Attachment 8

Tier 4 Bat Mitigation Monitoring: 2-Year Baseline Monitoring Summary for February 2020–March 2022

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TECHNICAL MEMORANDUM

Date: September 16, 2022

To: George Akau – Auwahi Wind

From: Joel Thompson and Kristina Hammond-Rendon–WEST, Inc.

Subject: Tier 4 Bat Mitigation Monitoring: 2-Year Baseline Monitoring Summary for February 2020–March 2022

INTRODUCTION

Auwahi Wind Energy LLC (Auwahi Wind) established a Tier 4 Mitigation Site (Mitigation Site) to mitigate the take of Hawaiian hoary bat (HAHOBA) at their Auwahi Wind Energy Facility. Within the Mitigation Site, Auwahi Wind is implementing management actions to improve habitat conditions for HAHOBA 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 goal of the monitoring is to document changes in HAHOBA activity over time in order to assess the impact of management actions on bat activity within the Mitigation Site.

In spring 2020, Auwahi Wind deployed acoustic bat detectors to begin baseline (Year 0) monitoring of HAHOBA activity in and adjacent the Mitigation Site (Figure 1). Auwahi Wind provided all acoustic monitoring equipment and associated accessories (e.g., microphones, solar panels, and batteries). Auwahi Wind staff are responsible for managing all aspects of the field study, including the ongoing maintenance of the detectors and swapping of data cards.

Once collected in the field, Auwahi Wind staff provided the raw data for QAQC and analysis by Western EcoSystems Technology, Inc. (WEST). This Technical Memorandum (Memo) provides a summary of the cumulative acoustic monitoring dataset spanning the first two years (Year 0 and Year 1) of acoustic monitoring at the Mitigation Site, from February 2020–March 2022.

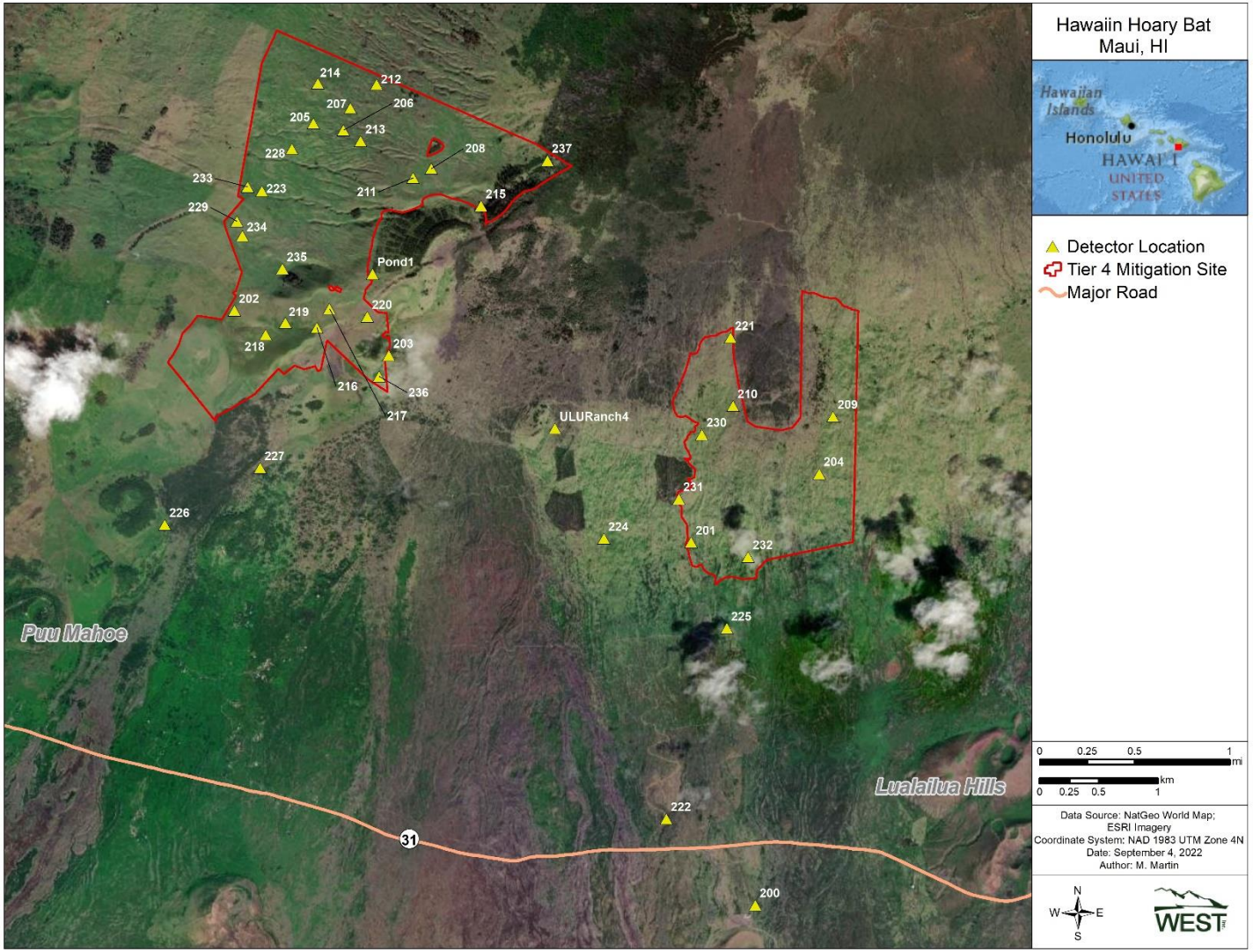

Figure 1. Overview of the Auwahi Wind Tier 4 Hawaiian hoary bat mitigation site and acoustic bat detector locations, Maui, Hawaii.

METHODS

Thirty-eight Wildlife Acoustics SM4Bat full spectrum bat detectors (Wildlife Acoustics, Maynard, Massachusetts) were deployed across the Mitigation Site in spring 2020. In fall 2021, two additional acoustic detectors (Pond1 and ULURanch4) were added to the monitoring effort (Figure 1); however, data collected at ULURanch4 was compromised due to apparent equipment issues and therefore not included in the analysis of Year 1 metrics reported on herein. 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). Thirty detectors were subset into three habitat subtypes for future management activities within the Mitigation Site: pasture, hedgerow, and water trough/pond. Eight additional detectors were placed outside of the Mitigation Site and spread among similar habitat features (i.e., pasture, trough, and hedgerow). These eight locations are meant to serve as controls when conducting analyses to assess increasing trends in bat activity within the Mitigation Site following mitigation activities, although it is not known how distant from the Mitigation Site the impacts on bat acoustic activity may be observed. The two detectors added in fall 2021 were located near a trough (ULURanch4) located outside the Mitigation Site, and at a newly created pond (Pond1) located within the Mitigation Site;

A baseline habitat condition was identified for each detector station. The baseline (i.e., Year 0) conditions for the 30 initial sampling stations within the Mitigation site included 20 pasture and 10 trough/pond locations (nine trough and one pond; Table 1). As mitigation activities are completed and hedgerows and ponds are installed, it is anticipated that pasture stations located within 100 meters of installed features will transition to hedgerow or pond stations during future analyses. The nine detectors located outside the Mitigation Site include two trough, two hedgerow, and five pasture locations (Table 1). 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 amended HCP (Tetra Tech 2019).

Acoustic data from the acoustic bat detectors was collected by Auwahi Wind staff and transferred to WEST. Once downloaded and verified for completeness, WEST completed a quality check of the summary and acoustic files to ensure detectors and microphones were 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), reducing the overall file sizes for storage and further analysis. During the conversion process, Kaleidoscope 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 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, consistency with the call parameters of HAHOBA (both call frequency and pattern), and to classify the call type (i.e., searching/location calls or feeding buzzes). Data handling procedures were consistent with those used by WEST for other acoustic studies conducted in Hawaii (e.g., Oahu

and Leeward Haleakala occupancy studies; Thompson and Starcevich 2021a, 2021b) to ensure consistent organization and comparability of data across studies.

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

1. **Call abundance** = total bat calls / total active detector-nights; and
2. **Call nightly detection** = total nights with bat calls / total active detector-nights.

A second set of metrics was generated based on feeding buzzes only:

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.

A detector-night was defined as one detector operating for one full night.

RESULTS

Cumulative Data (Years 0 and 1 Combined)

All calls

Bat calls were recorded at all 39 detectors used in analyses. For the period February 26–March 30, 2022, the number of detector nights totaled 27,390, and ranged from 168 to 757 among the 39 detectors monitored (Table 1). Among the 39 detectors, the number of bat calls recorded ranged from a low of 572 calls at station AW222 to a high of 117,019 calls at station AW237 (Table 1). Bat call abundance at these same 39 detectors averaged 12.36 calls/detector night across all stations during the survey period, and varied from a low of 0.74 at station AW222 to a high of 156.44 at station AW237 (Table 1; Figure 2). Call nightly detection averaged 0.74 at the 39 stations during the survey period, and varied from a low of 0.34 at detector AW222 to a high of 0.98 at detector AW215 (Table 1). Bat calls were recorded on more than 50% of all detector nights at 38 of the 39 detectors with bat calls and more than 75% of detector nights at 21 of the 39 detectors with bat calls.

Feeding Buzz Calls

Feeding buzzes were recorded at all 39 (100%) detectors; however, 50% of all feeding buzzes were recorded at only two detectors, AW215 and AW237 (Table 2). Feeding buzz abundance averaged 0.04 buzzes/detector night and varied from a low of <0.01 buzzes/detector night detectors to a high of 0.42 at stations AW237 (Table 2). The feeding buzz nightly detection rate was consistently low, averaging 0.03 across all stations (Table 2). With the exception of detectors AW215, AW237, and Pond1, which recorded feeding buzzes on 21%, 16%, and 15% of detector nights, respectively, feeding buzzes were recorded on 5% or fewer detector nights (Table 2).

Table 1. Results of acoustic surveys conducted at monitoring stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from February 26, 2020–March 30, 2022. Calls are separated by total number of bat calls, the number of detector-nights bats were detected, total number of detector-nights, call abundance, and nightly detection rate.

Station	Associated Habitat Feature	# of Bat Calls	Detector-Nights with Bat Calls	Total Detector-Nights	Call Abundance[a] (Bat Calls/ Detector-Night)	Nightly Detection (Nights Bats Detected/Total Detector-Nights)
AW200[c]	trough	767	308	717	1.07±0.10	0.43
AW201	pasture	1,701	402	757	2.25±0.11	0.53
AW202	pasture	3,717	471	697	5.33±0.28	0.68
AW203	pasture	3,400	424	618	5.50±0.30	0.69
AW204	pasture	1,915	499	738	2.59±0.13	0.68
AW205	trough	3,868	612	734	5.27±0.24	0.83
AW206	trough	4,427	640	734	6.03±0.25	0.87
AW207	trough	4,298	647	734	5.86±0.24	0.88
AW208	trough	3,792	476	586	6.47±0.36	0.81
AW209	pasture	2,401	598	755	3.18±0.12	0.79
AW210	pasture	2,473	558	736	3.36±0.16	0.76
AW211	pasture	4,137	571	731	5.66±0.25	0.78
AW212	pasture	3,515	605	731	4.81±0.22	0.83
AW213	pasture	4,720	644	731	6.46±0.24	0.88
AW214	pasture	4,138	618	732	5.65±0.24	0.84
AW215	pasture	104,076	698	713	145.97±8.83	0.98
AW216	pasture	6,842	648	715	9.57±0.34	0.91
AW217	pasture	5,435	610	715	7.60±0.35	0.85
AW218	pasture	1,983	345	631	3.14±0.24	0.55
AW219	pasture	1,820	437	713	2.55±0.14	0.61
AW220[c]	pasture	6,769	647	707	9.57±0.37	0.92
AW221[c]	pasture	3,462	625	710	4.88±0.18	0.88
AW222[c]	pasture	527	246	716	0.74±0.05	0.34
AW223	pasture	2,683	523	700	3.83±0.19	0.75
AW224[c]	pasture	1,741	447	703	2.48±0.14	0.64
AW225[c]	pasture	1,300	380	716	1.82±0.12	0.53
AW226[c]	hedgerow	10,481	651	708	14.80±0.55	0.92
AW227[c]	hedgerow	8,669	634	708	12.24±0.55	0.90
AW228	pasture	3,408	519	731	4.66±0.28	0.71
AW229	pasture	2,327	481	731	3.18±0.18	0.66
AW230	pasture	2,175	570	743	2.93±0.12	0.77
AW231	trough	1,584	386	744	2.13±0.13	0.52
AW232	pasture	2,227	505	756	2.95±0.17	0.67
AW233	trough	2,797	416	621	4.50±0.28	0.67
AW234	trough	3,613	543	746	4.84±0.24	0.73
AW235	trough	4,407	552	746	5.91±0.35	0.74
AW236	trough	4,793	607	751	6.38±0.28	0.81
AW237	pond	117,019	712	748	156.44±8.23	0.95
Pond1	pond	1,967	142	168	11.71±1.17	0.85
Total		**351,374**	**20,397**	**27,371**	**12.36±0.49**[b]	**0.75**

[a] estimate ± bootstrapped standard error

[b] average of individual detectors to account for unbalanced design (i.e., differing number of detector nights)

[C] indicates detector location is outside the Tier 4 Mitigation Site

Table 2. Results for feeding buzz detections during acoustic surveys conducted at 40 stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from February 26, 2020–March 30, 2022. Calls are separated by number of feeding buzz calls, detector-nights buzz calls were detected, total detector-nights, feeding buzz abundance, and feeding buzz nightly detection rate.

Station	Baseline Habitat Type	# of Feeding Buzzes	Detector-Nights with Feeding Buzz Calls	Total Detector - Nights	Feeding Buzz Abundance[a] (Feeding Buzzes Calls/ Detector-Night)	Feeding Buzz Nightly Detection (Nights Feeding Buzz detected/Total Detector-Nights)
AW200[c]	trough	7	6	717	0.01±0.00	0.01
AW201	pasture	3	3	757	0.00±0.00	0.00
AW202	pasture	4	3	697	0.01±0.00	0.00
AW203	pasture	9	9	618	0.01±0.00	0.01
AW204	pasture	9	8	738	0.01±0.00	0.01
AW205	trough	16	16	734	0.02±0.01	0.02
AW206	trough	18	18	734	0.02±0.01	0.02
AW207	trough	19	15	734	0.03±0.01	0.02
AW208	trough	19	16	586	0.03±0.01	0.03
AW209	pasture	17	17	755	0.02±0.01	0.02
AW210	pasture	19	17	736	0.03±0.01	0.02
AW211	pasture	9	8	731	0.01±0.00	0.01
AW212	pasture	7	7	731	0.01±0.00	0.01
AW213	pasture	12	11	731	0.02±0.01	0.02
AW214	pasture	13	12	732	0.02±0.01	0.02
AW215	pasture	193	116	713	0.27±0.03	0.16
AW216	pasture	31	27	715	0.04±0.01	0.04
AW217	pasture	21	20	715	0.03±0.01	0.03
AW218	pasture	7	7	631	0.01±0.00	0.01
AW219	pasture	3	3	713	0.00±0.00	0.00
AW220[c]	pasture	42	36	707	0.06±0.01	0.05
AW221[c]	pasture	13	12	710	0.02±0.01	0.02
AW222[c]	pasture	1	1	716	0.00±0.00	0.00
AW223	pasture	4	3	700	0.01±0.00	0.00
AW224[c]	pasture	6	6	703	0.01±0.00	0.01
AW225[c]	pasture	6	6	716	0.01±0.00	0.01
AW226[c]	hedgerow	40	35	708	0.06±0.01	0.05
AW227[c]	hedgerow	30	26	708	0.04±0.01	0.04
AW228	pasture	10	9	731	0.01±0.00	0.01
AW229	pasture	1	1	731	0.00±0.00	0.00
AW230	pasture	9	8	743	0.01±0.00	0.01
AW231	trough	5	5	744	0.01±0.00	0.01
AW232	pasture	6	6	756	0.01±0.00	0.01
AW233	trough	5	4	621	0.01±0.00	0.01
AW234	trough	9	9	746	0.01±0.00	0.01
AW235	trough	15	15	746	0.02±0.00	0.02
AW236	trough	17	17	751	0.02±0.01	0.02
AW237	pond	316	160	748	0.42±0.04	0.21
Pond1		52	26	168	0.31±0.11	0.15
Total		**1,023**	**724**	**27,371**	**0.04±0.00**[b]	**0.03**

[a] estimate ± bootstrapped standard error

[b] average of abundance estimates for individual detectors to account for unbalanced design (i.e., differing number of detector nights)

[C] indicates detector location is outside the Tier 4 Mitigation Site

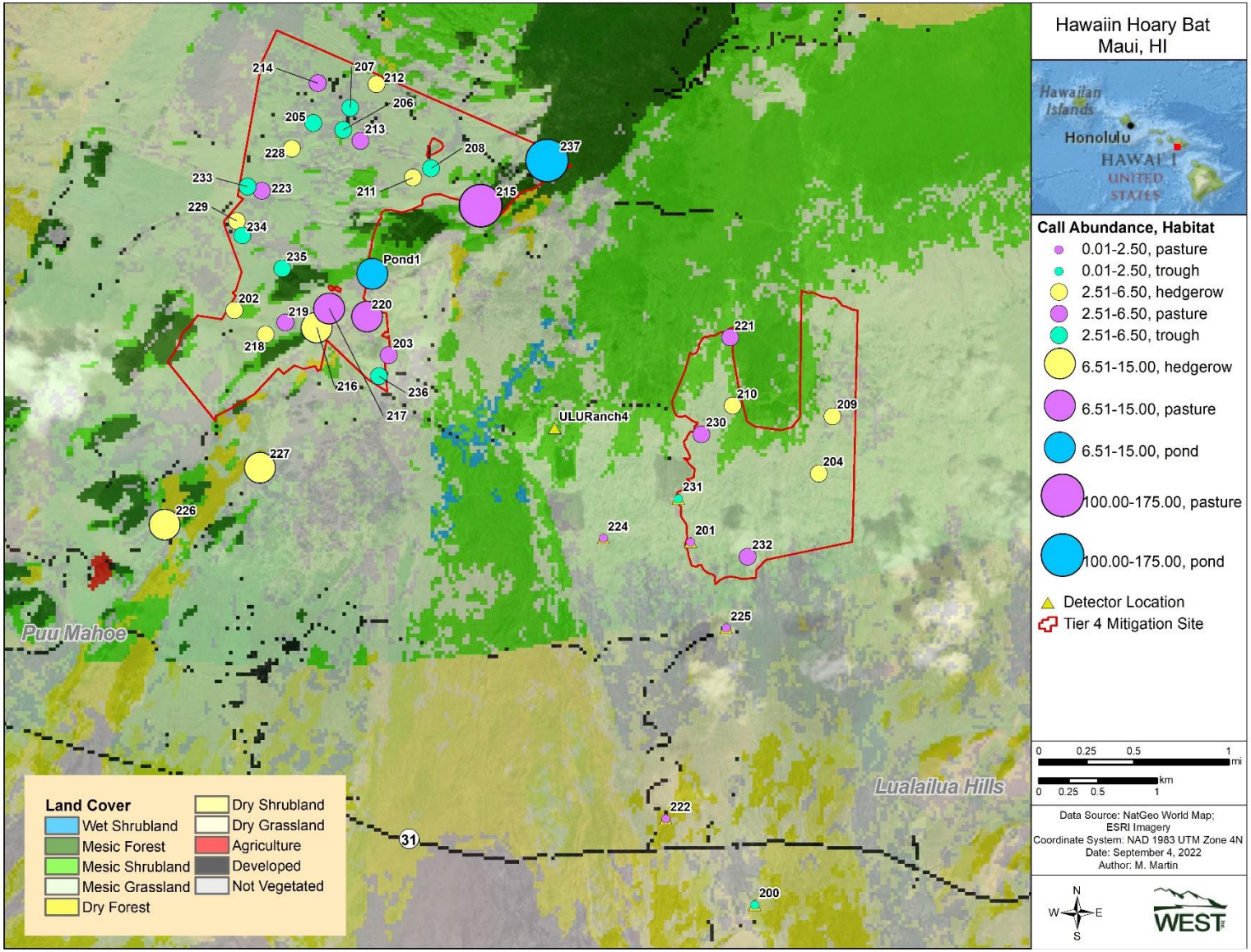

Figure 2. Call abundance by habitat feature type at Auwahi Wind's Tier 4 Hawaiian hoary bat mitigation site for the period February 26, 2020–March 30, 2022.

Annual Data

All Bat Calls

Bat calls were recorded at all detectors in both years (Appendix A1 and A2) of the study. For Year 0 (February 26, 2020–March 31, 2021), the number of detector nights sampled totaled 14,327 and the number of bat calls recorded totaled 158,054, for an overall average call abundance of 10.90 bat calls/detector night (Appendix A1). Bat call abundance varied from a low of 0.81 at station AW222 to a high of 152.86 at station AW237 (Appendix A1). Call nightly detection averaged 0.76 at the 38 stations during the survey period, and varied from a low of 0.39 at detector AW222 to a high of 0.97 at detector AW215 (Appendix A1). Bat calls were recorded on more than 50% of all detector nights at 35 of the 38 detectors and more than 75% of detector nights at 20 of the 38 detectors.

For Year 1 (April 1, 2021–March 30, 2022), the number of detector nights sampled totaled 9,536 and the number of bat calls recorded totaled 193,320, for an overall average call abundance of 14.57 bat calls/detector night (Appendix A2). Bat call abundance varied from a low of 0.66 at station AW222 to a high of 192.13 at station AW215 (Appendix A2). Call nightly detection averaged 0.73 at the 39 stations evaluated during the survey period, and varied from a low of 0.30 at detector AW222 to a high of 0.99 at detector AW215 (Appendix A2). Bat calls were recorded on more than 50% of all detector nights at 32 of the 39 detectors and more than 75% of detector nights at 20 of the 38 detectors (Appendix A2).

Feeding Buzz Calls

In Year 0, feeding buzzes were recorded at 25 of 38 (66%) detectors; however, 65% of all feeding buzzes were recorded at only two stations, AW215 and AW237 (Appendix B1). Feeding buzz abundance averaged 0.02 buzzes/detector night and varied from a low of zero at several detectors to a high of 0.22 at AW237 (Appendix B1). The feeding buzz nightly detection rate was consistently low, averaging 0.01 across all stations (Appendix B1). With the exception of detectors AW215 and AW237, which recorded feeding buzzes on 12% and 14% of detector nights, respectively, feeding buzzes were only recorded on 3% or fewer detector nights (Appendix B1).

In Year 1, feeding buzzes were recorded at all 39 (100%) detectors monitored; however, 45% of all feeding buzzes were again recorded at only two stations, AW215 and AW237 (Appendix B2). Newly added detector Pond1 accounted for another almost 7% of feeding buzzes Feeding buzzes at Pond1 totaled 52 buzzes over a much shorter sampling period of only 168 detector nights compared to 348 nights each at AW215 and AW237. Feeding buzz abundance averaged 0.06 buzzes/detector night and varied from a low of <0.01 buzzes/detector night at several detectors to a high of 0.65 at station AW237 (Appendix B2). The feeding buzz nightly detection rate in Year 1 was again consistently low, averaging 0.04 across all stations (Appendix B2). With the exception of detectors Pond1, AW215, AW237, which recorded feeding buzzes on 15%, 21%, and 30% of detector nights, respectively, feeding buzzes were recorded on only 8% or fewer detector nights (Appendix B1).

DISCUSSION

Based on the data collected during the monitoring period, HAHOBA were regularly active throughout the Mitigation Site, with bat activity recorded at all 39 functional stations monitored during the 2-year study period. In addition, bat activity was recorded and on most nights (74% of nights on average across all detectors). Only one (AW222) out of 39 detectors averaged less than one call per detector night during the cumulative study period, while 90% averaged more than two calls per detector night.

Relative to the baseline (Year 0) survey results, call abundance estimates appeared generally consistent with or slightly elevated at most stations in Year 1 (Figure 3), with an overall mean call abundance up from 10.9 in Year 0 to 14.6 in Year 1 (Figure 4). Detectors AW237 and Pond1 are the only detectors located in close proximity to ponds. Detector AW237 had the highest feeding buzz abundance rate in both Year 0 and Year 1 (0.22 and 0.65 buzzes/detector night, respectively), while Pond1 had the third highest feeding buzz abundance rate in Year 1 (0.31), its first year of monitoring (Appendix B). Detector AW237 also had the highest overall call abundance rate (152.86 calls/detector night) in Year 0 and the second highest overall abundance rate in Year 1 (160.55), while Pond1 ranked 5th in overall call abundance (11.71), substantially lower than that at AW237 (Figure 4; Appendix A).

While AW237 was located in close proximity to a pond, it was also among the highest elevation sites and was located in a small opening within the largest area of mesic forest land cover within or adjacent the Mitigation Site (Figure 2). The higher elevation and proximity to the larger mesic forest patch are two characteristics also shared with detector AW215, which exhibited the second highest activity rate (145.97 calls/detector night) over the full monitoring period, and the highest rate (192.13) in Year 1. This pattern of activity was consistent with that recorded in the Leeward Haleakala occupancy study conducted in 2019–2020 immediately east of the Mitigation Site (Thompson and Starcevich 2021b), which also found higher activity rates at upper elevation sites associated with mesic land cover types. The USGS study conducted in the Waihou Mitigation Area from 2015–2018 (Pinzari et al. 2019) also documented substantially higher activity rates (based on mean monthly detection rate) at their two upper most sample sites, which were located in roughly the same areas as AW215 and AW237. The Pond1 detector is also located at upper elevations within the Mitigation Site, although still at least 1,000 ft lower than detectors AW215 and AW237. While feeding buzz rates at the two pond sites (AW237 and Pond1) were among the highest of all detectors in this dataset, ongoing monitoring will provide additional data to better evaluate activity rates at ponds located at different elevational gradients and in differing land cover types. Additional monitoring will also allow for assessing changes in activity rates at ponds over time, as they mature and show increased aquatic vegetation growth and a likely commensurate increase in insect activity.

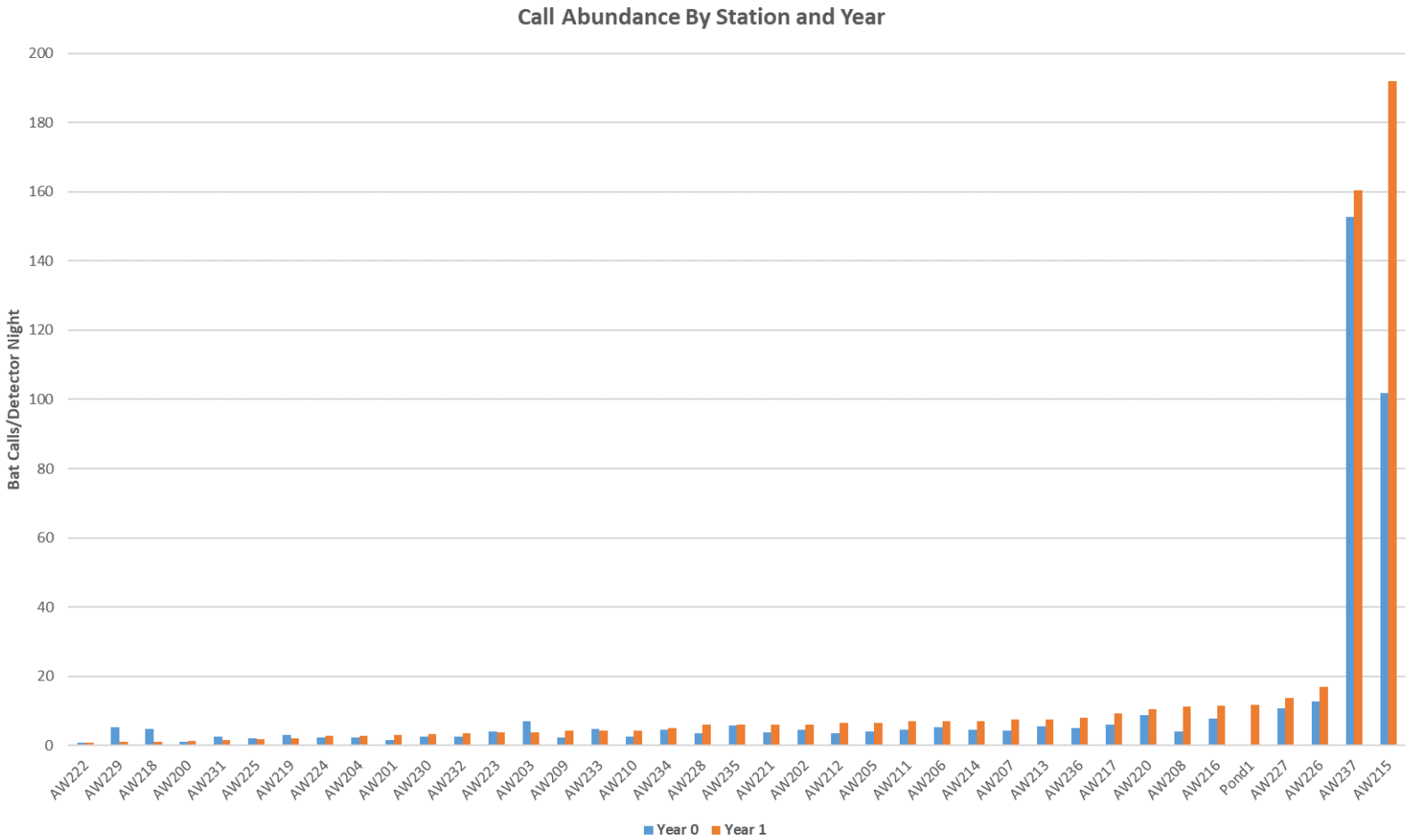

Figure 3. Call abundance (bat calls/detector night) by station and year based on acoustic surveys conducted at 39 sampling stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from February 26, 2020–March 30, 2022. Year 0 spans February 26, 2020–March 31, 2021, and Year 1 spanned April 30, 2021–March 30, 2022.

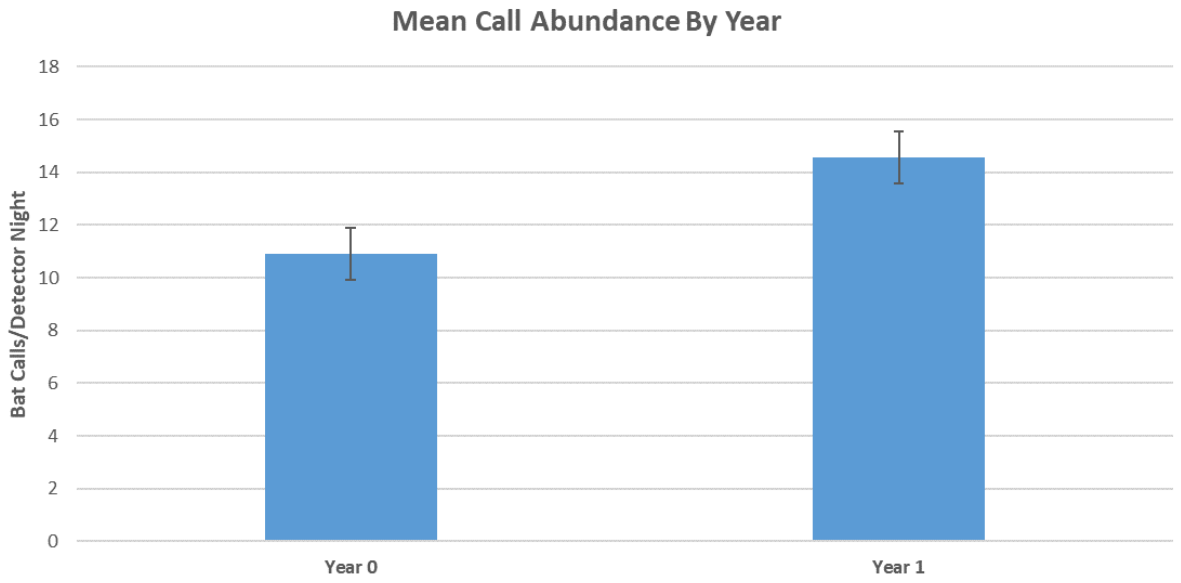

Figure 4. Mean call abundance (bat calls/detector night) for all stations combined by year based on acoustic surveys conducted at 39 sampling stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from February 26, 2020–March 30, 2022. Year 0 spans February 26, 2020–March 31, 2021, and Year 1 spanned April 30, 2021–March 30, 2022.

Overall call abundance and feeding buzz activity rates during the second-year of monitoring (Year 1) were generally consistent with or slightly elevated, on average, relative to the baseline year (Year 0) monitoring. Additionally, with the exception of detectors AW215 and AW237, activity rates in and around the Mitigation Site were also generally consistent with the activity rates measured in the Leeward Haleakala study at similar elevations (approximately 2–18 bat calls/detector night; Thompson and Starcevich 2021b).

Monitoring of bat activity in and surrounding the Mitigation Site is planned for the another 10 years Years 2-11) as mitigation activities (e.g., hedgerow plantings, water source installations) continue to be implemented. The goal of the ongoing monitoring is to quantify bat activity rates both spatially and temporally relative to the mitigation activities, and ideally provide a robust means of determining mitigation success (i.e., did the mitigation actions increase bat abundance/use, as measured by bat activity rates within the Mitigation Site relative to areas outside the Mitigation Site). While data are limited at this point, given only one of year of post-baseline data collection, the initial indication is that bat activity rates associated with the Mitigation Site increased slightly from Year 0 to Year 1 (see Figures 3 and 4). However, additional collected in future years will provide a more robust dataset for evaluating trends in activity over time.

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Appendix A: Hawaiian Hoary Bat Call Abundance and Call Nightly Detection by Year for 39 Acoustic Monitoring Stations Associated with Auwahi Wind Energy's Tier-4 Mitigation Monitoring, Maui, Hawaii from February 26, 2020–March 30, 2022.

Appendix A1. Results for all bat detections during acoustic surveys conducted at 39 stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from February 26, 2020–March 31, 2021 (Year 0).

Station	Associated Habitat Feature	# of Bat Calls	Detector-Nights with Bat Calls	Total Detector-Nights	Call Abundance[a] (Bat Calls/ Detector-Night)	Nightly Detection (Nights Bats Detected/Total Detector-Nights)
AW200[c]	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	1,750	334	384	4.56± 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	385	4.41± 0.23	0.82
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	366	4.68± 0.35	0.66
AW219	pasture	1,108	227	365	3.04± 0.24	0.62
AW220[c]	pasture	3,155	325	359	8.79± 0.43	0.91
AW221[c]	pasture	1,344	305	359	3.74± 0.21	0.85
AW222[c]	pasture	285	138	352	0.81± 0.08	0.39
AW223	pasture	1,513	294	384	3.94± 0.25	0.77
AW224[c]	pasture	810	227	352	2.30± 0.17	0.64
AW225[c]	pasture	674	199	352	1.91± 0.20	0.57
AW226[c]	hedgerow	4,538	339	357	12.71± 0.72	0.95
AW227[c]	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	61,146	377	400	152.86±10.95	0.94
Pond1	pond	NA	NA	NA	NA	NA
Total		**158,054**	**10,861**	**14,327**	**10.90± 0.58**	**0.76**

[a] estimate ± bootstrapped standard error
[b] average of individual detectors to account for unbalanced design (i.e., differing number of detector nights)
[c] indicates detector location is outside the Tier 4 Mitigation Site

Appendix A2. Results for all bat detections during acoustic surveys conducted at 39 stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from April 1, 2021–March 31, 2022 (Year 1).

Station	Associated Habitat Feature	# of Bat Calls	Detector-Nights with Bat Calls	Total Detector-Nights	Call Abundance[a] (Bat Calls/ Detector-Night)	Nightly Detection (Nights Bats Detected/Total Detector-Nights)
AW200[c]	trough	438	156	364	1.20± 0.18	0.43
AW201	pasture	1,084	213	364	2.98± 0.21	0.59
AW202	pasture	2,104	219	347	6.06± 0.47	0.63
AW203	pasture	1,085	143	282	3.85± 0.40	0.51
AW204	pasture	997	220	347	2.87± 0.21	0.63
AW205	trough	2,283	292	347	6.58± 0.47	0.84
AW206	trough	2,417	305	347	6.97± 0.39	0.88
AW207	trough	2,609	310	347	7.52± 0.41	0.89
AW208	trough	2,265	189	200	11.32± 0.88	0.95
AW209	pasture	1,515	311	364	4.16± 0.20	0.85
AW210	pasture	1,506	281	351	4.29± 0.27	0.80
AW211	pasture	2,387	237	347	6.88± 0.43	0.68
AW212	pasture	2,213	299	347	6.38± 0.37	0.86
AW213	pasture	2,613	307	347	7.53± 0.37	0.88
AW214	pasture	2,441	304	347	7.03± 0.41	0.88
AW215	pasture	66,861	344	348	192.13±15.00	0.99
AW216	pasture	4,019	319	348	11.55± 0.58	0.92
AW217	pasture	3,213	309	348	9.23± 0.49	0.89
AW218	pasture	270	105	265	1.02± 0.10	0.40
AW219	pasture	712	210	348	2.05± 0.15	0.60
AW220[c]	pasture	3,614	322	348	10.39± 0.56	0.93
AW221[c]	pasture	2,118	320	351	6.03± 0.28	0.91
AW222[c]	pasture	242	108	364	0.66± 0.07	0.30
AW223	pasture	1,170	229	316	3.70± 0.30	0.72
AW224[c]	pasture	931	220	351	2.65± 0.20	0.63
AW225[c]	pasture	626	181	364	1.72± 0.16	0.50
AW226[c]	hedgerow	5,943	312	351	16.93± 0.99	0.89
AW227[c]	hedgerow	4,810	304	351	13.70± 0.85	0.87
AW228	pasture	2,059	251	347	5.93± 0.50	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± 0.34	0.70
AW233	trough	924	97	222	4.16± 0.58	0.44
AW234	trough	1,770	254	347	5.10± 0.38	0.73
AW235	trough	2,078	260	347	5.99± 0.44	0.75
AW236	trough	2,774	286	351	7.90± 0.41	0.81
AW237	pond	55,873	335	348	160.55±11.86	0.96
Pond1	pond	1,967	142	168	11.71± 1.20	0.85
Total		**193,320**	**9,536**	**13,044**	**14.57± 0.85**	**0.73**

[a] estimate ± bootstrapped standard error
[b] average of individual detectors to account for unbalanced design (i.e., differing number of detector nights)
[c] 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 for 39 Acoustic Monitoring Stations Associated with Auwahi Wind Energy's Tier-4 Mitigation Monitoring, Maui, Hawaii from February 26, 2020–March 30, 2022.

Appendix B1. Results for feeding buzz detections during acoustic surveys conducted at 39 stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from February 26, 2020–March 31, 2021 (Year 0).

Station	Associated Habitat Feature	# of Bat Calls	Detector-Nights with Bat Calls	Total Detector-Nights	Call Abundance[a] (Bat Calls/ Detector-Night)	Nightly Detection (Nights Bats Detected/Total Detector-Nights)
AW200[c]	trough	0	0	353	0.00±0.00	0.00
AW201	pasture	0	0	393	0.00±0.00	0.00
AW202	pasture	0	0	350	0.00±0.00	0.00
AW203	pasture	4	4	336	0.01±0.01	0.01
AW204	pasture	1	1	391	0.00±0.00	0.00
AW205	trough	2	2	387	0.01±0.00	0.01
AW206	trough	3	3	387	0.01±0.00	0.01
AW207	trough	2	2	387	0.01±0.00	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	0.00±0.00	0.00
AW211	pasture	1	1	384	0.00±0.00	0.00
AW212	pasture	0	0	384	0.00±0.00	0.00
AW213	pasture	1	1	384	0.00±0.00	0.00
AW214	pasture	0	0	385	0.00±0.00	0.00
AW215	pasture	65	43	365	0.18±0.03	0.12
AW216	pasture	2	2	367	0.01±0.00	0.01
AW217	pasture	6	6	367	0.02±0.01	0.02
AW218	pasture	6	6	366	0.02±0.01	0.02
AW219	pasture	1	1	365	0.00±0.00	0.00
AW220[c]	pasture	10	10	359	0.03±0.01	0.03
AW221[c]	pasture	1	1	359	0.00±0.00	0.00
AW222[c]	pasture	0	0	352	0.00±0.00	0.00
AW223	pasture	1	1	384	0.00±0.00	0.00
AW224[c]	pasture	0	0	352	0.00±0.00	0.00
AW225[c]	pasture	0	0	352	0.00±0.00	0.00
AW226[c]	hedgerow	6	6	357	0.02±0.01	0.02
AW227[c]	hedgerow	3	3	357	0.01±0.01	0.01
AW228	pasture	0	0	384	0.00±0.00	0.00
AW229	pasture	0	0	384	0.00±0.00	0.00
AW230	pasture	1	1	392	0.00±0.00	0.00
AW231	trough	0	0	393	0.00±0.00	0.00
AW232	pasture	0	0	392	0.00±0.00	0.00
AW233	trough	0	0	399	0.00±0.00	0.00
AW234	trough	3	3	399	0.01±0.00	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	89	54	400	0.22±0.04	0.14
Pond1	pond	NA	NA	NA	NaN± NA	NA
Total		**237**	**180**	**14,327**	**0.02±0.00[b]**	**0.01**

[a] estimate ± bootstrapped standard error

[b] average of individual detectors to account for unbalanced design (i.e., differing number of detector nights)

[c] indicates detector location is outside the Tier 4 Mitigation Site

Appendix B2. Results for feeding buzz detections during acoustic surveys conducted at 39 stations associated with Auwahi Wind Energy's tier 4 mitigation monitoring, Maui, Hawaii from April 1, 2021–March 31, 2022 (Year 1).

Station	Associated Habitat Feature	# of Bat Calls	Detector-Nights with Bat Calls	Total Detector-Nights	Call Abundance[a] (Bat Calls/ Detector-Night)	Nightly Detection (Nights Bats Detected/Total Detector-Nights)
AW200[c]	trough	7	6	364	0.02±0.01	0.02
AW201	pasture	3	3	364	0.01±0.00	0.01
AW202	pasture	4	3	347	0.01±0.01	0.01
AW203	pasture	5	5	282	0.02±0.01	0.02
AW204	pasture	8	7	347	0.02±0.01	0.02
AW205	trough	14	14	347	0.04±0.01	0.04
AW206	trough	15	15	347	0.04±0.01	0.04
AW207	trough	17	13	347	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	347	0.02±0.01	0.02
AW212	pasture	7	7	347	0.02±0.01	0.02
AW213	pasture	11	10	347	0.03±0.01	0.03
AW214	pasture	13	12	347	0.04±0.01	0.03
AW215	pasture	128	73	348	0.37±0.05	0.21
AW216	pasture	29	25	348	0.08±0.02	0.07
AW217	pasture	15	14	348	0.04±0.01	0.04
AW218	pasture	1	1	265	0.00±0.00	0.00
AW219	pasture	2	2	348	0.01±0.00	0.01
AW220[c]	pasture	32	26	348	0.09±0.02	0.07
AW221[c]	pasture	12	11	351	0.03±0.01	0.03
AW222[c]	pasture	1	1	364	0.00±0.00	0.00
AW223	pasture	3	2	316	0.01±0.01	0.01
AW224[c]	pasture	6	6	351	0.02±0.01	0.02
AW225[c]	pasture	6	6	364	0.02±0.01	0.02
AW226[c]	hedgerow	34	29	351	0.10±0.02	0.08
AW227[c]	hedgerow	27	23	351	0.08±0.02	0.07
AW228	pasture	10	9	347	0.03±0.01	0.03
AW229	pasture	1	1	347	0.00±0.00	0.00
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	222	0.02±0.01	0.02
AW234	trough	6	6	347	0.02±0.01	0.02
AW235	trough	7	7	347	0.02±0.01	0.02
AW236	trough	10	10	351	0.03±0.01	0.03
AW237	pond	227	106	348	0.65±0.08	0.30
Pond1	pond	52	26	168	0.31±0.12	0.15
Total		**786**	**544**	**13,044**	**0.06±0.00[b]**	**0.04**

[a] estimate ± bootstrapped standard error

[b] average of individual detectors to account for unbalanced design (i.e., differing number of detector nights)

[c] indicates detector location is outside the Tier 4 Mitigation Site