	0.02	0.02	NA
AW232	Pasture	0	0.02	0.02	NA	0	0.02	0.02	NA
Avg <sup>a,d</sup>	Pasture	0.01 (<0.01 <sup>b</sup> )	0.04 (0.03 <sup>b</sup> )	0.05 (0.03 <sup>b</sup> )	0.16 (0.08 <sup>b</sup> )	0.01 (<0.01 <sup>b</sup> )	0.03 (0.02 <sup>b</sup> )	0.04 (0.03 <sup>b</sup> )	0.09 (0.07 <sup>b</sup> )
AW226 <sup>c</sup>	Hedgerow	0.02	0.09	0.23	0.78	0.02	0.08	0.19	0.36
AW227 <sup>c</sup>	Hedgerow	0.01	0.07	0.05	0.24	0.01	0.06	0.05	0.18
Avg <sup>a,d</sup>	Hedgerow	0.02	0.08	0.14	0.51	0.01	0.07	0.12	0.27
AW237	Pond	0.19	0.62	0.29	8.32	0.11	0.29	0.19	0.64
Pond1	Pond	NA	0.28	0.10	4.63	NA	0.14	0.07	0.62
Avg <sup>a,d</sup>	Pond	0.19	0.45	0.20	6.48	0.11	0.22	0.13	0.63
AW200 <sup>c</sup>	Trough	0	0.02	NA	0.01	0	0.02	NA	0.01
AW205	Trough	0.01	0.04	NA	0.07	0.01	0.04	NA	0.07
AW206	Trough	0.01	0.04	NA	0.06	0.01	0.04	NA	0.06
AW207	Trough	0.01	0.05	0.02	0.05	0.01	0.04	0.02	0.05
AW208	Trough	0.02	0.06	NA	0.03	0.02	0.05	NA	0.03
AW231	Trough	0	0.01	NA	NA	0	0.01	NA	NA
AW233	Trough	0	0.02	NA	NA	0	0.02	NA	NA

Table 4.3. Feeding buzz abundance and feeding buzz nightly detection for Hawaiian hoary bats recorded during acoustic surveys associated with Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025.

Station	Associated Habitat Feature	Buzz Call Abundance (Bat Calls/Detector-night)				Buzz Nightly Detection (Nights Bats Detected/ Total Detector Nights)			
		Year 0	Year 1	Year 2	Year 4	Year 0	Year 1	Year 2	Year 4
AW234	Trough	0.01	0.02	0.02	0.03	0.01	0.02	0.02	0.03
AW235	Trough	0.02	0.02	NA	NA	0.02	0.02	NA	NA
AW236	Trough	0.02	0.03	<0.01	0.09	0.02	0.03	<0.01	0.09
Avg <sup>a,d</sup>	Trough	0.01	0.03	0.01	0.05	0.01	0.03	0.01	0.05

<sup>a</sup>. Average of individual detectors.

<sup>b</sup>. Average excluding AW215 outlier.

<sup>c</sup>. Detector located outside the Mitigation Site.

<sup>d</sup> Averages may not equal totals shown due to rounding.

Note: Stations with <50% of sample nights or that were malfunctioning (e.g., bad microphones) were excluded (NA).

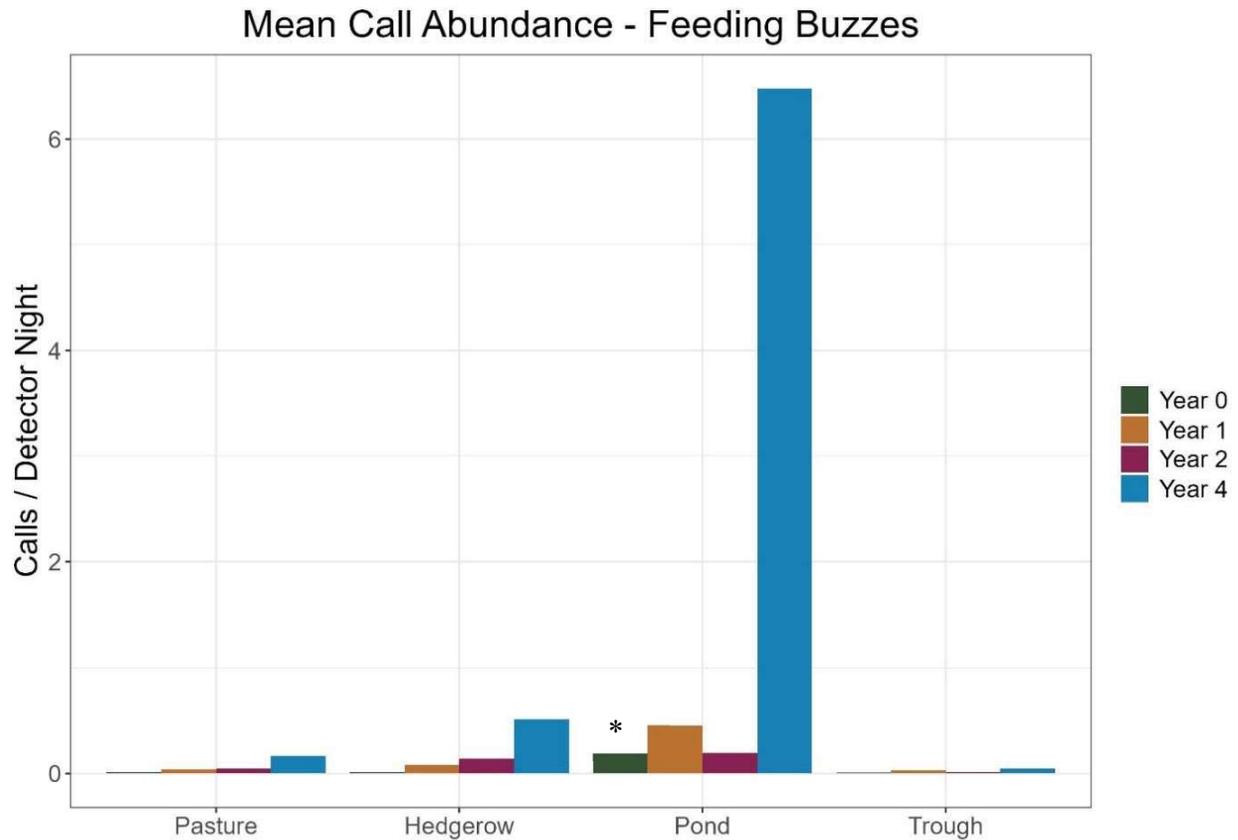


Figure 4.2. Mean number of feeding buzzes per detector-night for all acoustic detectors, by habitat feature type and year, in Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii.

\* Year 0 had only one pond. One new pond site was added part way through Year 1, significantly influencing the mean for ponds.

Note: Year 3 was omitted due to paucity of data.

### 4.1.3 Discussion – Call Abundance

Mean call abundance followed similar trends for all calls and feeding buzzes, although the number of feeding buzzes recorded was substantially lower than the total number of calls. While the objective of the monitoring study is to ultimately measure an increase in bat activity within the Mitigation Site, the current dataset remains limited relative to making inferences at this point. With four years of data spanning a 5-year period, and Year 3 data being excluded, there are now three datapoints to assess changes (i.e., years 0–1, years 1–2, years 2–4). Given the potential for annual variability, more years of data will be necessary before any meaningful inference can be made; however, both metrics showed increases in Year 4 at all feature types, and at ponds and hedgerows in particular, compared to prior years.

It must be noted however, that hedgerows and ponds were only represented by two stations at this point, and of those, both hedgerow sites are outside the Mitigation Site boundary and meant to serve as controls. Some hedgerows have been planted within the Mitigation Site, but the nearby sampling stations are still represented in the data as pasture sites. Hedgerow development has recently been evaluated, and the habitat feature types associated with each detector will be updated prior to the next analysis. Once updated, data can further be evaluated as to potential increases in activity relative to the change in feature type. The change in habitat feature association will be limited to the transition of pasture sites to hedgerow sites, as no other feature types have both pre- and post-mitigation acoustic data as the specific feature locations.

Two new ponds have been constructed but neither are at locations that had a detector previously; therefore, neither have any baseline data for the specific location prior to their construction and only one (Pond1) was monitored after its construction. Pond1 was built part way through Year 1 and is, therefore, different from the pre-existing pond in the dataset (AW237). Pond1 has a liner bottom and was largely devoid of vegetation after installation but has begun to “mature” and in Year 4 had substantially more bat activity than in prior years, though still substantially less than the other pond (AW237), which is decades old, has silted in, and is full of aquatic vegetation. As such, AW237 likely provides both high quality foraging and drinking opportunities for bats, while Pond1 may still be limited in its foraging opportunities as it has not matured to a point that likely provides for a similar abundance of aquatic insects compared to AW237. Given the timing of construction and differences in pond maturity, averages among the pond category are dramatically influenced by the addition of the new pond part way through Year 1. The large decline in mean abundance in the pond category in years 1 and 2 was due to this new pond, not a decrease in overall bat abundance. Although data were lacking in Year 3, the Year 4 data suggest that Pond1 has matured and is now providing more foraging opportunities for bats, as evidenced by a substantial increase in both overall call abundance and buzz call abundance. As more data are gathered and mitigation features mature, annual comparisons should become more meaningful as more robust comparisons are made that may include trends at individual detectors in addition to the feature covariates.

## 4.2 Call Nightly Detection

### 4.2.1 All Call Nightly Detection

Mean nightly detection for all bat calls varied among detectors and across years and habitat feature types and trended downward from years 0–2, but rebounded in Year 4 across all habitat

feature types (Figure 4.3, Table 4.2; Appendix A). Among feature types, mean nightly detection was on average lower at troughs and pasture sites compared to hedgerows and ponds (Figure 4.3).

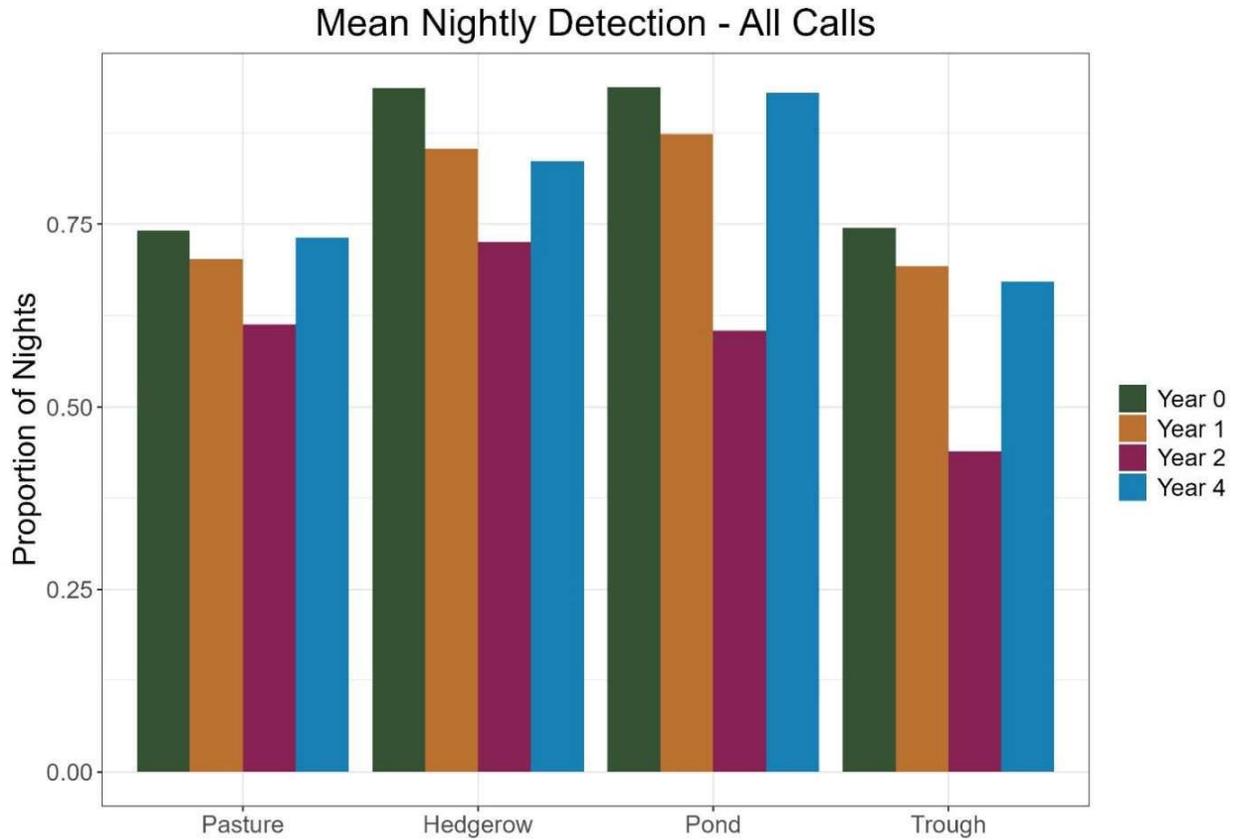


Figure 4.3. The proportion of nights with bat calls for all acoustic detectors, by habitat feature type and year, in Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii. Note: Year 3 was omitted due to paucity of data.

#### 4.2.2 Feeding Buzz Nightly Detection

Mean feeding buzz nightly detection also varied among detectors and across years and habitat feature types (Figure 4.4, Table 4.3; Appendix B) but followed a pattern different from that of all bat calls (Figure 4.3). Buzz nightly detection rates followed different trends among habitat feature types, increasing year over year at pasture and hedgerow sites, while increasing from years 0–4, but fluctuating yearly, at ponds and troughs (Figure 4.4). Among feature types, mean feeding buzz nightly detection was on average lower at troughs and pastures compared to hedgerows and ponds (Figure 4.4).

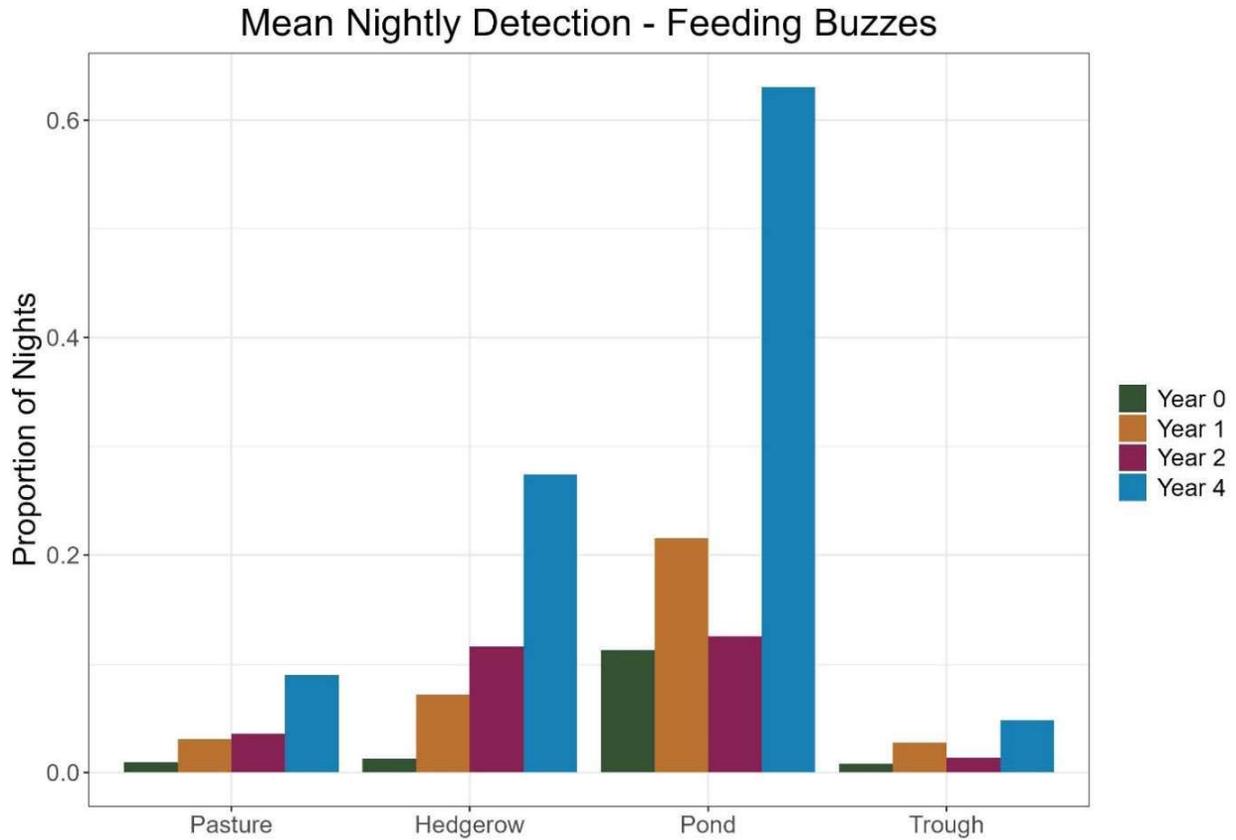


Figure 4.4. The proportion of nights with feeding buzzes for all acoustic detectors, by habitat feature type and year, in Auwahi Wind Energy’s Tier 4 Mitigation Site, Maui, Hawaii.

Note: Year 3 was omitted due to paucity of data.

#### 4.2.3 Discussion - Nightly Detection

Unlike call abundance, mean nightly detection did not follow similar trends over time for all calls and feeding buzzes (Figures 4.3 and 4.4). For all calls, nightly detection rates showed consistent declines over years 0–2, followed by an increase in Year 4 (Figure 4.3), whereas buzz nightly detection showed an increase in Year 4, but no consistent pattern across all feature types in years 0–2 (Figure 4.4). Despite the differences in patterns among all calls and feeding buzzes, both metrics showed substantial increases in Year 4 relative to Year 2 (the prior dataset). For buzz calls, nightly detection in Year 4 was substantially higher than in all other years, whereas it rebounded to rates similar to Year 0 for all calls (Figures 4.3 and 4.4).

Interestingly, the oldest pond (AW237) within the Mitigation Site had previously been recording the highest activity metrics across years 0–2; however, activity metrics at the new pond (Pond1) have increased substantially over the years and are now similar to those from AW237 for both all calls and buzz calls in Year 4 (Tables 4.2 and 4.3). It is also worth noting that while AW215 was a substantial outlier among the pasture sites related to call abundance, this site’s influence on mean nightly detection was not substantial for all bat calls or feeding buzzes (Tables 4.2 and 4.3).

While the dataset is limited given only three datapoints related to changes over time (i.e., years 0–1, years 1–2, years 2–4), the Year 4 increases in call nightly detection are consistent with the increases in call abundance, and suggests that not only was bat activity at detector locations greater (i.e., more calls recorded on average) on nights when bats were present, but that bats were also present on more nights. While analysis for changes at individual sites has not been conducted relative to mitigation activities, the increased activity at all feature types could indicate a broader response to mitigation activities and increased activity within the Mitigation Site as a whole. As more data are gathered and mitigation features continue to mature, annual comparisons should become more meaningful as more robust comparisons are made that may include trends at individual detectors in addition to the feature covariates.

### 4.3 Minutes of Activity

#### 4.3.1 All Calls – Minutes of Activity

Minutes of bat activity, defined as the number of minutes during a night that contained one or more bat calls, were also tabulated for the operational detectors (Table 4.1; Appendix C). The number of bat activity minutes averaged across sites ranged from 7.46– 15.58 minutes/detector-night during the four years (years 0–2 and 4) of monitoring with good data (see Table 4.1). While the average minutes per night varied little (less than 1.5 minutes/detector-night) on average across the first three years, this metric approximately doubled in Year 4, following a pattern similar to call abundance in that it was slightly higher in Year 1 than Year 0, but then declined slightly in Year 2 and increased substantially in Year 4. The minutes with activity metric continued to show clear seasonal patterns, with substantially more minutes containing bat calls recorded during the late spring through fall relative to other seasons in all years, including Year 3 when data were sparse (Figure 4.5).

#### 4.3.2 Discussion – Minutes of Activity

The seasonal pattern in call minutes was apparent and consistent across years, even though minutes with activity were lower in Year 2 and Year 3 due to equipment issues (Figure 4.5). While data were sparse in the later part of Year 2 through Year 3 due to equipment failures, the greater number of minutes with activity clearly continued through the fall in both years (Figure 4.5). While seasonal estimates were not calculated for call abundance and call nightly detection, it is assumed that call abundance at minimum would likely follow a similar seasonal pattern, which is consistent with the seasonal patterns of ‘ōpe‘ape‘a activity reported by others (e.g., Menard 2001, Gorresen et al. 2013, Thompson and Starcevich 2022).

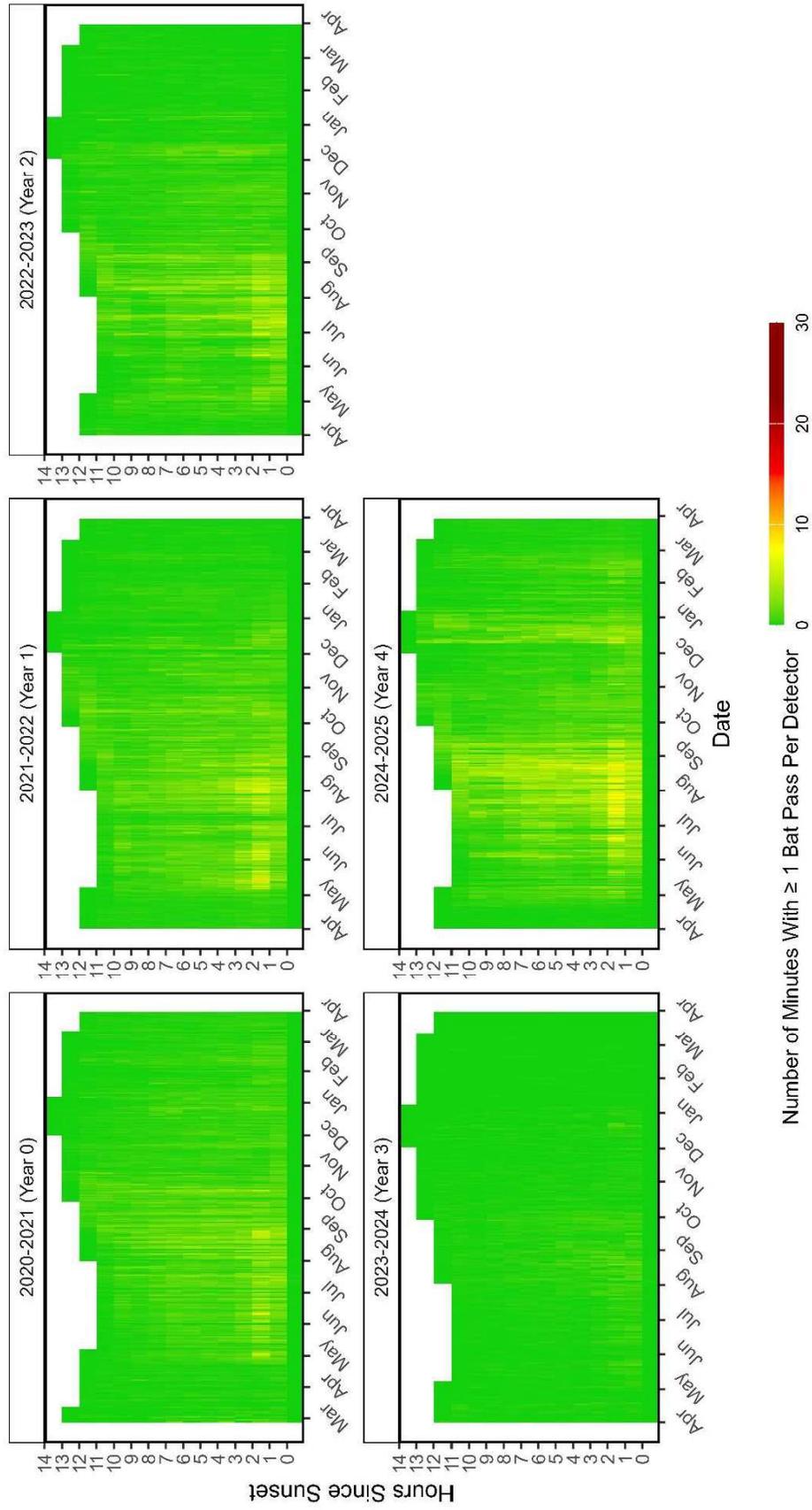


Figure 4.5. Bat activity patterns relative to sunset (hour zero), illustrated by the number of minutes with one or more bat calls averaged across acoustic sampling stations, with Auwahi Wind Energy’s Tier 4 Mitigation Site, from February 16, 2020, to March 30, 2025, Maui, Hawaii.

## 5 CONCLUSION

The primary objective of the Tier 4 mitigation monitoring is to document changes in ‘ōpe‘ape‘a activity over time using the designated activity metrics (call abundance and call nightly detection) to assess the impact of management actions on bat activity within the Mitigation Site. Data from Year 3 (April 2023 – March 2024) of monitoring was largely lost due to issues with equipment; however, most detectors were updated and provided quality data again in Year 4 and, in most instances, resulted in substantial increases in all activity metrics compared to prior years. Additional monitoring of bat activity in and surrounding the Mitigation Site is planned over the next seven years (years 5–11). As mitigation activities continue to become established, more formal analyses to assess trends in activity in response to the mitigation actions will become possible and completed.

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Appendix A: Hawaiian Hoary Bat Call Abundance and Call Nightly Detection by Year for Acoustic Monitoring Stations Associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025

Appendix A1. Results for all bat detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 31, 2021 (Year 0).

Station	Associated Habitat Feature	# of Bat Calls	Detector Nights with Bat Calls	Total Detector Nights	Call Abundance <sup>a</sup> (Bat Calls/Detector-night)	Nightly Detection (Nights Bats Detected/Total Detector Nights)
AW200 <sup>b</sup>	Trough	329	152	353	0.93 ± 0.08	0.43
AW201	Pasture	617	189	393	1.57 ± 0.12	0.48
AW202	Pasture	1,613	252	350	4.61 ± 0.35	0.72
AW203	Pasture	2,315	281	336	6.89 ± 0.40	0.84
AW204	Pasture	918	279	391	2.35 ± 0.14	0.71
AW205	Trough	1,585	320	387	4.10 ± 0.23	0.83
AW206	Trough	2,010	335	387	5.19 ± 0.32	0.87
AW207	Trough	1,689	337	387	4.36 ± 0.24	0.87
AW208	Trough	1,527	287	386	3.96 ± 0.27	0.74
AW209	Pasture	886	287	391	2.27 ± 0.13	0.73
AW210	Pasture	967	277	385	2.51 ± 0.16	0.72
AW211	Pasture	1,749	333	383	4.57 ± 0.23	0.87
AW212	Pasture	1,302	306	384	3.39 ± 0.23	0.80
AW213	Pasture	2,107	337	384	5.49 ± 0.30	0.88
AW214	Pasture	1,697	314	386	4.40 ± 0.23	0.81
AW215	Pasture	37,215	354	365	101.96 ± 8.14	0.97
AW216	Pasture	2,823	329	367	7.69 ± 0.45	0.90
AW217	Pasture	2,222	301	367	6.05 ± 0.39	0.82
AW218	Pasture	1,713	240	367	4.67 ± 0.35	0.65
AW219	Pasture	1,108	227	365	3.04 ± 0.24	0.62
AW220	Pasture	3,155	325	359	8.79 ± 0.43	0.91
AW221	Pasture	1,344	305	359	3.74 ± 0.21	0.85
AW222 <sup>b</sup>	Pasture	285	138	352	0.81 ± 0.08	0.39
AW223	Pasture	1,513	294	384	3.94 ± 0.25	0.77
AW224 <sup>b</sup>	Pasture	810	227	352	2.30 ± 0.17	0.64
AW225 <sup>b</sup>	Pasture	674	199	352	1.91 ± 0.20	0.57
AW226 <sup>b</sup>	Hedgerow	4,538	339	357	12.71 ± 0.72	0.95
AW227 <sup>b</sup>	Hedgerow	3,859	330	357	10.81 ± 0.57	0.92
AW228	Pasture	1,349	268	384	3.51 ± 0.22	0.70
AW229	Pasture	1,976	313	384	5.15 ± 0.28	0.82
AW230	Pasture	994	281	392	2.54 ± 0.16	0.72
AW231	Trough	1,011	255	393	2.57 ± 0.19	0.65
AW232	Pasture	943	251	392	2.41 ± 0.18	0.64
AW233	Trough	1,873	319	399	4.69 ± 0.29	0.80
AW234	Trough	1,843	289	399	4.62 ± 0.31	0.72
AW235	Trough	2,329	292	399	5.84 ± 0.51	0.73
AW236	Trough	2,019	321	400	5.05 ± 0.31	0.80
AW237	Pond	58,266	331	353	165.06 ± 12.16	0.94

<sup>a</sup>. Estimate ± bootstrapped standard error.

<sup>b</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

Appendix A2. Results for all bat detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2021, to March 31, 2022 (Year 1).

Station	Associated Habitat Feature	# of Bat Calls	Detector Nights with Bat Calls	Total Detector Nights	Call Abundance <sup>a</sup> (Bat Calls/Detector-night)	Nightly Detection (Nights Bats Detected/Total Detector Nights)
AW200 <sup>b</sup>	Trough	438	156	364	1.20 ± 0.18	0.43
AW201	Pasture	1,084	213	364	2.98 ± 0.22	0.59
AW202	Pasture	2,104	219	347	6.06 ± 0.47	0.63
AW203	Pasture	1,085	143	299	3.63 ± 0.38	0.48
AW204	Pasture	997	220	347	2.87 ± 0.21	0.63
AW205	Trough	2,289	297	365	6.27 ± 0.44	0.81
AW206	Trough	2,422	309	365	6.64 ± 0.39	0.85
AW207	Trough	2,619	318	365	7.18 ± 0.39	0.87
AW208	Trough	2,265	189	200	11.32 ± 0.87	0.95
AW209	Pasture	1,515	311	364	4.16 ± 0.20	0.85
AW210	Pasture	1,506	281	351	4.29 ± 0.28	0.80
AW211	Pasture	2,387	237	365	6.54 ± 0.40	0.65
AW212	Pasture	2,225	307	365	6.10 ± 0.36	0.84
AW213	Pasture	2,623	313	365	7.19 ± 0.37	0.86
AW214	Pasture	2,441	304	347	7.03 ± 0.41	0.88
AW215	Pasture	66,927	359	365	183.36 ± 15.07	0.98
AW216	Pasture	4,031	324	365	11.04 ± 0.58	0.89
AW217	Pasture	3,223	316	365	8.83 ± 0.49	0.87
AW218	Pasture	273	106	282	0.97 ± 0.09	0.38
AW219	Pasture	712	210	365	1.95 ± 0.14	0.58
AW220	Pasture	3,619	327	365	9.92 ± 0.53	0.90
AW221	Pasture	2,118	320	351	6.03 ± 0.30	0.91
AW222 <sup>b</sup>	Pasture	242	108	364	0.66 ± 0.07	0.30
AW223	Pasture	1,170	229	334	3.50 ± 0.28	0.69
AW224 <sup>b</sup>	Pasture	931	220	351	2.65 ± 0.21	0.63
AW225 <sup>b</sup>	Pasture	626	181	364	1.72 ± 0.16	0.50
AW226 <sup>b</sup>	Hedgerow	5,951	316	365	16.30 ± 0.98	0.87
AW227 <sup>b</sup>	Hedgerow	4,814	307	365	13.19 ± 0.84	0.84
AW228	Pasture	2,059	251	347	5.93 ± 0.51	0.72
AW229	Pasture	351	168	347	1.01 ± 0.08	0.48
AW230	Pasture	1,181	289	351	3.36 ± 0.18	0.82
AW231	Trough	573	131	351	1.63 ± 0.15	0.37
AW232	Pasture	1,284	254	364	3.53 ± 0.33	0.70
AW233	Trough	924	97	240	3.85 ± 0.54	0.40
AW234	Trough	1,770	254	347	5.10 ± 0.39	0.73
AW235	Trough	2,084	264	365	5.71 ± 0.45	0.72
AW236	Trough	2,774	286	365	7.60 ± 0.39	0.78
AW237	Pond	56,051	348	365	153.56 ± 11.07	0.95
Pond1 <sup>c</sup>	Pond	1,976	147	185	10.68 ± 1.10	0.79

<sup>a</sup>. Estimate ± bootstrapped standard error.

<sup>b</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

<sup>c</sup>. Detector deployed September 28, 2021.

Appendix A3. Results for all bat detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2022, to March 31, 2023 (Year 2).

Station	Associated Habitat Feature	# of Bat Calls	Detector Nights with Bat Calls	Total Detector Nights	Call Abundance <sup>a</sup> (Bat Calls/Detector-night)	Nightly Detection (Nights Bats Detected/Total Detector Nights)
AW203	Pasture	1,250	133	329	3.80 ± 0.35	0.40
AW207	Trough	668	121	365	1.83 ± 0.17	0.33
AW210	Pasture	624	119	224	2.79 ± 0.37	0.53
AW212	Pasture	1,632	305	365	4.47 ± 0.21	0.84
AW213	Pasture	1,828	315	365	5.01 ± 0.29	0.86
AW214	Pasture	1,367	216	253	5.40 ± 0.32	0.85
AW215	Pasture	42,884	344	365	117.49 ± 12.22	0.94
AW216	Pasture	1,853	169	209	8.87 ± 0.56	0.81
AW217	Pasture	1,666	202	328	5.08 ± 0.35	0.62
AW218	Pasture	1,420	288	365	3.89 ± 0.23	0.79
AW219	Pasture	418	160	365	1.15 ± 0.10	0.44
AW220	Pasture	1,377	149	303	4.54 ± 0.37	0.49
AW221	Pasture	872	139	223	3.91 ± 0.34	0.62
AW224 <sup>b</sup>	Pasture	259	87	260	1.00 ± 0.15	0.33
AW226 <sup>b</sup>	Hedgerow	2,759	160	209	13.20 ± 0.88	0.77
AW227 <sup>b</sup>	Hedgerow	5,690	250	365	15.59 ± 1.10	0.68
AW228	Pasture	157	99	253	0.62 ± 0.07	0.39
AW229	Pasture	154	64	253	0.61 ± 0.10	0.25
AW230	Pasture	826	183	254	3.25 ± 0.23	0.72
AW232	Pasture	1,065	132	254	4.19 ± 0.48	0.52
AW234	Trough	713	163	214	3.33 ± 0.23	0.76
AW236	Trough	246	81	365	0.67 ± 0.09	0.22
AW237	Pond	34,042	254	365	93.27 ± 9.95	0.70
Pond1	Pond	1,282	187	365	3.51 ± 0.33	0.51

<sup>a</sup>. Estimate ± bootstrapped standard error.

<sup>b</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

Appendix A4. Results for all bat detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2023, to March 31, 2024 (Year 3).

Station	Associated Habitat Feature	# of Bat Calls	Detector Nights with Bat Calls	Total Detector Nights	Call Abundance <sup>a</sup> (Bat Calls/Detector-night)	Nightly Detection (Nights Bats Detected/Total Detector Nights)
AW212	Pasture	1,627	239	366	4.45 ± 0.28	0.65
AW213	Pasture	1,227	204	366	3.35 ± 0.24	0.56
AW214	Pasture	1,804	248	366	4.93 ± 0.32	0.68
AW218	Pasture	906	199	366	2.48 ± 0.17	0.54

<sup>a</sup>. Estimate ± bootstrapped standard error.

Appendix A5. Results for all bat detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2024, to March 30, 2025 (Year 4).

Station	Associated Habitat Feature	# of Bat Calls	Detector Nights with Bat Calls	Total Detector Nights	Call Abundance <sup>a</sup> (Bat Calls/Detector-night)	Nightly Detection (Nights Bats Detected/Total Detector Nights)
AW200 <sup>b</sup>	Trough	170	97	334	0.51 ± 0.06	0.29
AW201	Pasture	1,014	185	252	4.02 ± 0.38	0.73
AW202	Pasture	2,387	270	316	7.55 ± 0.53	0.85
AW204	Pasture	834	208	269	3.10 ± 0.23	0.77
AW205	Trough	2,122	278	335	6.33 ± 0.34	0.83
AW206	Trough	1,490	151	341	4.37 ± 0.36	0.44
AW207	Trough	1,974	223	283	6.98 ± 0.41	0.79
AW208	Trough	1,844	218	281	6.56 ± 0.41	0.78
AW209	Pasture	187	51	282	0.66 ± 0.12	0.18
AW211	Pasture	2,641	299	354	7.46 ± 0.37	0.84
AW213	Pasture	1,818	196	258	7.05 ± 0.39	0.76
AW214	Pasture	2,366	315	364	6.50 ± 0.33	0.87
AW215	Pasture	51,442	330	354	145.32 ± 11.50	0.93
AW216	Pasture	4,101	304	348	11.78 ± 0.65	0.87
AW217	Pasture	2,716	227	250	10.86 ± 0.66	0.91
AW218	Pasture	632	137	364	1.74 ± 0.18	0.38
AW220	Pasture	4,075	310	345	11.81 ± 0.59	0.90
AW221	Pasture	1,938	292	360	5.38 ± 0.37	0.81
AW222 <sup>b</sup>	Pasture	237	116	283	0.84 ± 0.09	0.41
AW223	Pasture	1,178	171	252	4.67 ± 0.35	0.68
AW226 <sup>b</sup>	Hedgerow	9,238	326	351	26.32 ± 1.89	0.93
AW227 <sup>b</sup>	Hedgerow	5,807	269	361	16.09 ± 0.91	0.75
AW229	Pasture	1,909	198	247	7.73 ± 0.48	0.80
AW234	Trough	1,837	265	332	5.53 ± 0.36	0.80
AW236	Trough	4,698	279	361	13.01 ± 1.60	0.77
AW237	Pond	11,0275	250	265	416.13 ± 36.31	0.94
Pond1	Pond	5,740	175	191	30.05 ± 2.77	0.92

<sup>a</sup>. Estimate ± bootstrapped standard error.

<sup>b</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

Appendix B: Hawaiian Hoary Bat Feeding Buzz Abundance and Feeding Buzz Nightly  
Detection by Year at Acoustic Monitoring Stations Associated with Auwahi Wind Energy's  
Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025

Appendix B1. Results for feeding buzz detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 31, 2021 (Year 0).

Station	Associated Habitat Feature	# of Feeding Buzzes	Detector Nights with Feeding Buzzes	Total Detector Nights	Feeding Buzz Abundance <sup>b</sup> (Feeding Buzzes/Detector Nights)	Feeding Buzz Nightly Detection (Nights Feeding Buzzes/Total Detector Nights)
AW200 <sup>a</sup>	Trough	0	0	353	0 ± 0	0
AW201	Pasture	0	0	393	0 ± 0	0
AW202	Pasture	0	0	350	0 ± 0	0
AW203	Pasture	4	4	336	0.01 ± 0.01	0.01
AW204	Pasture	1	1	391	0 ± 0	0
AW205	Trough	2	2	387	0.01 ± 0	0.01
AW206	Trough	3	3	387	0.01 ± 0	0.01
AW207	Trough	2	2	387	0.01 ± 0	0.01
AW208	Trough	7	7	386	0.02 ± 0.01	0.02
AW209	Pasture	6	6	391	0.02 ± 0.01	0.02
AW210	Pasture	1	1	385	0 ± 0	0
AW211	Pasture	1	1	383	0 ± 0	0
AW212	Pasture	0	0	384	0 ± 0	0
AW213	Pasture	1	1	384	0 ± 0	0
AW214	Pasture	0	0	386	0 ± 0	0
AW215	Pasture	65	43	365	0.18 ± 0.03	0.12
AW216	Pasture	2	2	367	0.01 ± 0	0.01
AW217	Pasture	6	6	367	0.02 ± 0.01	0.02
AW218	Pasture	6	6	367	0.02 ± 0.01	0.02
AW219	Pasture	1	1	365	0 ± 0	0
AW220	Pasture	10	10	359	0.03 ± 0.01	0.03
AW221	Pasture	1	1	359	0 ± 0	0
AW222 <sup>a</sup>	Pasture	0	0	352	0 ± 0	0
AW223	Pasture	1	1	384	0 ± 0	0
AW224 <sup>a</sup>	Pasture	0	0	352	0 ± 0	0
AW225 <sup>a</sup>	Pasture	0	0	352	0 ± 0	0
AW226 <sup>a</sup>	Hedgerow	6	6	357	0.02 ± 0.01	0.02
AW227 <sup>a</sup>	Hedgerow	3	3	357	0.01 ± 0	0.01
AW228	Pasture	0	0	384	0 ± 0	0
AW229	Pasture	0	0	384	0 ± 0	0
AW230	Pasture	1	1	392	0 ± 0	0
AW231	Trough	0	0	393	0 ± 0	0
AW232	pasture	0	0	392	0 ± 0	0
AW233	Trough	0	0	399	0 ± 0	0
AW234	Trough	3	3	399	0.01 ± 0	0.01
AW235	Trough	8	8	399	0.02 ± 0.01	0.02
AW236	Trough	7	7	400	0.02 ± 0.01	0.02
AW237	Pond	66	40	353	0.19 ± 0.04	0.11

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

<sup>b</sup>. Estimate ± bootstrapped standard error.

Appendix B2. Results for feeding buzz detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2021, to March 31, 2022 (Year 1).

Station	Associated Habitat Feature	# of Feeding Buzzes	Detector Nights with Feeding Buzzes	Total Detector Nights	Feeding Buzz Abundance <sup>b</sup> (Feeding Buzzes/Detector Nights)	Feeding Buzz Nightly Detection (Nights Feeding Buzzes/Total Detector Nights)
AW200 <sup>a</sup>	Trough	7	6	364	0.02 ±0.01	0.02
AW201	Pasture	3	3	364	0.01 ±0	0.01
AW202	Pasture	4	3	347	0.01 ±0.01	0.01
AW203	Pasture	5	5	299	0.02 ±0.01	0.02
AW204	Pasture	8	7	347	0.02 ±0.01	0.02
AW205	Trough	14	14	365	0.04 ±0.01	0.04
AW206	Trough	15	15	365	0.04 ±0.01	0.04
AW207	Trough	17	13	365	0.05 ±0.02	0.04
AW208	Trough	12	9	200	0.06 ±0.02	0.05
AW209	Pasture	11	11	364	0.03 ±0.01	0.03
AW210	Pasture	18	16	351	0.05 ±0.01	0.05
AW211	Pasture	8	7	365	0.02 ±0.01	0.02
AW212	Pasture	8	8	365	0.02 ±0.01	0.02
AW213	Pasture	13	11	365	0.04 ±0.01	0.03
AW214	Pasture	13	12	347	0.04 ±0.01	0.03
AW215	Pasture	128	73	365	0.35 ±0.05	0.20
AW216	Pasture	29	25	365	0.08 ±0.02	0.07
AW217	Pasture	15	14	365	0.04 ±0.01	0.04
AW218	Pasture	1	1	282	0 ±0	<0.01
AW219	Pasture	2	2	365	0.01 ±0	0.01
AW220	Pasture	32	26	365	0.09 ±0.02	0.07
AW221	Pasture	12	11	351	0.03 ±0.01	0.03
AW222 <sup>a</sup>	Pasture	1	1	364	0 ±0	<0.01
AW223	Pasture	3	2	334	0.01 ±0.01	0.01
AW224 <sup>a</sup>	Pasture	6	6	351	0.02 ±0.01	0.02
AW225 <sup>a</sup>	Pasture	6	6	364	0.02 ±0.01	0.02
AW226 <sup>a</sup>	Hedgerow	34	29	365	0.09 ±0.02	0.08
AW227 <sup>a</sup>	Hedgerow	27	23	365	0.07 ±0.02	0.06
AW228	Pasture	10	9	347	0.03 ±0.01	0.03
AW229	Pasture	1	1	347	0 ±0	<0.01
AW230	Pasture	8	7	351	0.02 ±0.01	0.02
AW231	Trough	5	5	351	0.01 ±0.01	0.01
AW232	Pasture	6	6	364	0.02 ±0.01	0.02
AW233	Trough	5	4	240	0.02 ±0.01	0.02
AW234	Trough	6	6	347	0.02 ±0.01	0.02
AW235	Trough	7	7	365	0.02 ±0.01	0.02
AW236	Trough	10	10	365	0.03 ±0.01	0.03
AW237	Pond	227	106	365	0.62 ±0.07	0.29
Pond1 <sup>c</sup>	Pond	52	26	185 <sup>c</sup>	0.28 ±0.11	0.14

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

<sup>b</sup>. Estimate ± bootstrapped standard error.

<sup>c</sup>. Detector deployed September 28, 2021.

Appendix B3. Results for feeding buzz detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2022, to March 31, 2023 (Year 2).

Station	Associated Habitat Feature	# of Feeding Buzzes	Detector Nights with Feeding Buzzes	Total Detector Nights	Feeding Buzz Abundance <sup>b</sup> (Feeding Buzzes/Detector Nights)	Feeding Buzz Nightly Detection (Nights Feeding Buzzes/Total Detector Nights)
AW203	Pasture	11	11	329	0.03 ± 0.01	0.03
AW207	Trough	8	7	365	0.02 ± 0.01	0.02
AW210	Pasture	11	8	224	0.05 ± 0.02	0.04
AW212	Pasture	6	6	365	0.02 ± 0.01	0.02
AW213	Pasture	14	13	365	0.04 ± 0.01	0.04
AW214	Pasture	8	7	253	0.03 ± 0.01	0.03
AW215	Pasture	124	71	365	0.34 ± 0.05	0.19
AW216	Pasture	16	15	209	0.08 ± 0.02	0.07
AW217	Pasture	13	12	328	0.04 ± 0.01	0.04
AW218	Pasture	8	7	365	0.02 ± 0.01	0.02
AW219	Pasture	2	2	365	0.01 ± 0	0.01
AW220	Pasture	17	16	303	0.06 ± 0.01	0.05
AW221	Pasture	6	6	223	0.03 ± 0.01	0.03
AW224 <sup>a</sup>	Pasture	0	0	260	0 ± 0	0
AW226 <sup>a</sup>	Hedgerow	49	39	209	0.23 ± 0.04	0.19
AW227 <sup>a</sup>	Hedgerow	20	17	365	0.05 ± 0.01	0.05
AW228	Pasture	3	3	253	0.01 ± 0.01	0.01
AW229	Pasture	0	0	253	0 ± 0	0
AW230	Pasture	4	4	254	0.02 ± 0.01	0.02
AW232	Pasture	5	5	254	0.02 ± 0.01	0.02
AW234	Trough	4	4	214	0.02 ± 0.01	0.02
AW236	Trough	1	1	365	0 ± 0	<0.01
AW237	Pond	107	68	365	0.29 ± 0.04	0.19
Pond1	Pond	36	24	365	0.10 ± 0.02	0.07

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

<sup>b</sup>. Estimate ± bootstrapped standard error.

Appendix B4. Results for feeding buzz detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2023, to March 31, 2024 (Year 3).

Station	Associated Habitat Feature	# of Feeding Buzzes	Detector Nights with Feeding Buzzes	Total Detector Nights	Feeding Buzz Abundance <sup>a</sup> (Feeding Buzzes/Detector Nights)	Feeding Buzz Nightly Detection (Nights Feeding Buzzes/Total Detector Nights)
AW212	Pasture	27	27	366	0.07 ± 0.01	0.07
AW213	Pasture	22	20	366	0.06 ± 0.01	0.05
AW214	Pasture	19	18	366	0.05 ± 0.01	0.05
AW218	Pasture	10	10	366	0.03 ± 0.01	0.03

<sup>a</sup>. Estimate ± bootstrapped standard error.

Appendix B5. Results for feeding buzz detections during acoustic surveys conducted at operational acoustic monitoring stations associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2024, to March 30, 2025 (Year 4).

Station	Associated Habitat Feature	# of Feeding Buzzes	Detector Nights with Feeding Buzzes	Total Detector Nights	Feeding Buzz Abundance <sup>b</sup> (Feeding Buzzes/Detector Nights)	Feeding Buzz Nightly Detection (Nights Feeding Buzzes/Total Detector Nights)
AW200 <sup>a</sup>	Trough	4	4	334	0.01 ± 0.01	0.01
AW201	Pasture	17	17	252	0.07 ± 0.02	0.07
AW202	Pasture	17	15	316	0.05 ± 0.01	0.05
AW204	Pasture	27	25	269	0.10 ± 0.02	0.09
AW205	Trough	25	23	335	0.07 ± 0.02	0.07
AW206	Trough	22	22	341	0.06 ± 0.01	0.06
AW207	Trough	15	14	283	0.05 ± 0.01	0.05
AW208	Trough	8	8	281	0.03 ± 0.01	0.03
AW209	Pasture	0	0	282	0 ± 0	0
AW211	Pasture	28	28	354	0.08 ± 0.01	0.08
AW213	Pasture	23	20	258	0.09 ± 0.02	0.08
AW214	Pasture	38	28	364	0.10 ± 0.02	0.08
AW215	Pasture	488	142	354	1.38 ± 0.15	0.40
AW216	Pasture	34	31	348	0.10 ± 0.02	0.09
AW217	Pasture	27	24	250	0.11 ± 0.02	0.10
AW218	Pasture	7	7	364	0.02 ± 0.01	0.02
AW220	Pasture	68	53	345	0.20 ± 0.03	0.15
AW221	Pasture	54	38	360	0.15 ± 0.03	0.11
AW222 <sup>a</sup>	Pasture	5	5	283	0.02 ± 0.01	0.02
AW223	Pasture	9	9	252	0.04 ± 0.01	0.04
AW226 <sup>a</sup>	Hedgerow	274	128	351	0.78 ± 0.09	0.36
AW227 <sup>a</sup>	Hedgerow	85	66	361	0.24 ± 0.03	0.18
AW229	Pasture	19	18	247	0.08 ± 0.02	0.07
AW234	Trough	10	9	332	0.03 ± 0.01	0.03
AW236	Trough	31	31	361	0.09 ± 0.02	0.09
AW237	Pond	2,205	169	265	8.32 ± 0.96	0.64
Pond1	Pond	885	119	191	4.63 ± 0.54	0.62

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

<sup>b</sup>. Estimate ± bootstrapped standard error.

Appendix C: Minutes per Detector-night Containing Hawaiian Hoary Bat Calls by Year at Acoustic Monitoring Stations Associated with Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 30, 2025

Appendix C1. Minutes of the night with bat detections during acoustic surveys at operational acoustic monitoring stations within the Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from February 26, 2020, to March 31, 2021 (Year 0).

Station	Associated Habitat Feature	Total Detector Nights	Total Minutes with Bat Calls	Average Minutes per Detector-night with Bat Calls
AW200 <sup>a</sup>	Trough	353	307	0.87
AW201	Pasture	393	584	1.49
AW202	Pasture	350	1,316	3.76
AW203	Pasture	336	1,981	5.90
AW204	Pasture	391	865	2.21
AW205	Trough	387	1,433	3.70
AW206	Trough	387	1,835	4.74
AW207	Trough	387	1,570	4.06
AW208	Trough	386	1,439	3.73
AW209	Pasture	391	827	2.12
AW210	Pasture	385	894	2.32
AW211	Pasture	383	1,650	4.31
AW212	Pasture	384	1,219	3.17
AW213	Pasture	384	1,940	5.05
AW214	Pasture	386	1,561	4.04
AW215	Pasture	365	22,158	60.71
AW216	Pasture	367	2,513	6.85
AW217	Pasture	367	1,985	5.41
AW218	Pasture	367	1,344	3.66
AW219	Pasture	365	948	2.60
AW220	Pasture	359	2,828	7.88
AW221	Pasture	359	1,259	3.51
AW222 <sup>a</sup>	Pasture	352	263	0.75
AW223	Pasture	384	1,328	3.46
AW224 <sup>a</sup>	Pasture	352	740	2.10
AW225 <sup>a</sup>	Pasture	352	590	1.68
AW226 <sup>a</sup>	Hedgerow	357	4,082	11.43
AW227 <sup>a</sup>	Hedgerow	357	3,352	9.39
AW228	Pasture	384	1,250	3.26
AW229	Pasture	384	1,773	4.62
AW230	Pasture	392	945	2.41
AW231	Trough	393	915	2.33
AW232	Pasture	392	874	2.23
AW233	Trough	399	1,674	4.20
AW234	Trough	399	1,620	4.06
AW235	Trough	399	1,812	4.54
AW236	Trough	400	1,788	4.47
AW237	Pond	353	28,466	80.64

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

Appendix C2. Minutes of the night with bat detections during acoustic surveys at operational acoustic monitoring stations within the Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2021, to March 31, 2022 (Year 1).

Station	Associated Habitat Feature	Total Detector Nights	Total Minutes with Bat Calls	Average Minutes per Detector-night with Bat Calls
AW200 <sup>a</sup>	Trough	364	375	1.03
AW201	Pasture	364	961	2.64
AW202	Pasture	347	1,810	5.22
AW203	Pasture	299	1,011	3.38
AW204	Pasture	347	922	2.66
AW205	Trough	365	2,070	5.67
AW206	Trough	365	2,203	6.04
AW207	Trough	365	2,400	6.58
AW208	Trough	200	2,000	10.00
AW209	Pasture	364	1,405	3.86
AW210	Pasture	351	1,344	3.83
AW211	Pasture	365	2,215	6.07
AW212	Pasture	365	2,050	5.62
AW213	Pasture	365	2,396	6.56
AW214	Pasture	347	2,231	6.43
AW215	Pasture	365	33,987	93.12
AW216	Pasture	365	3,604	9.87
AW217	Pasture	365	2,885	7.90
AW218	Pasture	282	260	0.92
AW219	Pasture	365	658	1.80
AW220	Pasture	365	3,317	9.09
AW221	Pasture	351	1,954	5.57
AW222 <sup>a</sup>	Pasture	364	227	0.62
AW223	Pasture	334	1,068	3.20
AW224 <sup>a</sup>	Pasture	351	845	2.41
AW225 <sup>a</sup>	Pasture	364	567	1.56
AW226 <sup>a</sup>	Hedgerow	365	5,086	13.93
AW227 <sup>a</sup>	Hedgerow	365	4,011	10.99
AW228	Pasture	347	1,841	5.31
AW229	Pasture	347	336	0.97
AW230	Pasture	351	1,117	3.18
AW231	Trough	351	516	1.47
AW232	Pasture	364	1,197	3.29
AW233	Trough	240	813	3.39
AW234	Trough	347	1,611	4.64
AW235	Trough	365	1,701	4.66
AW236	Trough	365	2,508	6.87
AW237	Pond	365	25,498	69.86
Pond1 <sup>b</sup>	Pond	185	1,635	8.84

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

<sup>b</sup>. Detector deployed September 28, 2021.

Appendix C3. Minutes of the night with bat detections during acoustic surveys at operational acoustic monitoring stations within the Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2022, to March 31, 2023 (Year 2).

Station	Associated Habitat Feature	Total Detector Nights	Total Minutes with Bat Calls	Average Minutes per Detector-night with Bat Calls
AW203	Pasture	329	1,172	3.56
AW207	Trough	365	622	1.70
AW210	Pasture	224	553	2.47
AW212	Pasture	365	1,537	4.21
AW213	Pasture	365	1,694	4.64
AW214	Pasture	253	1,254	4.96
AW215	Pasture	365	22,925	62.81
AW216	Pasture	209	1,690	8.09
AW217	Pasture	328	1,567	4.78
AW218	Pasture	365	1,263	3.46
AW219	Pasture	365	399	1.09
AW220	Pasture	303	1,294	4.27
AW221	Pasture	223	804	3.61
AW224 <sup>a</sup>	Pasture	260	256	0.98
AW226 <sup>a</sup>	Hedgerow	209	2,455	11.75
AW227 <sup>a</sup>	Hedgerow	365	4,145	11.36
AW228	Pasture	253	149	0.59
AW229	Pasture	253	142	0.56
AW230	Pasture	254	789	3.11
AW232	Pasture	254	1,001	3.94
AW234	Trough	214	658	3.07
AW236	Trough	365	240	0.66
AW237	Pond	365	17,303	47.41
Pond1	Pond	365	1,007	2.76

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.

Appendix C4. Minutes of the night with bat detections during acoustic surveys at operational acoustic monitoring stations within the Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2023, to March 31, 2024 (Year 3).

Station	Associated Habitat Feature	Total Detector Nights	Total Minutes with Bat Calls	Average Minutes per Detector-night with Bat Calls
AW212	Pasture	366	1,521	4.16
AW213	Pasture	366	1,124	3.07
AW214	Pasture	366	1,642	4.49
AW218	Pasture	366	807	2.20

Appendix C5. Minutes of the night with bat detections during acoustic surveys at operational acoustic monitoring stations within the Auwahi Wind Energy's Tier 4 Mitigation Site, Maui, Hawaii, from April 1, 2024, to March 30, 2025 (Year 4).

Station	Associated Habitat Feature	Total Detector Nights	Total Minutes with Bat Calls	Average Minutes per Detector-night with Bat Calls
AW200 <sup>a</sup>	Trough	334	157	0.47
AW201	Pasture	252	903	3.58
AW202	Pasture	316	2,117	6.70
AW204	Pasture	269	780	2.90
AW205	Trough	335	1,923	5.74
AW206	Trough	341	1,321	3.87
AW207	Trough	283	1,761	6.22
AW208	Trough	281	1,665	5.93
AW209	Pasture	282	177	0.63
AW211	Pasture	354	2,438	6.89
AW213	Pasture	258	1,644	6.37
AW214	Pasture	364	2,120	5.82
AW215	Pasture	354	28,942	81.76
AW216	Pasture	348	3,707	10.65
AW217	Pasture	250	2,488	9.95
AW218	Pasture	364	585	1.61
AW220	Pasture	345	3,702	10.73
AW221	Pasture	360	1,807	5.02
AW222 <sup>a</sup>	Pasture	283	223	0.79
AW223	Pasture	252	1,038	4.12
AW226 <sup>a</sup>	Hedgerow	351	7,251	20.66
AW227 <sup>a</sup>	Hedgerow	361	4,912	13.61
AW229	Pasture	247	1,685	6.82
AW234	Trough	332	1,640	4.94
AW236	Trough	361	3,759	10.41
AW237	Pond	265	42,937	162.03
Pond1	Pond	191	4,272	22.37

<sup>a</sup>. Indicates detector location is outside the Tier 4 Mitigation Site.