Hamilton City Annual Bat Survey 2024

August 2024

Author: Ellen Webb

This report should be cited as: ‘Go Eco. (2024). Hamilton City Annual Bat Survey 2024. Prepared for Project Echo’

Contents

Acknowledgements

We would like to thank Hamilton City Council for providing funding for this year's survey. A big thanks to Halle Aish and Dr. Grant Tempero from the University of Waikato for their time and efforts in analyzing all of the data. We would also like to thank Moira Pryde for providing ongoing input into the methodology, Grant Tempero, Andrew Styche, Wiea Montemezzani, Aimee Nooyen, Dario Alemany Sanchez and Fiona Collie for donating their time to deploy and retrieve the monitors this year. Thanks also goes to Grant and Kate Richardson for their reviewing. Finally, we would like to thank Andrew Thomas from Waikato Regional Council for lending us monitors for the survey.

Introduction

➔ Long-tailed bats

Long-tailed bats (*Chalinolobus tuberculatus*; pekapeka-tou-roa) are one of only two remaining native terrestrial mammal species in New Zealand. Their populations have experienced significant declines since the arrival of humans and mammalian predators and are classified as Threatened - Nationally Critical by the Department of Conservation[1]. Major threats to the survival of long-tailed bats include deforestation, the introduction of predatory mammals, and increasing urbanisation[1];[2].

➔ Project background and objective

Hamilton City is among three known urban areas where long-tailed bat populations reside. Unfortunately, the expansion of urban areas and the development of roads have led to the loss of potential roosting and foraging habitats[3,4]. Long-term monitoring of bat activity in Hamilton City aims to identify long-term changes in spatial distribution of long-tailed bats and may assist in identifying anthropogenic impacts on the population. The inaugural city-wide bat survey in 2012, carried out by Project Echo and Kessels Ecology[4], instigated interest in the presence and distribution of bats within Hamilton City. Subsequently, annual city-wide surveys have been conducted from 2016 to 2023[5-11]

Annual bat surveys of Hamilton city are currently coordinated by Go Eco with assistance from other Project Echo partners (including Department of Conservation (DOC), Waikato Regional Council (WRC), Hamilton City Council (HCC), University of Waikato and community volunteers). The following report covers the findings from the 2024 annual acoustic monitoring survey, the eighth annual survey since 2016.

Methods

➔ Survey design

From 2016 to 2020, selection of acoustic monitoring sites for city-wide bat surveys depended on expert judgment, and were limited by low ABM availability. Consequently, acoustic monitors were mainly placed in public parks and areas with low human population density as it was assumed that this would aid bat detection. Following data collection, information was summarized descriptively without conducting significant quantitative analysis.

In 2021, following advice from DOC scientists, a new survey method was adopted with the aim of detecting trends in spatial distribution of long-tailed bats across Hamilton City using Generalised Linear Mixed Modeling (GLMM). Monitoring sites were selected using a 'balance acceptance sampling' (BAS) method[12] to generate a master sample of potential monitoring sites. This is a more spatially balanced method of survey site selection and minimizes site selection bias, providing the ability to conduct environmental surveys with good spatial balance and at a wide range of spatial scales. A power analysis was undertaken using Green & MacLeod's (2016[13]) method to determine the number sites and days required to allow detection of trends over time. This analysis indicated that a minimum of 25-30 sites with an Acoustic Bat Monitors (ABM) deployed for 10-12 days annually for 5-10 years would be sufficient to show a trend (M. Pryde, pers. comm.).

A total of 113 potential survey locations were generated using 'R' statistical software (Appendix 1) and incorporating 20 historical sites (sites 1-20) used in previous surveys to allow for continuity with surveys done prior to 2021. However, in 2024 the number of survey locations was reduced to 31 sites (Figure 1), due to a combination of changing resource availability and the reduced need for sampling sites following the results of the power analysis. These sites were selected sequentially based on having had ABMs consistently deployed in set locations from 2021 (15 of which are historical sites [sites 2-11, 14-16, 19, 20]).

This 2024 survey marks the fourth year of utilizing this methodology.

➔ ABM monitoring

A total of 31 omnidirectional frequency compression Automated Bat Monitors (model AR4 DOC electronic workshop) were deployed across the city (Figure 1). All monitors were pre-set to start 1 hour before official sunset and left recording until 1 hour after official sunrise. Six ABMs deployed on February 28 recorded for 26 consecutive nights, and 25 ABMs deployed on March 4 and 5 recorded for 23 consecutive nights . All monitors were collected during the week of March 25. Due to ABM failures, three monitors were redeployed April 2 and retrieved April 23 (20 nights) to meet the minimum requirement of 10-12 recording nights.

Following protocols described by Lloyd (2017)[15], the data was analyzed using BatSearch 3.12 software (developed by DOC). The data was then tabulated using Microsoft Excel and mapped using ArcMap 10.8.2.

Air temperature (°C) and precipitation (mm) for the monitoring period were obtained from the NIWA Cliflo database, Ruakura EWS weather station number 26117. Refer to Appendix 3 for the nightly average weather parameters recorded during the survey period.

Results

A total of 3,223 echolocation passes were recorded at seven of 22 monitored sites, with a minimum of 0.11 and maximum of 67.57 passes/night (Figure 1 and Table 1).

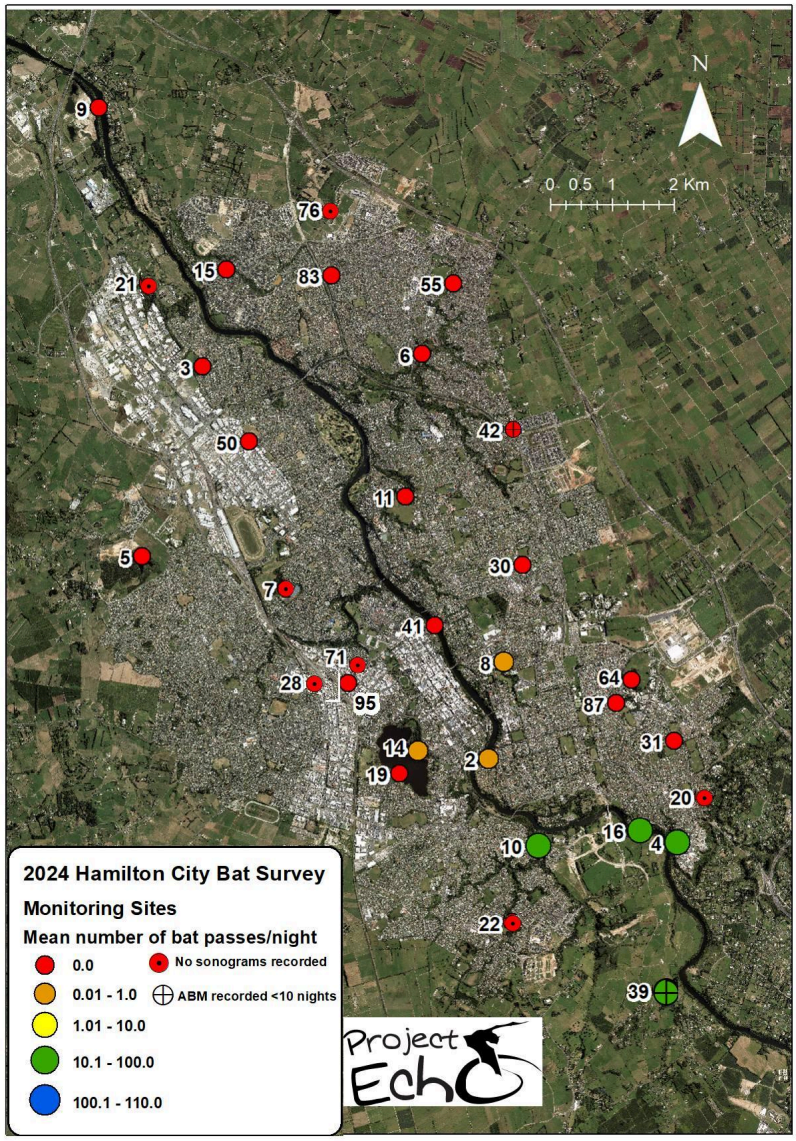
The top four number of bat passes were recorded at site 4 (67.57 passes/night), site 16 (20.91 passes/night) (Hammond Park), site 10 (45.14 passes/night) (Sandford Park) and site 39 (33 passes/night) (Peacocke).

Also of note, bat passes at site 8 (AJ Seeley Gully) during this survey were the first detections within the last 3 years (Appendix 2).
Long-tailed bats consistently emerge from roosts where temperatures at dusk are >8°C, ideally >10°C (O'Donnell 2000)[17] and <5 mm in the first 4 hours after official sunset. Temperatures and precipitation over all the survey nights were suitable for bat emergence (Appendix 3).

Table 1: Summary of bat passes detected across Hamilton City in the 2024 survey

Site Number	Location	Habitat type	No. of bat passes	Mean Number of Passes/Night 2024
2	Hamilton East	Park or gully	2	0.11
4	Riverlea	Park or gully	1554	67.57
8	Hamilton East	Park or gully	2	0.14
10	Melville	Park or gully	948	45.14
14	Hamilton	Park or gully	5	0.24
16	Riverlea	Park or gully	481	20.91
39	Peacockes	Agricultural or lifestyle	231	33

Figure 1: Map of 2024 survey results (mean number of bat passes/night) at each of the 31 sites within Hamilton City. indicates the monitors that did not have any sound recordings (7), indicates the monitors that did not record for the minimum 10 nights.



Discussion

Of the 31 ABMs deployed, 22 recorded >10 nights of recordings, this is lower than the suggested power analysis minimum. Seven monitors malfunctioned whereby the recording folders were empty, with no

sonograms recorded. The monitors without sonograms have been recorded as zero bat passes, but it's important to note the lack of sound files does not indicate a lack of bat presence. Three monitors experienced early battery death but had not recorded enough data and had to be redeployed. Unfortunately, after redeployment, only one of these recorded enough data and the rest (2) did not as the batteries had not been charged for enough time.
The monitor issues can be attributed to four being incorrectly preset to record Forest and Bat settings, recording twice each day causing batteries to fail faster. The remaining monitors experienced malfunctions for unknown reasons.

Despite the reliability issues of the ABMs, the combination of: high demand for and difficulty securing large numbers of monitors, the aging model of the monitors and their potential limited future use and, on the advice of DOC statisticians who conceived the original master dataset, the indication of a minimum sample size for analysis to specifically determine spatial distribution around the city and their suggestion to reduce the number of monitors accordingly. To assist this, every effort should be made to redeploy ABMs if there is an issue from first deployment. For this year's survey, it was becoming too late in the season to redeploy to achieve representative activity levels (May versus March deployment). Additionally, after consulting DOC, it has been indicated that, if necessary, statistical analysis can account for the number of nights (pers comm). However, this analysis accommodation should not be relied upon in future surveys.

Consistently across survey years, higher bat activity is observed within the gullies in southern Hamilton. All of these southern sites are within close proximity of crucial roosting sites. The encroaching development and infrastructure within these areas are expected to have an impact on these bat populations, what exactly these impacts will be are not well understood.

Conclusion

As per previous surveys, the highest number of bat passes occurred in the southern areas of Hamilton City. These areas, for now, have low urban densities and have large areas of natural green space (gullies) which home crucial roosting habitat for the long-tail bat. Bat activity is lower and more sporadic in the rest of the city.

A positive aspect was the detection of bat activity at site 8 (AJ Seeley Gully),for the first time in 3 years.

Despite the number of sites monitored not reaching minimum sample size, statistical analysis can account for this as a one-off occurrence. However, this accommodation should not be regularly relied upon and every effort should be made to redeploy ABMs if issues occur after initial deployment in March.

References

[1] O'Donnell CFJ, Borkin KM, Christie J, Davidson-Watts I, Dennis G, Pryde M and Michel P. 2023: Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p.

[2] Pryde MA, O'Donnell CFJ and Barker RJ. 2005. Factors influencing survival and long-term population viability of New Zealand long-tailed bats (*Chalinolobus tuberculatus*): Implications for conservation. Biological Conservation 126: 175-185.

[3] Dekrout AS, Clarkson BD and Parsons S. 2014. Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (*Chalinolobus tuberculatus*). New Zealand Journal of Zoology 41: 285-295.

[4] Le Roux DS and Le Roux NN. 2012. Hamilton City Bat Survey 2011-2012. Kessels & Associates Limited 2012. Hamilton. pp 24.

[5] Mueller H, Ulrich C, Purcell A. 2017. Hamilton City Long-tailed Bat Survey 2016 – 2017. Client report prepared for Project Echo. Kessels Ecology Ltd. Hamilton.

[6] van der Zwan W. 2018. Hamilton City Long-tailed Bat Survey, 2017 – 2018. Client report prepared for Project Echo by Tonkin & Taylor Ltd. Hamilton.

[7] van der Zwan W and Mueller H. 2019. Hamilton City Long-Tailed Bat Survey. Annual Monitoring Report 2018-2019 to Project Echo. Tonkin & Taylor Ltd. Hamilton.

[8] Dumbleton H and Montemezzani W. 2020. Hamilton City long-tailed bat survey. Annual Monitoring Report 2020 prepared for Project Echo. 4Sight Consulting. Hamilton.

[9] Aughton H. 2021. Project Echo 2021 Hamilton City wide bat survey. Go Eco. Hamilton.

[10] Caskey L and Tempero G. 2022. Hamilton City Long-tailed Bat Survey: Annual monitoring report, 2022. ERI report number 165. Prepared for Project Echo.

[11] 'Tītoki Landcare. (2023). Hamilton City Wide Bat Survey 2023. Prepared for Project Echo'

[12] van Dam-Bates P, Gansell O and Robertson B. 2018. Using balanced acceptance sampling as a master sample for environmental surveys. Methods in Ecology and Evolution, 9(7), 1718-1726.

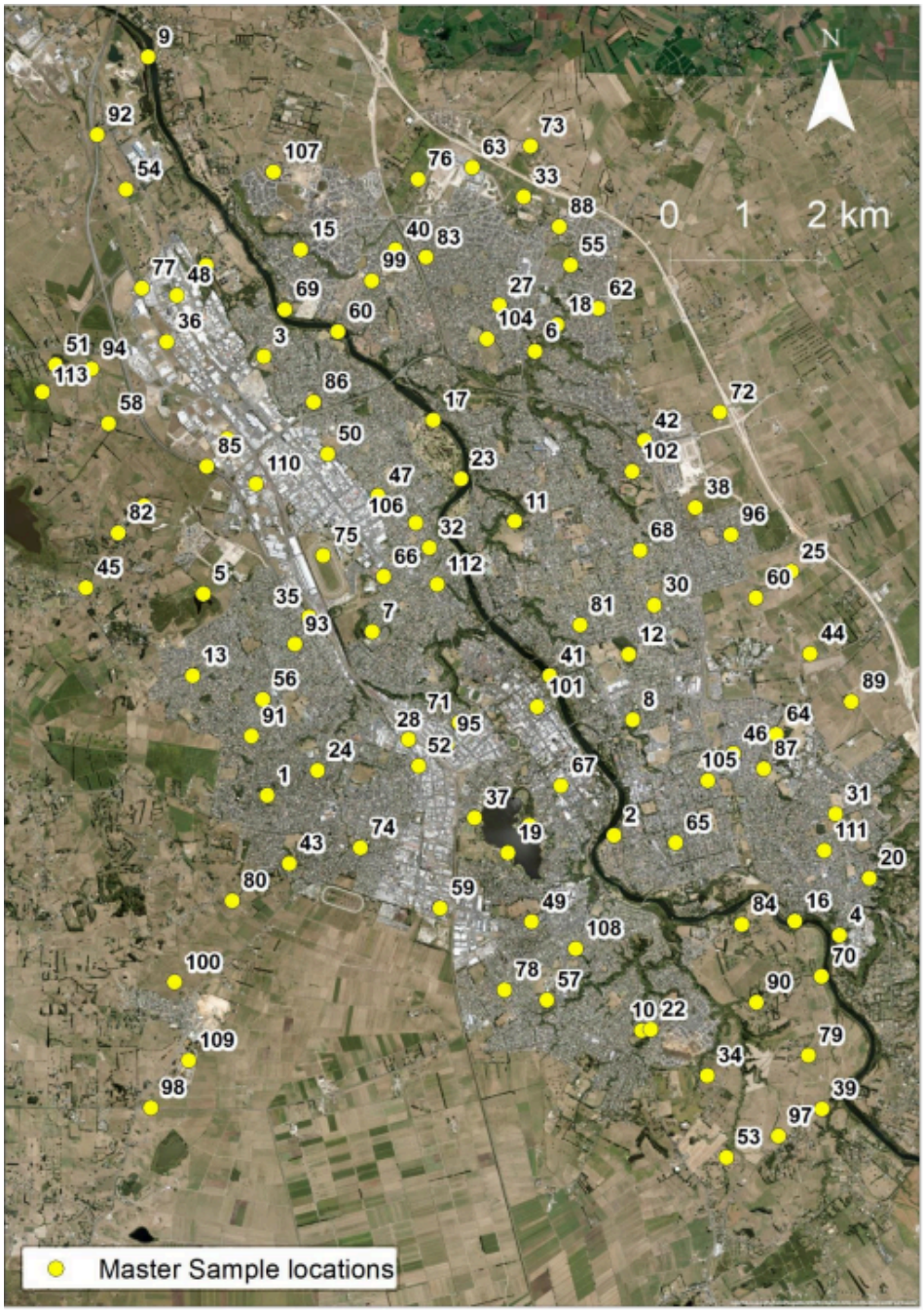
[13] Green P. and MacLeod C. 2015. SIMR: An R package for power analysis of generalized linear mixed models by simulation. Methods in Ecology and Evolution. 7. n/a-n/a. 10.1111/2041-210X.12504.

[14] Pryde MA. 2023a. Presentation at the national Bat Hui. May 2023. Presentation title: Progress and update on testing the use of ABMs to monitor trends.

[15] Lloyd B. 2017. Bat call identification manual for DOC's spectral bat detectors. (Ed. by The Department of Conservation). Wellington, New Zealand.

Appendices

Appendix 1: Master sample survey locations (van Dam-Bates et al. 2018)



Appendix 2: Complete 2024 monitor survey results of all 31 locations within Hamilton City. The highlighted sites indicate the monitors that were inviable (not recording a minimum of 10 nights). The **bolded** sites indicate the monitors that were redeployed in April.

Site Number	Location	Northing	Easting	Habitat type	Number of Nights Deployed	Number of Nights Recorded	No. of bat passes	Mean Number of Passes/Night 2024
2	Hamilton East	5814165.069	1801610.7	Park or gully	23	18	2	0.11
3	Pukete	5820499.902	1797005.42	Park or gully	30	30	0	0
4	Riverlea	5812814.108	1804657.91	Park or gully	23	23	1554	67.57
5	Baverstock	5817434.589	1796024.6	Park or gully	35	35	0	0
6	Rototuna	5820703.43	1800537.31	Park or gully	20	20	0	0
7	Forest Lake	5816913.327	1798356.26	Park or gully	33	27	0	0
8	Hamilton East	5815725.561	1801863.04	Park or gully	23	14	2	0.14
9	Horotiu	5824681.143	1795332.17	Park or gully	33	32	0	0
10	Melville	5812764.153	1802413.57	Park or gully	21	21	948	45.14
11	Fairfield	5818402.563	1800272.41	Park or gully	21	21	0	0
14	Hamilton	5814296.105	1800475.92	Park or gully	21	21	5	0.24
15	Flagstaff	5822067.435	1797386.81	Park or gully	20	20	0	0
16	Riverlea	5813007.108	1804054.91	Park or gully	23	23	481	20.91
19	Hamilton	5813930.104	1800180.92	Park or gully	21	21	0	0
20	Hillcrest	5813559.679	1805074.29	Park or gully	23	23	0	0
21	Pukete	5821853.372	1796120.63	Park or gully	29	23	0	0
22	Glenview	5811524.944	1801992.43	Park or gully	21	21	0	0
28	Frankton	5815414.998	1798790.37	Industrial and commercial	21	21	0	0
30	Enderley	5817295.401	1802164.07	Residential	23	23	0	0
31	Hillcrest	5814454.391	1804609.78	Park or gully	23	23	0	0
39	**Peacockes**	**5810424.327**	**1804455.24**	**Agricultural or lifestyle**	**21**	**7**	**231**	**33**
41	Claudelands	5816319.106	1800746.12	Park or gully	23	15	0	0
42	**Chedworth**	**5819492.247**	**1801989.56**	**Residential**	**21**	**5**	**0**	**0**
50	Te Rapa	5819289.233	1797755.32	Park or gully	35	23	0	0
55	Rototuna	5821845.922	1801041.32	Park or gully	20	20	0	0
64	Hillcrest	5815441.596	1803920.94	Park or gully	23	23	0	0
71	**Frankton**	**5815699.483**	**1799514.82**	**Residential**	**21**	**14**	**0**	**0**
76	Rototuna	5823048.312	1799077.27	Residential	21	13	0	0
83	Rototuna	5821971.277	1799077.73	Residential	20	20	0	0
87	Hillcrest	5815062.416	1803673.62	Park or gully	23	23	0	0
95	Frankton	5815391.694	1799354.47	Industrial and commercial	21	15	0	0

Appendix 3: Weather conditions obtained from NIWA Cliflo. Station: Ruakura EWS weather station. Station number 26117.

Date	Rain amount (mm) in 24 hrs	Average temperature
26/02/2024	4.4	20
27/02/2024	8	18.6
28/02/2024	0.2	16.6
29/02/2024	0	18.9
1/03/2024	0	19.6
2/03/2024	0	17.5
3/03/2024	14.4	19.3
4/03/2024	13.4	19.3
5/03/2024	16.4	17.2
6/03/2024	1.8	15.4
7/03/2024	0	14.6
8/03/2024	0	15.7
9/03/2024	0.2	17
10/03/2024	0	16.4
11/03/2024	0	17.2
12/03/2024	0	18.4
13/03/2024	5	17.8
14/03/2024	0.2	20.2
15/03/2024	23	16.7
16/03/2024	5	13.2
17/03/2024	0	12.3
18/03/2024	0.2	15.2
19/03/2024	0	14.1
20/03/2024	0	12.2
21/03/2024	0	13.1
22/03/2024	0	12.8
23/03/2024	2.2	14.8
24/03/2024	19.2	15.3
25/03/2024	0	16.8
26/03/2024	1.2	18
27/03/2024	1.2	18.5
28/03/2024	5.2	17.6
29/03/2024	1.4	16.7
30/03/2024	0	11.8
31/03/2024	0	11.1

Date	Rain amount (mm)	Average temperature
2/04/2024	0	13
3/04/2024	0	13.9
4/04/2024	0	16.5
5/04/2024	2.6	17.4
6/04/2024	0	15.9
7/04/2024	0	17.4
8/04/2024	0	16.6
9/04/2024	0	16.7
10/04/2024	0.4	17.5
11/04/2024	0	20.2
12/04/2024	3.8	20.4
13/04/2024	14.2	16.4
14/04/2024	4	15.3
15/04/2024	0	13.8
16/04/2024	0.6	15
17/04/2024	1	15.3
18/04/2024	1.8	14.7
19/04/2024	4	15.1
20/04/2024	5.2	16.7
21/04/2024	10.4	16.2
22/04/2024	0	14.7
23/04/2024	0	14