# Spatial distribution survey of long-tailed bats (*Chalinolobus tuberculatus*) north of Hamilton City

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## Executive Summary

The long-tailed bat (*Chalinolobus tuberculatus*) is endemic to New Zealand and is classified as Nationally Critical with factors such as predation and habitat destruction likely contributing to their ongoing population decline. Hamilton City is one of three urban centres in New Zealand (along with Auckland and Rotorua) with recognised populations of long-tailed bats. Landscape features associated with Hamilton City such as river gully systems and vegetation fragments are suggested to have facilitated the persistence of bats in promixity to Hamilton City.

Several city-wide surveys for long-tailed bats have previously been completed and radio-tracking studies have been conducted in the southern edge and surrounding rural fringe of Hamilton. However, little is known of the spatial distribution and abundance of this species in the northern rural surrounds of Hamilton City. This study aimed to determine the distribution of long-tailed bats in the northern rural and peri-urban surrounds of Hamilton.

The survey period spanned from 21 November 2019 to 28 January 2020. A total of 53 automated bat monitors (ABMs) were deployed across 41 locations with deployments lasting for between 14-20 days. A total of 542 bat passes were recorded over the study period. Bat presence was detected by 19 of 53 ABMs (35.8%) with all of these sites being kahikatea (*Dacrycarpus dacrydioides*) remnants or other significant natural areas (SNAs).

Overall, there were lower levels of bat activity compared to the southern fringes of Hamilton City, but some areas of higher activity were located. These results will assist in prioritising sites for future monitoring and restoration initiatives.

## Acknowledgements

I would like to thank Waikato Regional Council for funding this project. A special thank you to my supervisors and the University of Waikato Summer Research Scholarship Program. Also, thank you to Titia Schamhart and Warrick Powrie for being exceptional assistance in the field. Thank you to Project Echo members for their advice; in particular Hannah Mueller, Wiea van der Zwan, Andrew Styche (DOC) and Ben Wolf (WDC). Many thanks to all of the land-owners for allowing monitoring on their property.

## Introduction

Along with the lesser short-tailed bat (*Mystacina tuberculata*), the long-tailed bat (*Chalinolobus tuberculatus*) is one of two remaining terrestrial mammals native to New Zealand (O'Donnell, 2005). The conservation status of long-tailed bats is ranked as Nationally Critical and they are predicted to have an ongoing decline of >70% (O'Donnell *et al*., 2018). Hamilton, Auckland and Rotorua are the only New Zealand cities that have known long-tailed bat populations as a range of factors including urbanisation, deforestation and predation limit their abundance and spatial distribution and contribute to the populations decline (Pryde *et* al., 2005; Le Roux & Le Roux, 2012). Improved understanding of long-tailed bat populations around Hamilton City and its surrounds is fundamental for the management of these urban, peri-urban and rural ecosystems.

Hamilton City is an inland urban centre that has some landscape features that provide roosting and foraging habitat for long-tailed bats (Dekrout *et al*., 2014). The rural surrounds of Hamilton are primarily high intensity farmland, life-style blocks with a few scattered areas of native bush remnants (primarily kahikatea, *Dacrycarpus dacrydioides*) (Figure. 1a). There are also a large number of gully systems associated with the Waipa and Waikato Rivers (Figure. 1b), many of which have been designated as significant natural areas (SNAs). The presence of bats in this landscape is dependent on the availability of suitable roosting and foraging sites (Avila-Flores & Fenton, 2005).

Previous surveys conducted along the Waikato/Waipa River and in forest remnants have confirmed the highest levels of bat activity on the southern edge of Hamilton City (Le Roux & Le Roux, 2012; Mueller *et al*., 2017; van der Zwan & Mueller, 2018). Recent surveys have detected occasional passes of long-tailed bats in the northern parts of Hamilton city (e.g. at Mangaiti gully, Waiwhakareke), but it is not known whether these passes are from the southern bats moving north, or from unknown social groups to the north of the city. Little is known about the presence or spatial distribution of long-tailed bats in the city's surrounding rural fringes north of the city. Some past records exist (DOC National Bat Database), but no comprehensive surveys have been carried out in this area.

A ten-week acoustic survey for long-tailed bats focusing on Hamilton's northern rural fringes was undertaken. The objective of this project was to fill knowledge gaps around spatial distribution and abundance of long-tailed bats across rural and peri-urban landscape. By identifying sites that exhibit bat activity, the results of this survey should assist in prioritising sites for future monitoring and conservation/restoration initiatives.

**Figure. 1. (a)** *Kahikatea remnants at Gordonton Road,* **(b)** *riparian margin off the Waipa River.*

## Methods

Acoustic monitoring for long-tailed bats was conducted from 21 November 2019 to 28 January 2020 using AR4 automated bat monitors (ABMs) (Department of Conservation, Wellington). A scouting survey for potential monitoring sites was conducted at the beginning of the study in mid-November. Monitoring sites were selected by prioritising habitat types known to provide roost and foraging sites for bats, using knowledge of southern Hamilton bat

behaviour. Significant Natural Areas (SNAs) and kahikatea remnants were used as a starting point for site scoping, with other sites added on during the scoping exercise if they provided potential bat habitat. Monitoring sites were initially selected to be with 5 km of Hamilton City limits (Figure. 2), however this was relaxed to target potential roost habitats as the study progressed.

A total of 53 ABMs were deployed at 41 locations and were left for a monitoring period of 14 to 20 days. Each ABM was programmed to start recording 1-hour before sunset and finish recording 1-hour after sunrise. Recordings were captured on SD cards as spectrograms and files were created at the event of a bat-like pass. The date and time of each recording was saved on the SD card as the file was created. At each selected site, one ABM was positioned on a tree branch approximately 3 m above ground. Density of vegetation and potential for migratory routes was considered when selecting a suitable branch. Avoiding areas which indicated high levels of rodent or insect activity was also important to reduce number of non-bat recordings. Sonograms of potential bat passes recorded by the ABMs were visually analysed using BatSearch v.3.12 Software (DOC, 2017) following guidelines described by Lloyd (2017).

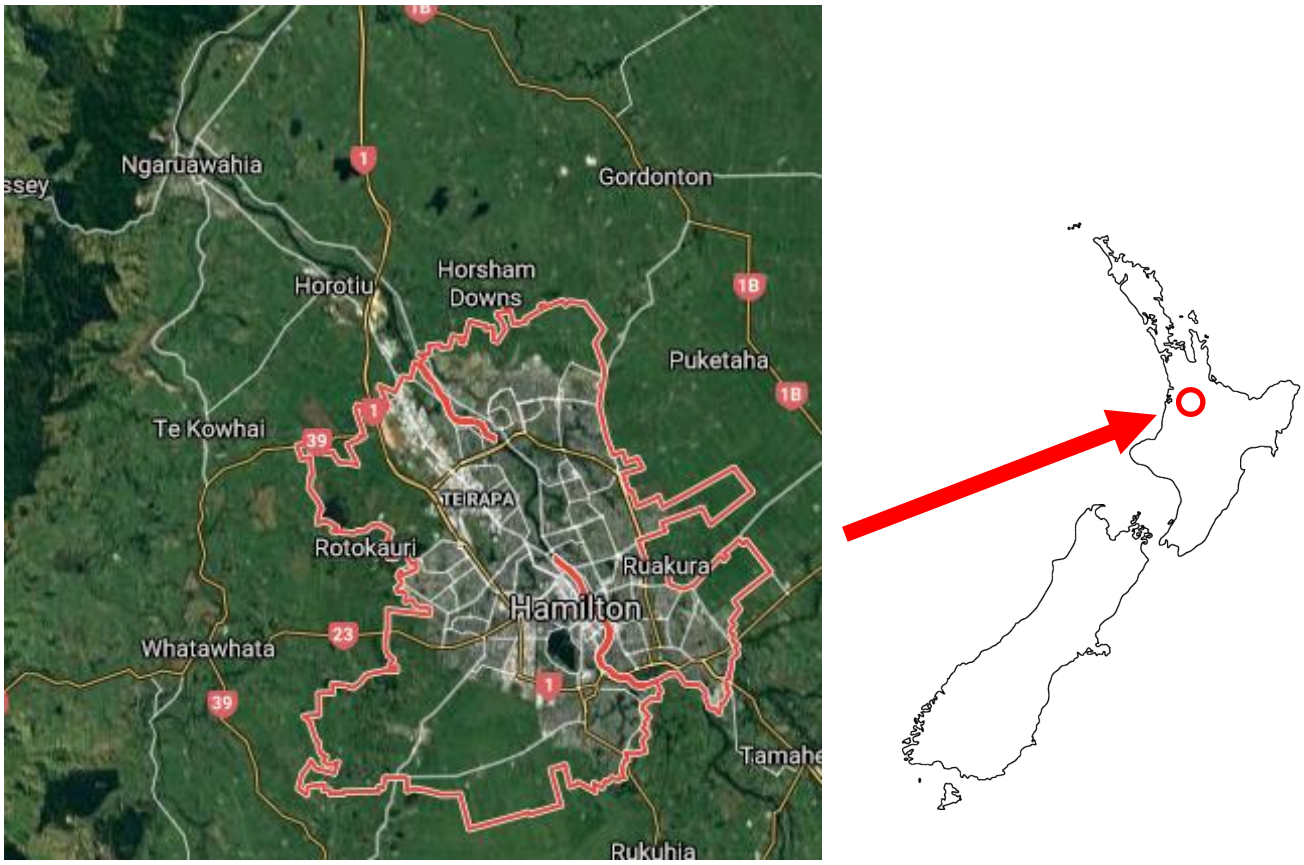


**Figure. 2:** *Map of Hamilton City and rural surrounds where monitoring took place. Hamilton City map retrieved from Google Maps; New Zealand vector map retrieved from www.worldatlas.com*

## Results

A total of 542 long-tailed bat passes were detected across 15 locations during the survey period, short-tailed bats were not detected. Bat activity was recorded by 19 of the 53 individual ABMs (35.8%) deployed at these sites (Figure 3).

Of the 19 sites where long-tailed bats were detected, Gordonton Road 4 exhibited the highest mean bat passes per night (4.9) (Table. 1). In addition, Barrett's Bush 1 and Gordonton Road 3 also had a similar number of mean number of bat passes per night (4.4 and 4.6, respectively).

Of the 53 ABM sites, 34 (64.2%) did not detect bat activity. The majority of these sites were situated near the Waikato River on the northern edge of Hamilton City, at Council Reserves or amidst farmland dominated terrain. There were four sites (Otamanui Walkway 2, Laxon Road 2, Perkins Road 1 and the Christian Camp) that only detected one bat pass during the deployment period (Appendix A).

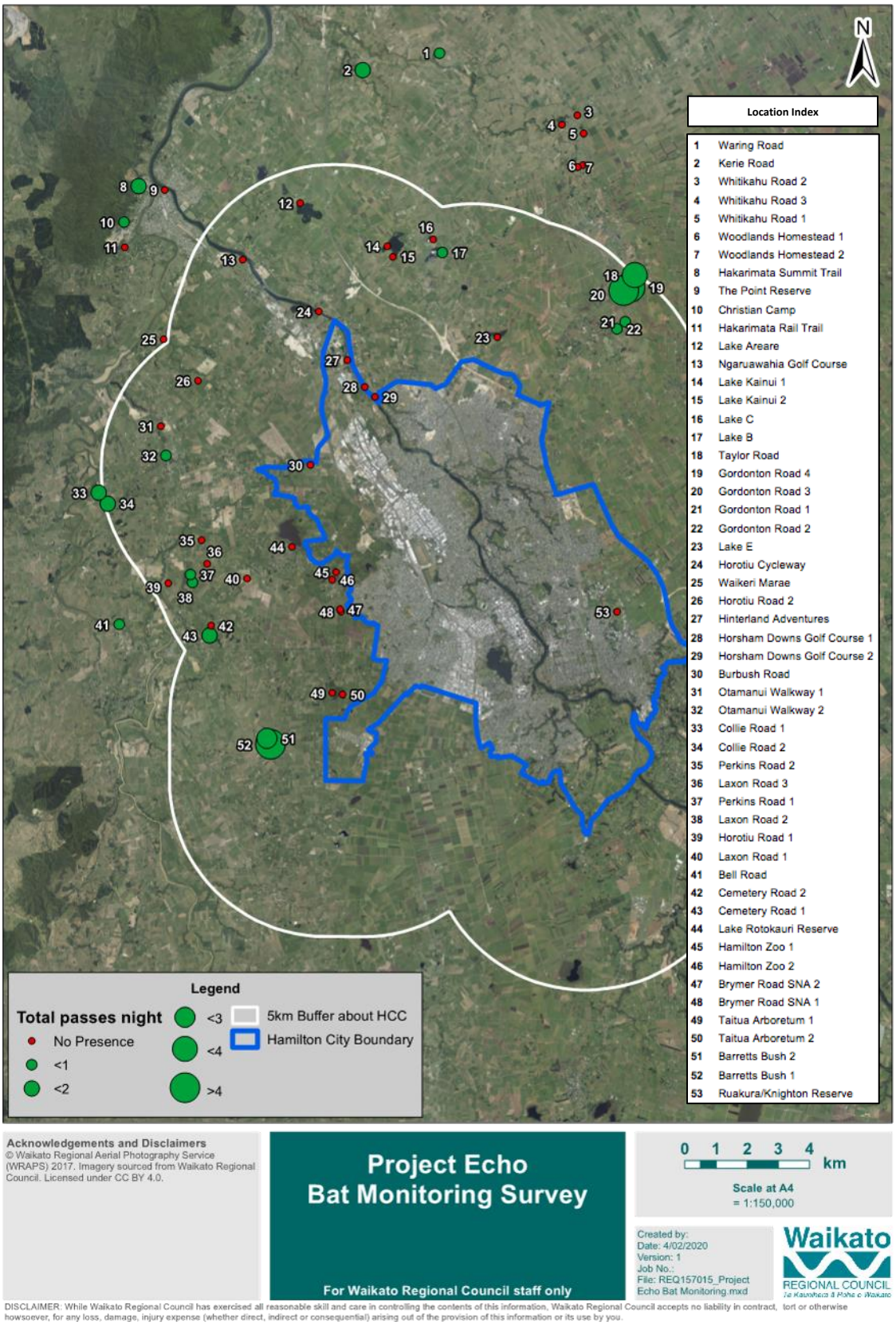


**Figure 3:** *Locations of ABMs deployed between 21 November 2019 and 28 January 2020. Red points indicate there was no bat activity detected at the corresponding ABM. Green points indicate bat passes detected. Dot size increases as bat activity increases.*

**Table. 1** *Mean and standard mean error of bat passes per night for each ABM that recorded bat activity*

| Site | Mean number of passes/night | Standard mean error | Habitat type |
|---|---|---|---|
| Gordonton Road 4 | 4.9 | 0.23 | Kahikatea/SNA |
| Gordonton Road 3 | 4.6 | 0.44 | Kahikatea/SNA |
| Barretts Bush 1 | 4.4 | 0.61 | Kahikatea/SNA |
| Taylor Road | 3.1 | 0.31 | Kahikatea/SNA |
| Barretts Bush 2 | 2.2 | 0.44 | Kahikatea/SNA |
| Collie Road 2 | 1.7 | 0.3 | Kahikatea/SNA |
| Kerie Road | 1.7 | 0.47 | SNA |
| Cemetery Road 1 | 1.7 | 0.46 | Kahikatea/SNA |
| Hakarimata Summit Trail | 1.2 | 0.74 | SNA |
| Collie Road 1 | 1.2 | 0.39 | Kahikatea/SNA |
| Gordonton Road 1 | 1.0 | 0.46 | Kahikatea/SNA |
| Bell Road | 0.7 | 0.30 | Kahikatea (Waipa River) |
| Waring Road | 0.7 | 0.49 | SNA |
| Gordonton Road 2 | 0.5 | 0.29 | Kahikatea/SNA |
| Lake B | 0.2 | 0.33 | Farm lake/SNA |
| Otamanui Walkway 2 | 0.1 | 0.27 | SNA |
| Laxon Road 2 | 0.1 | 0.27 | Mature Pine |
| Perkins Road 1 | 0.1 | 0.27 | Mature Gum |
| Christian Camp | 0.1 | 0.24 | SNA |

Nightly bat activity patterns were summarised graphically (Appendix B). Hours after sunset (HAS) data for each site that experienced 30 or higher bat passes over the study period were graphed. Bimodal activity showing peaks of activity (≥ 10 passes/ABM/night) in the first two hours after sunset and just before sunrise may suggest bats roosting nearby (Le Roux & Le Roux 2012), although increasing evidence suggests this is not a valid means of detecting bat

roosts (K. Richardson, pers. comm.). The graphical representation of Barrett's Bush 1, Taylor Road and Gordonton Road 3 exhibit traits of bimodal distribution (Appendix B). However, levels of bat activity found during this survey was not sufficient to make assumptions regarding proximity to roosting sites.

## Discussion

Long-tailed bat activity appears to be lower in the northern surrounds (i.e., with 10 km) of Hamilton City compared to the southern edge of the city. The highest overall mean bat activity found during the 2019/20 Project Echo Hamilton City survey was at Hammond Park with a mean 55 bat passes per night ($\pm$ 45.5 SE) (van der Zwan & Mueller 2018). This is more than 11 times greater than the highest mean number of bat passes per night of four (4.9 $\pm$ 0.23 SE) found during this present survey at site Gordonton 4. At this site, there was a range of 1 to 8 passes per night. Concentrating future bat monitoring around regions where highest activity levels were found such as Gordonton, may help pinpoint locations where significant abundances of bats are present, and ultimately, allowing for capturing and radio tracking bats to identify roosting sites.

Long-tailed bat activity tended to be greater at sites that were kahikatea forest remnants such as the stands near Gordonton and Barretts Bush or areas of mature forest such as the Hakarimata Ranges. Acoustic survey data from 53 ABMs deployed at 41 locations around the northern rural and peri-urban area of Hamilton City identified some areas of long-tailed bat activity, although still low relative to southern Hamilton. This study demonstrated that bats are still present in the Hakarimata Ranges, and that in addition there is bat activity in the kahikatea patches around Gordonton, and to the west of Hamilton.

## Recommendations

- Intensive acoustic monitoring of identified higher activity areas may further inform how bats are using the landscape in this part of the Hamilton region. Concentrating monitoring on areas where higher levels of bat activity have been detected may lead to opportunities of capturing individuals for radio tracking and roost identification.

- More detailed vegetation and landscape surveys in areas of higher bat activity may help in understanding long-tailed bat habitat requirements, and how these areas could be enhanced to support bat populations in the region.
- Predator control and protection of habitat at sites of confirmed bat activity will help secure long-tailed bat persistence in these parts of Hamilton. Predator control is likely to be a vital component of ensuring long-term survival of *C. tuberculatus*.
- Increased advocacy and awareness of the presence of bats in this part of Hamilton, and support for landowners to adopt bat-friendly management.

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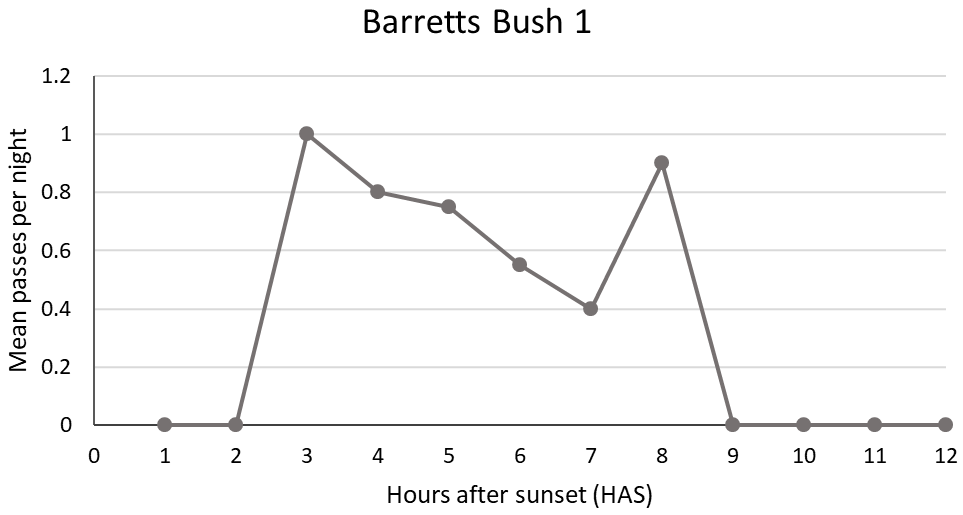
## Appendices

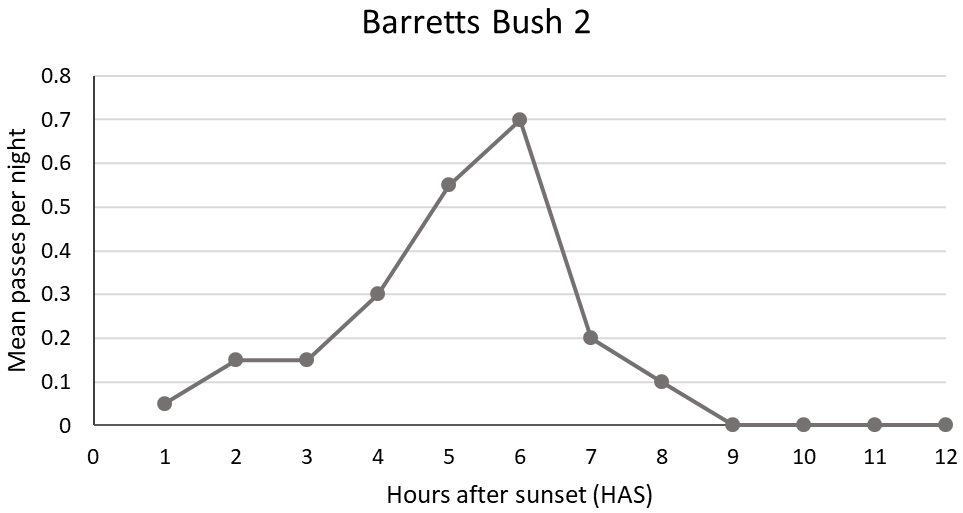
***Appendix A.*** Summary of survey results (shaded sites=bats present). Corresponds to results map.

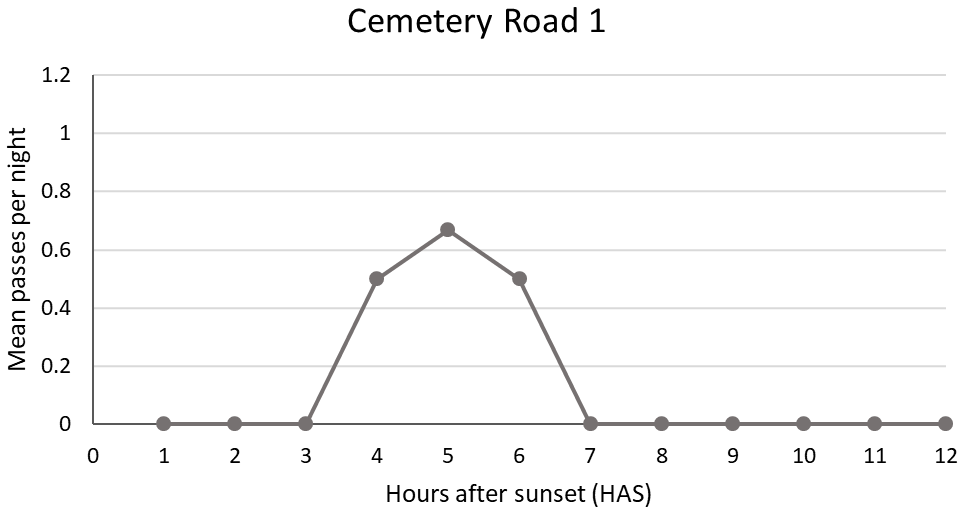
| Location | Lat | Long | Bats y/n | No. of bat calls | No. of recordings | No. recording days | Mean passes/night |
|---|---|---|---|---|---|---|---|
| **Taitua Arboretum 1** | -37.8071 | 175.2136 | n | 0 | 0 | 14 | 0 |
| **Taitua Arboretum 2** | -37.8075 | 175.2174 | n | 0 | 13 | 14 | 0 |
| **Woodlands Homestead 1** | -37.6529 | 175.3 | n | 0 | 128 | 14 | 0 |
| **Woodlands Homestead 2** | -37.6535 | 175.2982 | n | 0 | 47 | 14 | 0 |
| **Lake E** | -37.7032 | 175.2705 | n | 0 | 91 | 14 | 0 |
| **Lake Kainui 1** | -37.6777 | 175.2297 | n | 0 | 45 | 14 | 0 |
| **Lake Kainui 2** | -37.6806 | 175.2318 | n | 0 | 126 | 14 | 0 |
| **Lake B** | -37.679 | 175.2498 | y | 3 | 74 | 14 | 0.21 |
| **Lake C** | -37.6754 | 175.2464 | n | 0 | 75 | 14 | 0 |
| **Horotiu Cycleway** | -37.697 | 175.2054 | n | 0 | 153 | 14 | 0 |
| **Otamanui Walkway 1** | -37.7312 | 175.149 | n | 0 | 157 | 14 | 0 |
| **Otamanui Walkway 2** | -37.7396 | 175.1512 | y | 1 | 52 | 14 | 0.07 |
| **Lake Rotokauri Reserve** | -37.7651 | 175.1976 | n | 0 | 127 | 14 | 0 |
| **Horsham Downs Golf Course 1** | -37.7184 | 175.2228 | n | 0 | 59 | 14 | 0 |
| **Horsham Downs Golf Course 2** | -37.7212 | 175.2266 | n | 0 | 61 | 14 | 0 |
| **Ngaruawahia Golf Course** | -37.6825 | 175.1774 | n | 0 | 63 | 14 | 0 |
| **Hamilton Zoo 1** | -37.7721 | 175.214 | n | 0 | 15 | 14 | 0 |
| **Hamilton Zoo 2** | -37.7744 | 175.2127 | n | 0 | 42 | 14 | 0 |
| **Laxon Road 1** | -37.7746 | 175.1816 | n | 0 | 106 | 14 | 0 |
| **Laxon Road 2** | -37.7761 | 175.1618 | y | 1 | 148 | 14 | 0.07 |
| **Horotiu Road 1** | -37.7764 | 175.153 | n | 0 | 4277 | 14 | 0 |
| **Perkins Road 1** | -37.7738 | 175.161 | y | 1 | 70 | 14 | 0.07 |
| **Burbush Road** | -37.7414 | 175.2037 | n | 0 | 21 | 15 | 0 |
| **Horotiu Road 2** | -37.7177 | 175.1621 | n | 0 | 94 | 14 | 0 |
| **Perkins Road 2** | -37.7638 | 175.1647 | n | 0 | 83 | 14 | 0 |
| **Laxon Road 3** | -37.7706 | 175.167 | n | 0 | 99 | 14 | 0 |
| **Lake Areare** | -37.6657 | 175.1977 | n | 0 | 307 | 19 | 0 |
| **The Point Reserve** | -37.6629 | 175.1484 | n | 0 | 711 | 19 | 0 |

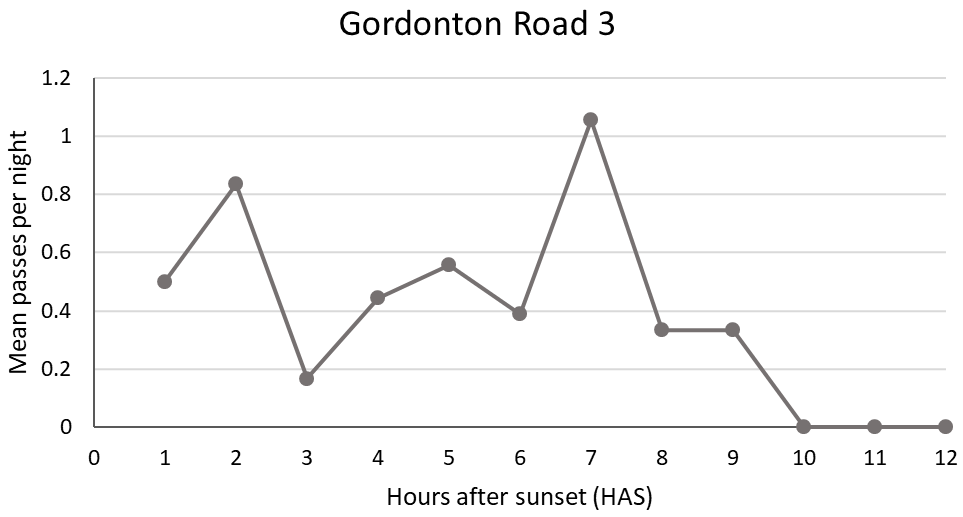
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Hinterland Adventures** | -37.7108 | 175.2162 | n | 0 | 76 | 19 | 0 |
| **Bell Road** | -37.7887 | 175.1355 | y | 12 | 115 | 18 | 0.67 |
| **Christian Camp** | -37.6725 | 175.1338 | y | 1 | 34 | 18 | 0.06 |
| **Hakarimata Rail Trail** | -37.6797 | 175.1345 | n | 0 | 571 | 18 | 0 |
| **Hakarimata Summit Trail** | -37.6619 | 175.1389 | y | 21 | 94 | 18 | 1.17 |
| **Ruakura/Knighton Reserve** | -37.7816 | 175.3165 | n | 0 | 0 | 18 | |
| **Brymer Road SNA 1** | -37.7836 | 175.2161 | n | 0 | 150 | 16 | 0 |
| **Brymer Road SNA 2** | -37.7829 | 175.2158 | n | 0 | 812 | 16 | 0 |
| **Collie Road 1** | -37.7508 | 175.1269 | y | 20 | 330 | 16 | 1.25 |
| **Collie Road 2** | -37.7539 | 175.1303 | y | 28 | 146 | 16 | 1.75 |
| **Waikeri Marae** | -37.706 | 175.1493 | n | 0 | 71 | 16 | 0 |
| **Barretts Bush 1** | -37.8223 | 175.1916 | y | 88 | 119 | 20 | 4.40 |
| **Barretts Bush 2** | -37.8206 | 175.1902 | y | 44 | 1842 | 20 | 2.20 |
| **Gordonton Road 1** | -37.6978 | 175.3168 | y | 15 | 208 | 15 | 1.00 |
| **Gordonton Road 2** | -37.6999 | 175.3138 | y | 8 | 235 | 15 | 1.00 |
| **Whitikahu Road 1** | -37.6437 | 175.3001 | n | 0 | 62 | 15 | 0 |
| **Kerie Road** | -37.6269 | 175.2194 | y | 26 | 43 | 15 | 1.73 |
| **Whitikahu Road 2** | -37.6385 | 175.2976 | n | 0 | 15 | 15 | 0 |
| **Whitikahu Road 3** | -37.6413 | 175.292 | n | 0 | 186 | 15 | 0 |
| **Waring Road** | -37.6214 | 175.247 | y | 11 | 54 | 15 | 0.73 |
| **Taylor Road** | -37.6842 | 175.3199 | y | 60 | 310 | 19 | 3.16 |
| **Cemetery Road 1** | -37.7913 | 175.1684 | y | 30 | 139 | 18 | 1.67 |
| **Cemetery Road 2** | -37.7885 | 175.1689 | n | 0 | 172 | 18 | 0 |
| **Gordonton Road 3** | -37.6888 | 175.316 | y | 83 | 1000 | 18 | 4.61 |
| **Gordonton Road 4** | -37.6878 | 175.3182 | y | 89 | 832 | 18 | 4.94 |

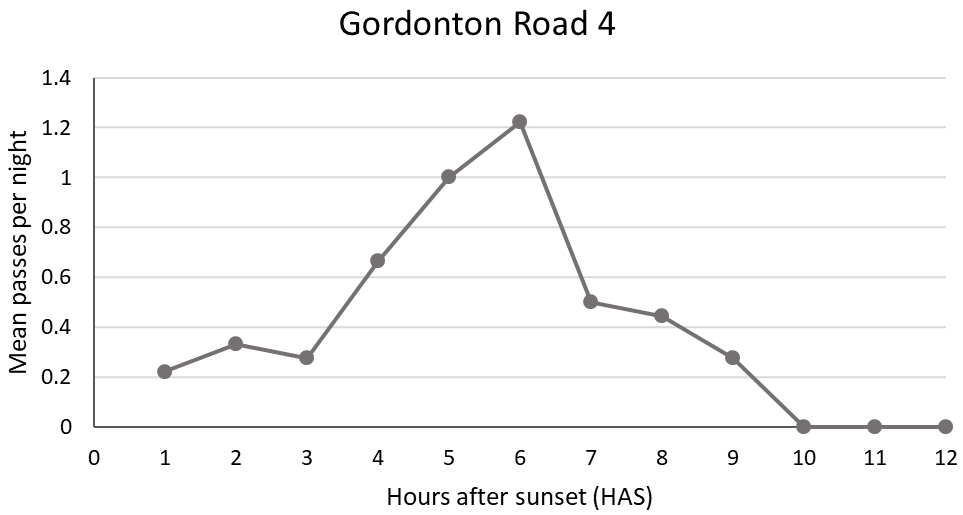
***Appendix B.*** Summary of Hours after sunset (HAS) data for each site that at least 30 bat passes were recorded (*n*= ≥30).

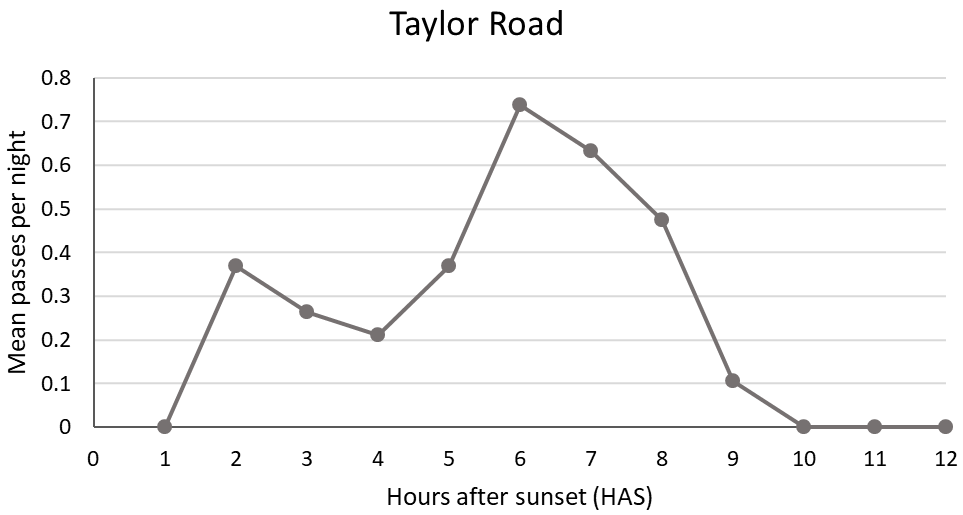



Gordonton Road 3
Mean passes per night
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (HAS)


Gordonton Road 4
Mean passes per night
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (HAS)


Taylor Road
Mean passes per night
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (HAS)