Project Echo
2021 Hamilton City Wide Bat Survey

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Acknowledgments

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Background

Hamilton City is one of at least three urban centres in New Zealand (along with Auckland and Rotorua) with known populations of long-tailed bats (pekapeka-tou-roa; *Chalinolobus tuberculatus*). Long-tailed bats are one of only two extant native terrestrial mammal species and are classified as 'Threatened – Nationally Critical' (O'Donnell et al. 2018). This makes the Hamilton long-tailed bat population important for national species management and conservation. In comparison to South Island and large national park populations, little research has been conducted on fragmented North Island populations, particularly those inhabiting urban areas. Annual monitoring surveys of Hamilton City were commenced by Project Echo in 2016, following on from an initial survey in 2011. The purpose of this monitoring was to identify, map and track changes in bat habitat use through bio-acoustic surveys and build on findings of earlier city-wide bat surveys which illustrated the importance of maintaining and restoring connected bat habitats in less developed areas of the city (Le Roux & Le Roux , 2012; Mueller, Ulrich, & Purcell, 2017; Van der Zwan 2018; Van der Zwan & Mueller 2019).

Previous Project Echo surveys of Hamilton City for long-tailed bats have generally found higher levels of bat activity in the south of the city, predominantly in the Mangakotukutuku Gully and Hammond Park gully habitats. Meanwhile, the northern, western, and central parts of the city had less or no activity.

Since the 2011/2012 survey, a large amount of infrastructure development has occurred or is currently under construction in areas of bat habitation. The under-construction Waikato Expressway crosses three major gully systems; Manganoua, Mangaone and Mangaharakeke, and urban development is proceeding in southern Hamilton, associated with the Peacocke Structure Plan (Hamilton City Council 2007). There has also been extensive development in the north of the city in recent years. Ongoing monitoring of bat activity and research into their habitat utilisation and distribution is therefore important to understand changes in spatial distribution and habitat use.

A total of 1,000 ha of open space is present within the urban footprint of Hamilton City, spread over 145 parks. Some of these parks were identified in the habitat prediction model (Crewther and Parsons, 2017) as potential habitat for long-tailed bats, of which some were surveyed as part this project.

Report Methods

The 2021 Hamilton City survey trialled a different monitoring method, with the aim of providing a more spatially balanced distribution of survey points using the Master Sample Design (van Dam

Bates et al. 2018), following advice from the Department of Conservation. Previous surveys had concentrated on expert opinion for detecting bats resulting in acoustic monitors being primarily deployed in public parks and other low-density areas of the city where bats were expected to be more likely to be detected. However, this methodology does not enable the tracking of long-term changes in spatial distribution across the city, and it is preferable to avoid biased selection of survey points while acknowledging it may reduce the probability of detecting bats.

The Master Sample Design provides the ability to conduct environmental surveys with good spatial balance and at a wide range of spatial scales for nearly all terrestrial species and allows for the incorporation of stratification and unequal probability design among other applications.

To ensure consistency between years a proportion of the original Project Echo sites were also retained. Survey points from the 2020 Project Echo survey represented 35% of the overall area within Hamilton City Council boundaries; therefore, it was determined that 35% of the 2021 sites would be selected from the Project Echo 2020 sites. The aim for 2021 was to deploy 90 ABMs at 90 sites across Hamilton; therefore, the plan was that 23 of these would be "original" sites, and the remaining sites generated using master sample methodology[1] to give a spatially balanced design across the city.

Due to survey logistics, it was possible to deploy a total of 66, of which 23 were "original" sites and 42 were generated by the master sample methodology (Figure 1). ABM deployment sites were chosen by working through the master sample model chronologically. Where it was not possible to deploy the ABM at the exact point, an attempt was made to deploy the ABM close by (usually within 25m but no more than 50m from the original point).At the majority of sites the main determining factors were 1) locating something to hang the ABM from (usually a tree) that was at the appropriate height and not visible to the public, and 2) where landowner permissions could be obtained – between these two factors there were generally few options from which to select.

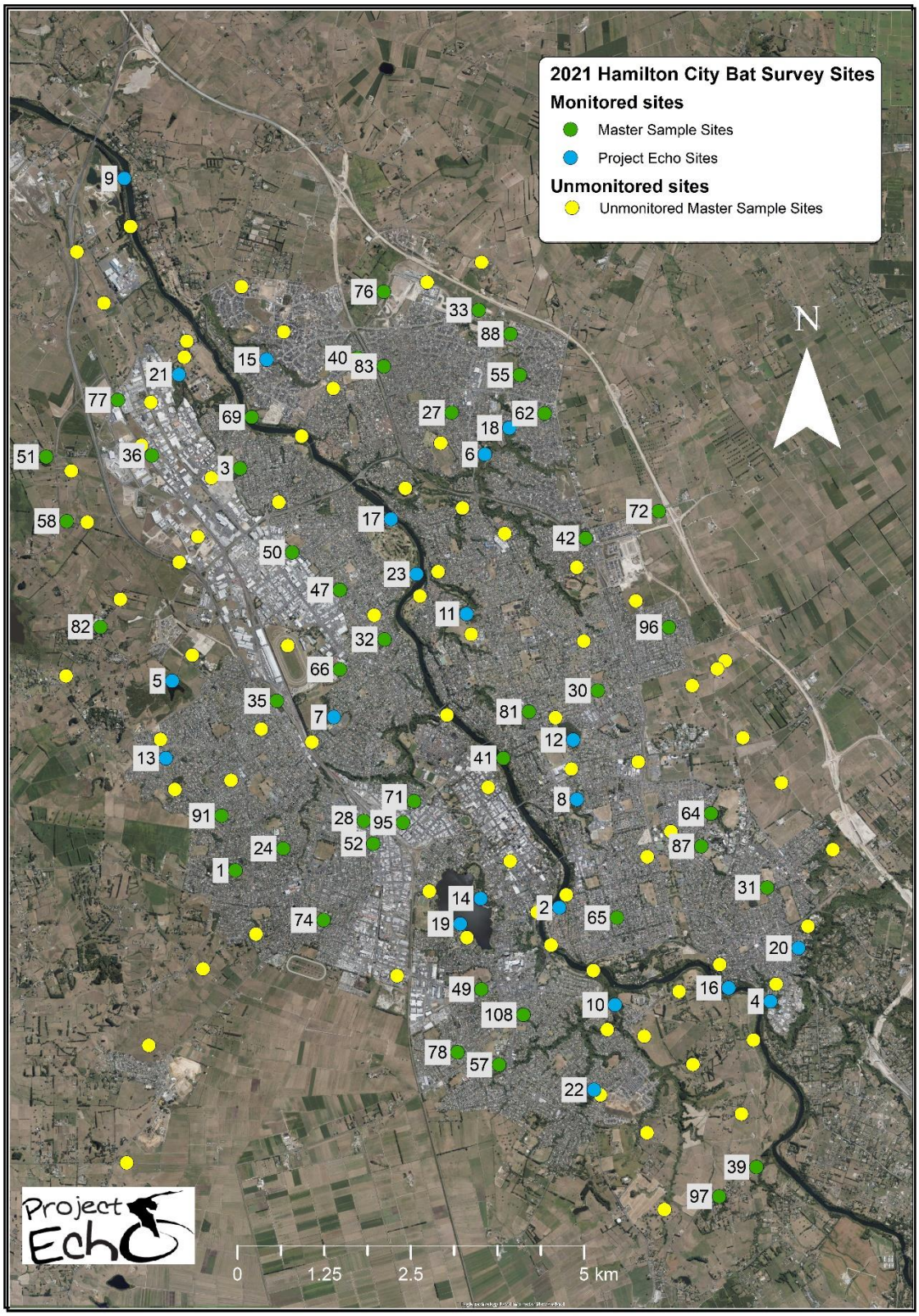
The extent of the city survey was also expanded to include the rural fringes of the city that are targeted or currently under development such as the Peacockes area to the south of the city which had not previously been included in Project Echo surveys (primarily due to resource limitations in previous years).

Omnidirectional frequency compression automatic bat monitors (ABMs; AR4 model, Department of Conservation, Wellington) were used to record the presence, absence, and activity patterns of bats in Hamilton City. The 66 survey sites were monitored concurrently from 3–25 March 2021. All ABMs were pre-set to start monitoring 1-h before sunset and stopped recording at 1-h after sunrise.

Wherever possible, the ABMs were suspended approximately 4 m above the ground using boat hooks. All echolocation sonograms were recorded with a date (day/month/year) and time (hour/minute/second) stamp. The recordings were visually analysed by Harvey Aughton and Harsha

[1] A total of 113 master sample survey points were generated, to allow for some to be removed if they were not logistically feasible. 25 number of points were not used for this reason (e.g. located in the middle of a highway, landowner permissions could not be obtained).

Joseph using BatSearch3.12 software (developed by DOC 2016) in accordance with protocols described by Lloyd (2017).



Hamilton City Bat Survey: Monitoring Sites 2021

Figure 1: Sites generated by the DOC master sample for the Project Echo 2021 city-wide survey of Hamilton, detailing total sites, actual sites used (green, blue), and sites previously used by Project Echo surveys.

Results

A total of 5921 echolocation passes were recorded across 20 sites. Two sites, Hammond Park (site 4) and Sandford Park (site 10) accounted for 88.2% (5,196) of all bat passes recorded in the 2021 survey. During this survey bat passes were recorded at sites not previously monitored by Project Echo, including site 95 (Kent Street, Frankton), site 71 (Norton Road, Frankton), and site 72 (Greenhill Road).

Table 1 details the data collected by each ABM, corresponding to individual sites in the Hamilton City master sample model. Three of the ABMs were lost or damaged during the monitoring period

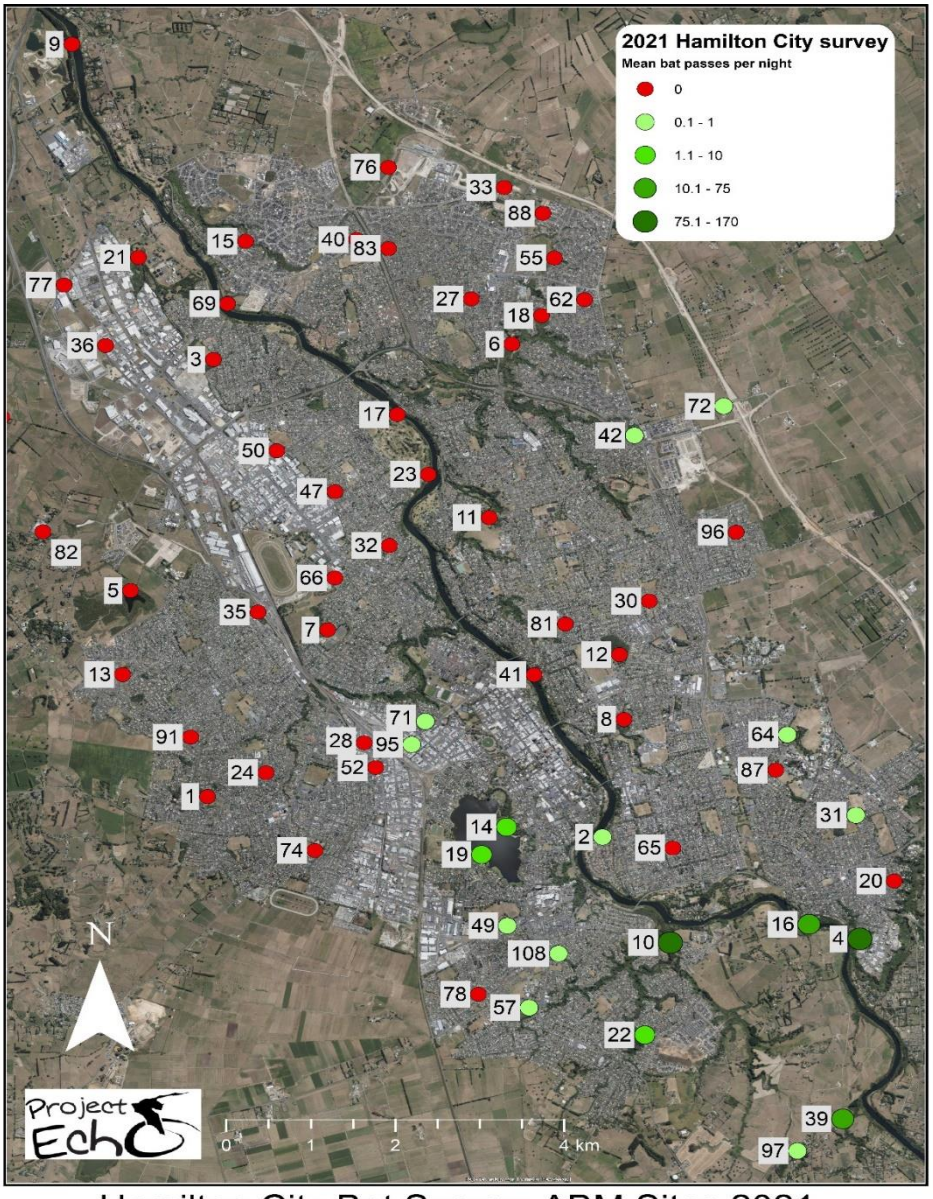


Figure 2: Map of Hamilton showing the results from the 2021 city-wide survey.

Discussion

90 sites were chosen from the master sample model because there only 90 ABMs available for use during the survey. Due to logistical issues at the time of ABM placement. only 66 sites were used – future surveys should aim to include another 25 of the sites identified in Figure 1. In addition, several sites were inaccessible due to large construction projects that did not allow for the ABM to be deployed close to the original point, and other sites were inappropriate for ABM placement. Many of the sites were on private land and permission was not given for entry onto some private properties.

The primary logistical issue encountered was insufficient volunteers to deploy all ABMs in the week that has been allocated for the survey. Due to this project relying on volunteers, it will be important to make sure there are more than enough people in any subsequent surveys to account for some volunteer defection on the day. It would also be advantageous to select deployment sites before the deployment week. 29 ABM's that did not record any bat passes are detailed in Appendix A, as well as 2 ABMS which may have been faulty from the start of the survey and did not record any effort. Therefore, an effective method may be to check ABMs are functional before the start of the survey using a app which produces ultrasonic sound.

For the 2021/2022 survey, a possible approach would be to use the same 66 sites where ABMs were deployed in the 2020/2021 survey, while adding more ABM sites to the south of the city. The project will need to ensure that the survey uses enough ABMS to establish a trend over the whole survey area.

References

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Appendix A

Site Number	Location	Address	Latitude	Longitude	Habitat type	Number of nights deployed	Number of passes	Average number of passes/night	Number of nights with bats detected
1	Dinsdale	Caenarven Park	-37.4737	175.1412	Native forest Park	22	0	0	0
2	Hamilton East	Hayes Paddock	-37.475122	175.17.2373	River Bank	21	10	0.48	5
3	Pukete	Ashhurst Park	-37.7416	175.2359	Park	22	0	0	0
4	Riverlea	Hammond Park(Balforu Crescent End)	-37.483254	175.192942	Native Forest Gully	22	3658	166.28	22
5	Baverstock	Waiwhakareke	-37.7694182	175.2256032	Native forest Lake	21	0	0	0
6	Rototuna	Mangaiti Gully	-37.739	175.2759	Gully	23	0	0	0
7	Forest Lake	Minogue Park (Beside Lake Rotokaeo)	-37.462447	175.150789	Native forest Lake	22	0	0	0
8	Hamilton East	AJ Seeley Gully	-37.47006	175.173246	Native Forest Gully	21	0	0	0
9	Horotiu	Waikato River Path	-37.7043	175.2158	River	22	0	0	0

10	Melville	SandFord Park	-37.4894	175.1757	Native/exotic Gully	19	1538	80.95	19
1 1	Fairfield	Donny Park	-37.4534	175.1624	Native/Exotic Gully	21	0	0	0
12	Claudelands	Te Papanui (Claudelands Bush)	-37.463196	175.172958	Native forest	21	0	0	0
13	Grandview Heights	53-61 Farnborough Drive	-37.464592	175.132944	Native forest park	22	0	0	0
14	Hamilton	Hamilton Lake Domain	-37.474798	175.163711	Lake	21	89	4.24	15
15	Flagstaff	Public Walk (Behind 14A Petersberg Drive)	-37.7274	175.2398	Gully	21			
16	Riverlea	Hammond Park (Boardwalk)	-37.482685	175.190464	Gully	22	255	11.59	22
17	St Andrews	Waikato River Path	-37.445171	175.153881	River	22	0	0	0
18	Rototuna	Mangaiti Gully (Sovereign Ilses)	-37.7355	175.2798	Gully	22	0	0	0
19	Hamilton	Innes Common	-37.480023	175.162542	Lake	20	34	1.7	6
20	Hillcrest	Humarie Park	-37.480726	175.19453	Park	22	0	0	0
21	Pukete	Pukete (Recreation Reserve)	-37.7296	175.2255	Park	20	0	0	0
22	Glenview	Te Anau Park	-37.49161	175.174665	Park	13	20	1.54	9

23	St Andrews	St Adrews Golf Course River Path	-37.451703	175.155453	River	22	0	0	0
24	Dinsdale	49 Russleigh Ave	-37.790837	175.244446	High Density Residential	18	0	0	0
27	Rototuna	21 Strathconnan Ct	-37.7337	175.2703	High density Residential	21	0	0	0
28	Frankton	20 Lincoln St	-37.78701	175.257536	Industrial	20	0	0	0
30	Enderley	12 Byron Road	-37.461007	175.174272	High Density Residential	0	0	0	0
31	Hillcrest	110 Masters Ave	-37.473972	175.19256	Exotic Forest Park	21	3	0.14	3
32	Beerescourt	16 Portal Cres	-37.763371	175.260193	High Density Residential	20	0	0	0
33	Rotatuna	129 Horsham Downs Road	-37.7203	175.2743	Low Density Residential	22	0	0	0
35	Nawton	Behind 104 Avalon Drive	-37.7716789	175.2428019	Industrial	21		0	0
36	Te Rapa	45 The Boulevard	-37.7402	175.2214	Industrial	21	0	0	0
39	Peacockes	34 Gainsford Road	-37.4949	175.192213	Semi-rural	21	218	10.38	20
40	Rototuna	53 Diomede Glade	-37.7269	175.2547	High Density Residential	4	0	0	0
41	Claudelands	Miropiko	-37.464222	175.164616	River	20	0	0	0
42	Chedworth	Milford Place	-37.445817	175.173499	Low Density Residential	21	1	0.05	1

43	Dinsdale	1B Monique Place	-37.8020749	175.2402297					
47	Te Rapa	16 Croall Crescent	-37.757079	175.252696	High Density Residential	22	0	0	0
49	Melville	44 kahikatea drive	-37.8084937	175.277452	High density Residential	19	1	0.05	1
50	Te Rapa	Te Rapa Rugby Club	-37.752342	175.2447344	Sports Park	22	0	0	0
51	Burbush	245 Te Kowhai Road	-37.7407	175.2041	Semi-rural	22	0	0	0
52	Frankton	KFC - Greenwood St	-37.7899483	175.2591604	Industrial	19	0	0	0
55	Rototuna	Huntington Gully	-37.7286	175.2813	Gully	22	0	0	0
57	Deanwell	23 Collins Road	-37.490426	175.164894	Low Density Residential	21	6	0.29	5
58	Burbush	87 Burbush Road	-37.749	175.2077	Semi-rural	22	0	0	0
62	Huntington	5 Ravenscourt Place	-37.7335	175.2855	High Density Residential	0	0	0	0
64	Hillcrest	Waikato University	-37.470538	175.185162	Native/Exotic Forest Park	22	1	0.05	1
65	Hamilton East	Naylor Street	-37.47556	175.175776	High density Residential	4	0	0	0
66	Forest Lake	66 Garnett Avenue	-37.7673905	175.253	High Density Residential	13	0	0	0
69	Flagstaff	Feathertone Park	-37.7349	175.2376	Park	1	0	0	0

71	Frankton	43 Norton Road	-37.78429	175.265679	High Density Residential	20	15	0.75	10
72	Chedworth	104 Greenhill Road	-37.444504	175.181637	Semi-rural	18	1	0.06	1
74	Frankton	Rhode Street Park	-37.8	175.2513193	Exotic Forest Park	0	0	0	0
76	Rototuna	46 North City road	-37.7182	175.2587	Low Density Residential	21	0	0	0
77	Te Rapa	97 Ruffell Road	-37.7331	175.2156	Industrial	22	0	0	0
78	Deanwell	9-11 Yvonne Street	-37.490029	175.16256	High Density Residential	21	0	0	0
81	Fairfield	5 Alfred Street	-37.461978	175.17022	High Density Residential	21	0	0	0
82	Burbush	19 Lee Road	-37.7626157	175.2136527	Semi-rural	21	0	0	0
83	Rototuna	60 Wentworth Drive	-37.7279	175.259	High Density Residential	22	0	0	0
84	Peacocke	11 Weston Lea Drive	-37.482912	175.183549	Semi Rural	18	15	0.83	13
87	Hillcrest	13 Bleakley Place	-37.472142	175.184688	Exotic Forest Park	22	0	0	0
88	Rototuna	1 Oolong Court	-37.7233	175.2796	Low Density Residential	22	0	0	0
91	Western Heights	40 Blomfield Street	-37.7867762	175.2342225	High Density Residential	18	0	0	0
95	Frankton	72 Kent Street	-37.787097	175.263944	Industrial	20	2	0.1	1

96	Fairview Downs	11 Sarindah Place	-37.453854	175.182414	High Density Residential	18	0	0	0
97	Peacockes	600 Peacockes Road	-37.500149	175.185841	Semi-rural	22	22	1	13
108	Melville	20 Normandy Avenue	-37.484157	175.170403	High Density Residential	21	4	0.19	3
Total						**659**	**5893**	**34.66**	**170**