

Te Hoiere Pelorus Bat Recovery Project Season 5 Report



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Long-tailed bat (*Chalinolobus tuberculatus*) monitoring in the Pelorus and Rai catchments, Season 5: Jan. 2022-Feb. 2023, by Grant Maslowski & Jen Waite

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1.0 Summary

Season 5 of Forest and Bird's Te Hoiere Pelorus Bat Recovery Project in Marlborough, for the long-tailed bat (*Chalinolobus tuberculatus*), was reprioritised and simplified this season. The recapture rate at Pelorus Bridge Scenic Reserve (PBSR) during previous seasons had not been high enough to accurately assess population status and trends using the mark-recapture method, so the focus for this season turned to only include the less-studied Rai Valley subpopulation. The aim was to better understand this subpopulation's roosting locations - especially how or even if they were using the local reserves that were being restored - as well as their demographics through the mark-recapture method.

After beginning with inspections of the reserves and valleys as well as equipment inventory and preparation from 3 Jan 2023, Automatic Bat Monitors (ABMs) were deployed at suitable bat-catching sites spread across the three reserves in the Rai Valley (11 in Brown River Reserve, 7 in Carluke Reserve, and 5 in Ronga Reserve). The sites with the highest activity were to then be prioritized for free-standing (ground-based) harp traps to begin the mark-recapture. The two early problems were the horrendous weather of near constant rain during the first week and the need for the permit to be amended with a new bat trainer/lead/handler. Thanks to DOC Technical Advisor Moira Pryde and DOC Sounds Senior Biodiversity Ranger Phil Clerke, the permit issue was resolved, and after a bat maternity roost was found before dawn with the use of a thermal imaging device and perseverance, the mark-recapture method was able to begin by trapping this roost with a harp trap and attaching radio transmitters to bats from 12 Jan 2023. Continuous active transmitters, enabled from the deployment of new transmitters at further maternity roosts, eliminated the need for free-standing harp-trapping until the end of the fieldwork on 4 Feb 2023. Only seven transmitters were required during season 5, and were attached to five lactating adult females (one used for two transmitters five days apart), and one parous adult female.

Bats emerging from maternity roosts were captured using a "baby" harp trap on seven occasions (four roosts in Carluke Reserve, and three roosts in Ronga Reserve). A total of 121 captures were made from these roosts (40 new, five recaptures from prior seasons, and 76 repeat captures from within this season). Given a very high repeat capture rate it is concerning that there was only four juvenile females captured (9% of the total number of individual bats caught), whereas there were three times as many juvenile males (27%). Such a low recruitment of females to this subpopulation will limit its potential recovery rate.

A total of 16 maternity roosts were confirmed including for the first time on record in Ronga Reserve (nine in Ronga Reserve, five in Carluke Reserve, and two in Brown River Reserve - one of which was the first roost found four years ago at the start of this project). Three further likely maternity roost sites and one likely single roost (exact trees/roosts not found) were in Ronga Reserve, and one confirmed single roost in Brown River Reserve. Beyond the reserves was one roost site in a private forestry plantation between Brown and Ronga, although this may have been an unusual decision by the bat due to the stress of having a transmitter attached the same night. The other detected roost sites outside of the reserves were all in Mount Richmond Forest Park. One was up the Opouri Valley on the South side and up high near the tops (5km from Ronga Reserve), and the same bat returned to this location ("triangulated" from the Opouri rd) two days later after roosting in Carluke Reserve for a day in between. Two other locations up the Ronga Valley were used by another bat but on different sides of the valley (5km and 3.5km from Ronga Reserve) after also having a day in a reserve (Brown) in between.

By the start of the last week of fieldwork only two maternity roosts had been found in Brown River Reserve and none trapped. There had also been no recaptures from 14 bats previously

caught in Brown River Reserve which was in contrast to 5 recaptures from 14 bats previously caught in Carluke Reserve. The bat activity in Brown River Reserve, recorded on acoustic bat monitors, was also not much less than what was recorded in the other two reserve. For these reasons it was decided to try and eliminate the unlikely possibility of a separate subpopulation in Brown River Reserve by using free-standing harp traps. Over three nights, using three free-standing harp traps with the use of a lure (used one evening and twice in the hours of greatest recorded activity before dawn), only two bats were caught at the Brown River Reserve site of the most recorded bat activity. This was also the same site that had been used in prior seasons at Brown River reserve, including season 1 when all of the 14 bats were caught there. These two bats were repeat captures and had been caught the very same night emerging from a roost in Carluke Reserve. Adding these two bats to the total number of bats caught emerging from roosts brings the total captures for the season to 123. The total number of individuals in the subpopulation totaled 45, although two died for currently unknown reasons while in their bat bag after trapping the first roost.

Reliable emergence counts - usually with the help of a thermal imaging device - were achieved for the fifteen confirmed maternity roosts on twenty-two evenings (five roosts on two evenings, and one roost on three evenings). None of the roosts that were trapped this season were used again this season. The maximum number of bats emerging from a roost was 32, the minimum three, and the median was 16. All of the confirmed maternity roosts were in matai/miro trees and with a minimum DBH of 0.6m, a maximum DBH of 1.18m, and an average of 0.84m. Tree heights for these roosts ranged from 18-30m, with roost heights ranging from 8-20m. All of these trees with confirmed maternity roosts were still alive, with eleven of these roosts in branches, three in the trunk, and one unknown. Three of these roosts had 2 known exit holes, whereas the other roosts were only known to have one hole. All of these confirmed maternity roosts have been marked with yellow triangles, and have had their photos taken - as well as many thermal photos and videos - to complement their completed roost forms. Five of these roosts are recommended as candidates for trunk protection from invasive mammalian predators (wrapping with tin or plastic), as they are isolated above the base of their trunks. Such protection would also benefit the trees by preventing possums from browsing and also competing for these roosts. All of these candidate trees are in Ronga Reserve. Predator control in the reserves of Rai Valley is highly and urgently recommended, especially Carluke Reserve and Ronga Reserve that were the most used for maternity roosts this season. These two reserves are also the smallest, making them the most economical to control for predators given scarce conservation resources.

The catchment-wide survey that was piloted last season is still planned to continue during every March from 2023 to provide long-term trends in bat distribution and abundance for informing management decisions. March has been chosen to not interfere with the intensive mark-recapture during January/February, and March is also a dependable time when all of the surviving new bats born this season will be past the pup stage and able to be picked up by the ABMs as juveniles along with the adults.

2.0 Introduction

The Te Hoiere Pelorus Bat Recovery Project is a national project run by the Royal Forest and Bird Protection Society of New Zealand ('Forest & Bird'). The project was established in 2010 and aims to work with communities to ensure protection and enhancement of the critically endangered long-tailed bat (*Chalinolobus tuberculatus*) population inhabiting the Te Hoiere Pelorus catchment. Long-tailed bats are critically threatened by introduced predators and by degradation and loss of foraging and roosting habitats (O'Donnell et al., 2010, 2018). Each year since 2010, volunteers have given around 1000 hours of their time to trap predators including rats, stoats and possums at Pelorus Bridge Scenic Reserve, an important site of the bats. A bat monitoring programme was initiated in October 2018 with three years of supporting funding from the Department of Conservation (DOC) community Conservation fund, to collect information about roosting locations and population trends to inform management decisions about predator control and habitat protection and enhancement.

The work of the Bat Recovery Project is closely aligned with the Kotahitanga mō te Taiao Strategy. The Strategy has been created by the Kotahitanga mō te Taiao Alliance, a collaborative partnership of Regional Councils, iwi and DOC in the top of the South Island. The Alliance supports the Te Hoiere Pelorus Catchment Restoration Project, an initiative that involves communities in restorative actions to improve catchment health. Under this framework, the Bat Recovery Project secured a further three years of funding in December 2021 to continue and expand its work.

Seasonal monitoring of long-tailed bats is undertaken by the Bat Recovery Project's Bat Team in the Te Hoiere Pelorus catchment each summer to coincide with the bats' breeding season. The main focus of bat monitoring has been the Pelorus Bridge Scenic Reserve (PBSR) for the previous four seasons. Radio-tracking through the use of transmitters is used to locate roosts, and intensive population monitoring using the mark-recapture method is used to assess population status and trends so that appropriate management can be applied. Unfortunately the recapture rate at PBSR during previous seasons had not been high enough to accurately assess population status and trends, so the focus for this season turned to only include the less-studied Rai Valley subpopulation. The aim was to better understand this subpopulation's roosting locations - especially how or even if they were using the local reserves that were being restored (Figure 1) - as well as their demographics through the mark-recapture method. Any roost sites identified outside of the reserve network may also indicate sites where bats could benefit from pest management and habitat restoration.

The recently-expanded annual acoustic surveys at PBSR were shelved before the start of this season as the reliability of this less-intrusive and more economical monitoring approach depended on correlating with an accurate estimation of population status and trends that were dependent on a high recapture rate using the mark-recapture method of the PBSR subpopulation. The catchment-wide survey, however, which was piloted last season is still planned to continue during every March (post-breeding season) from 2023 to provide long-term trends in bat distribution and abundance for informing management decisions.

the project has involved local, regional and national volunteers in bat monitoring and survey activities and aims to foster understanding and appreciation of bats in the local and wider communities to encourage support for the conservation of this critically threatened species and its habitat.

This report outlines the results of the fifth season of long-tailed bat survey and monitoring work in the Te Hoiere Pelorus catchment, conducted 3 Jan 2023 and 5 Feb 2023.

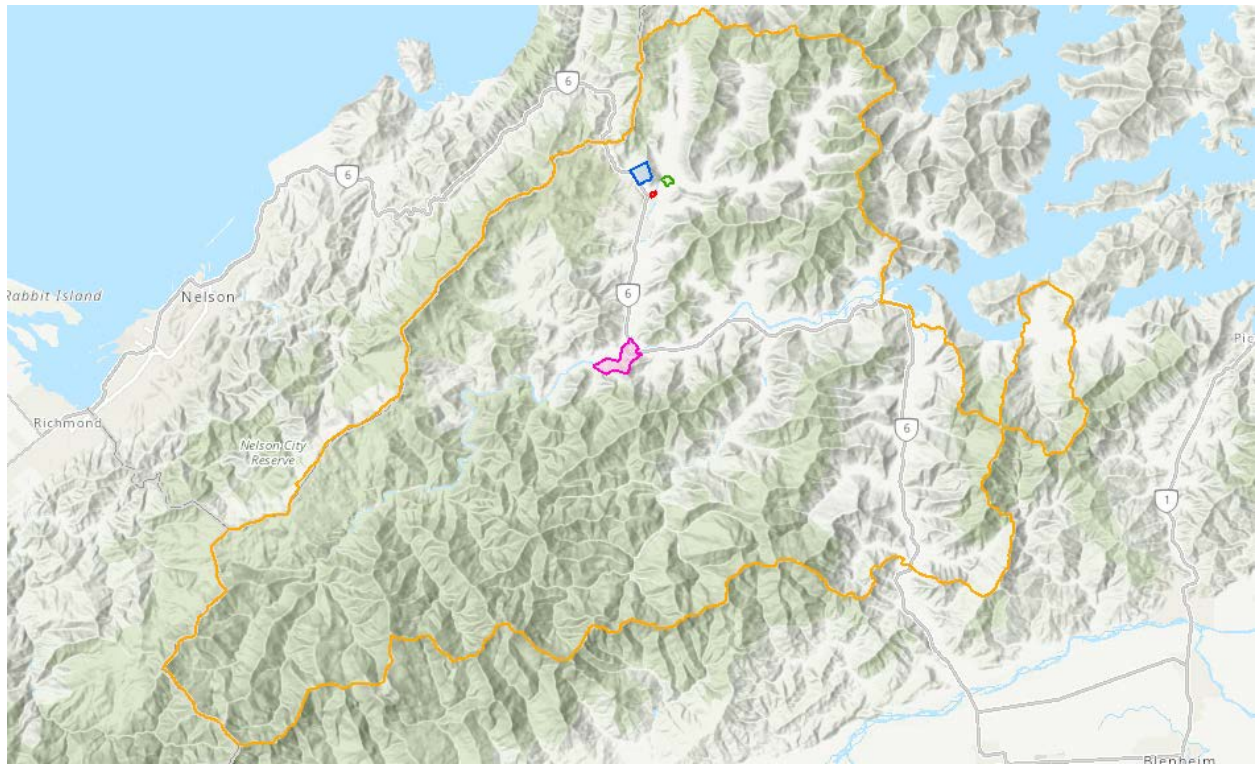


Figure 1. Te Hoiere Pelorus catchment in Marlborough region, showing the four reserves where long-tailed bats are monitored; Brown Reserve (blue), Carluke Reserve (red), Ronga Reserve (green), and Pelorus Bridge Scenic Reserve (pink). Catchment boundary=orange line.

3.0 Acoustic surveys

PBSR surveys

Last season the Bat Monitoring Program was expanded to include acoustic survey programs at PBSR and across the Te Hoiere Pelorus catchment. Population trends of long-tailed bats in response to management are currently measured using mark-recapture techniques to measure annual survival. This is undertaken at limited sites in New Zealand since the method is relatively intrusive and requires specialized skills. One of the priorities identified by DOC's Bat Recovery Group is to determine whether surveys using acoustic recorders to detect bat activity can be used to provide a robust index of bat abundance as a less-intrusive and more economical alternative to mark-recapture methods for assessing population trends. To help clarify the relationship between survey results and population trends measured using mark-recapture methods, acoustic surveys were proposed to be conducted within the managed area at PBSR each summer, coinciding with the annual mark-recapture monitoring period. Unfortunately the recapture rate from the mark-recapture at PBSR during prior seasons had not been high enough to accurately assess population trends, which meant the relationship or correlation

between the mark-recapture and acoustic surveys was not strong or reliable. Perhaps the recapture rate at PBSR could be high enough in future seasons to eventually allow for acoustic surveys to provide a robust index of bat abundance as a less-intrusive and more economical alternative to mark-recapture, but for this season the acoustic surveys at PBSR were shelved.

Catchment-wide surveys

The Kotahitanga mō te Taiao Strategy identifies ‘expanding populations of long-tailed bats in the Te Hoiere Pelorus catchment’ as a measure of management success. With successful predator management at PBSR, Brown River Reserve, Carluke Reserve, and Ronga Reserve, the bat population would be expected to increase over time, with a corresponding increase in activity at sites important for bats outside of the reserves, and potentially, expansion of bats into areas where they had not previously been detected. To monitor these trends in bat distribution and activity, long-term catchment-wide acoustic surveys will be conducted every March at a set of fixed points in the catchment. Activity is measured as an index of abundance, since individual bats cannot be identified using this method.

3.1 Survey design

(See Season 4 report; Dennis, 2022)

3.2 PBSR pilot survey and results

(See Season 4 report; Dennis, 2022)

3.3 Catchment-wide survey

(See Season 4 report; Dennis, 2022)

The catchment-wide acoustic survey will be conducted every March. This month has been chosen as it is post-breeding season so fieldworkers will be free to do this survey and will not miss out on doing the important mark-recapture fieldwork in the summer. Also, as March is post-breeding season the ABMs will also detect juvenile dispersal in addition to just the adult activity. March is also generally not a relatively cold month, so the bats should still be active - colder months like May or especially the winter months would of course be subject to bats going into torpor much more often and the activity results may just reflect the cold rather than an accurate index of abundance.

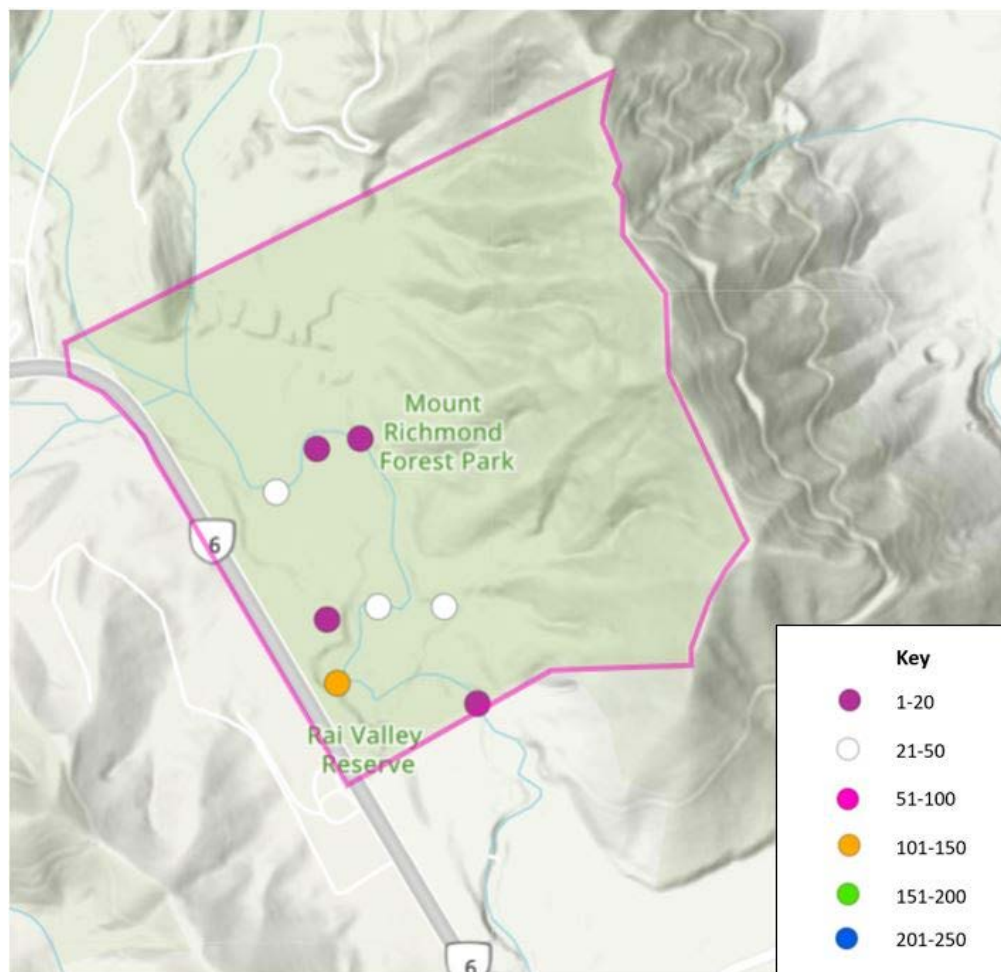
The catchment-wide survey will also help to identify areas that are important for the bats outside of the reserves, so that it can be better understood how they can be protected beyond their known breeding sites. This survey presents an opportunity to partner with other organizations in the future (e.g. Nelson City Council, Brook-Waimarama Sanctuary and Nelson Marlborough Institute of Technology) whom could potentially run complementary surveys across catchment boundaries. These surveys would target sites where bat sightings have been reported in recent years or where low levels of bat activity have been detected in previous surveys (e.g. Cable Bay, Brook Valley, Maitai Caves) and may reflect the success of management in the Te Hoiere Pelorus catchment in helping to restore bat activity in neighboring areas.

4.0 Bat monitoring

The fifth season of the Te Hoiere Pelorus Bat Recovery Project was reprioritised and simplified this season. The recapture rate at Pelorus Bridge Scenic Reserve (PBSR) during previous seasons had not been high enough to accurately assess population status and trends using the mark-recapture method, so the focus for this season turned to only include the less-studied Rai Valley subpopulation. The aim was to better understand this subpopulation's roosting locations - especially how or even if they were using the local reserves such as Ronga reserve which is being restored - as well as their demographics through the mark-recapture method.

4.1 Identification of trap sites for monitoring

Automatic Bat Monitors (ABMs) were deployed at “suitable” bat-catching sites spread across the three reserves in the Rai Valley (11 in Brown River Reserve, 7 in Carluke Reserve, and 5 in Ronga Reserve) (Figure 2). Suitable was loosely defined as open areas where bats were expected to be able to forage as flyways without obstruction, such as along the edges of forest or walking tracks or over ponds or rivers. These locations were also chosen where a free-standing harp trap could easily be placed or especially where three of them could be lined up side by side effectively making a wall of harp traps with three times the normal area. These sites were also chosen to spread across the reserves but also be practical in terms of access for carrying the harp traps, e.g. not far up the steep slopes of Brown River Reserve. These sites were not chosen systematically like for the PBSR pilot survey as they were not intended for long-term monitoring, rather these sites were primarily chosen quickly to give insight into where greater bat activity was at the same time across the reserves during January 2023 and thereby where free-standing harp traps should be placed to maximize the probability of catching bats for monitoring.



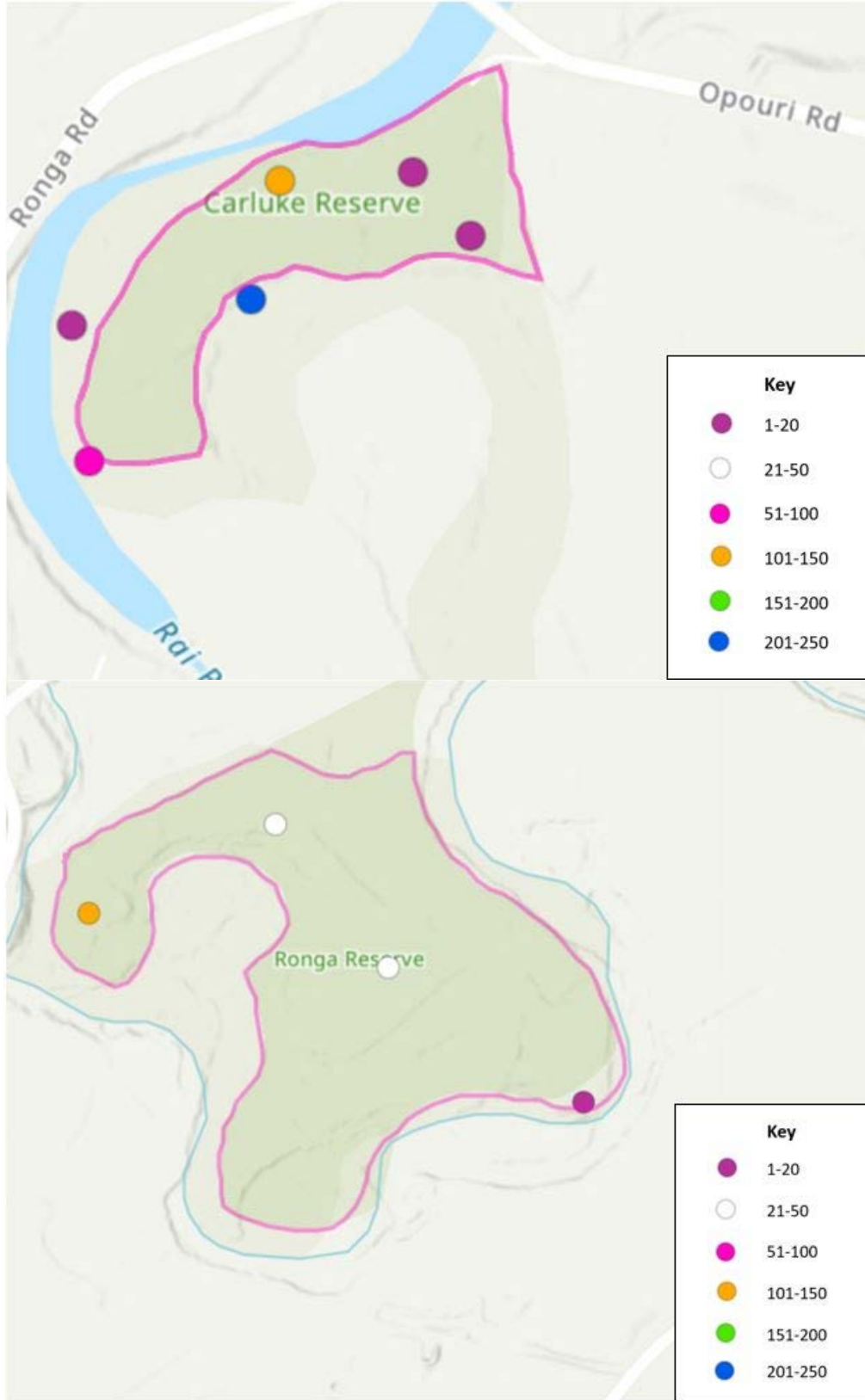


Figure 2. The median number of bat passes per night for each of the Automatic Bat Monitors (ABMs) that worked throughout the six consecutive fine nights from 11 Jan - 16 Jan 2023 (eight in Brown River Reserve, six in Carluk Reserve, and four in Ronga Reserve).

During the first week after ABMs had been deployed, there was only one fine night (without rain) and six of the ABMs had failed. Rechargeable batteries were replaced and six consecutive fine nights were recorded from 11 Jan - 16 Jan 2023. Another six ABMs failed at different stages, so it was decided to only use non-rechargeable batteries for future ABM deployment, especially important for the landscape-wide surveys. Of the ABMs that worked throughout the six consecutive fine nights there were eight in Brown River Reserve, six in Carluke Reserve, and four in Ronga Reserve. High levels of activity for one or two nights at an ABM site could be misleading due to the nearby location of a temporarily occupied roost, therefore the median number of bat passes per night across the six fine nights was chosen to eliminate skewing the data from extreme values. The median number of bat passes per night across all the ABMs that worked for the entire six consecutive fine nights was 21 for Brown River Reserve, 41 for Carluke Reserve, and 49 for Ronga Reserve. It was a pleasant surprise to see Ronga Reserve with the greatest overall median activity recorded by the ABMs but these results did align with the number of confirmed maternity roosts found in each reserve (see section 4.5 Roost Trees). Within each reserve however there was great variation between activity levels of the ABMs. Most relevant for placing free-standing harp traps were the ABM sites with the three highest median number of bat passes per night, which were spread across the three reserves; a site in Carluke Reserve with 241 passes per night (E1649440 N5436910), a site in Brown River Reserve with 146 passes per night (E1648606 N5437640), and a site in Ronga Reserve with 128 passes per night (E1650033 N5437744). The site with the highest median number of bat passes per night in Brown River Reserve was also the site that had been used in prior seasons (Figure 3).



Figure 3. Bat team members Jen Waite and Nick Eade give a sense of scale to the triple harp trap set up at the site of greatest recorded bat activity at Brown River Reserve. (Photo Grant Maslowski).

4.2 Harp-trapping and acoustic lure use for transmitter attachment

An acoustic lure had been kindly provided by DOC Technical Advisor Moira Pryde, but free-standing harp trapping was not required to start the mark-recapture method this season. A bat maternity roost was found before dawn in Carluke Reserve with the use of a thermal imaging device and perseverance, and with Moira Pryde helping to resolve the permit issue, this roost was able to be trapped and transmitters were attached on 12 January 2023 (Figure 4). The ideal strategy is to pace the deployment of the finite number of transmitters over the monitoring period so that when transmitters fail there is always another active one that can be used to find a maternity roost that can then be trapped and more transmitters deployed. This season we started with 13, but four were sent down to the Catlins as the Forest and Bird Bat Team there had been sent the wrong transmitters from the supplier in Canada. We only deployed seven transmitters this season though, as this was enough to provide continuous active transmitters over the entire monitoring period ending on 4 Feb 2023. These transmitters were attached to six bats during season 5; five lactating adult females (one used for two transmitters, five days apart), and one parous adult female. The remaining two transmitters were sent down to DOC Te Anau as there was a transmitter shortage there too.



Figure 4. Radio-transmitter attached to a long-tailed bat for the purpose of radio-tracking to locate roosts and continue the mark-recapture method. (Photo Grant Maslowski).

There are great advantages of trapping and banding bats only at roosts. Firstly, there are often many more bats to be caught - and banded - emerging from roosts than there are to be caught in an evening of using free-standing harp traps in sites of known high bat activity even when a lure is used. Secondly, all of the bats banded after emerging from roosts that were found sharing with bats with transmitters are highly likely to be of the same subpopulation or social group. Whereas when bats are banded after being caught in free-standing harp traps it is assumed that they are all of the same subpopulation whereas multiple subpopulations could conceivably have just been overlapping in their foraging areas. Therefore, it is highly likely that all of the bats caught during season 5 - and their roost locations - were of the same population.

The method for attaching transmitters was trimmed hair (leaving stubble) and the use of Ados F2 multipurpose contact adhesive. The minimum number of days that any of the seven transmitters was working effectively for was three days, and the maximum was at least 18 days. The average number of days that the transmitters worked effectively for was nine although this is likely an underestimate as on the last monitoring day there was at least one transmitter still active and probably two more.

4.3 Harp trapping effort

Bats emerging from maternity roosts were captured using a “baby” harp trap on seven occasions (four in Carluke Reserve, and three in Ronga Reserve). The first roost that was found during Season 1 was also attempted to be trapped this season, but not even the baby harp trap could not be obstructed by a large side branch too close to the roost’s exit.

By the start of the last week of fieldwork only two maternity roosts had been found in Brown River Reserve and none trapped. There had also been no recaptures from 14 bats previously caught in Brown River Reserve which was in contrast to 5 recaptures from 14 bats previously caught in Carluke Reserve. The bat activity in Brown River Reserve, recorded on acoustic bat monitors, was also not much less than what was recorded in the other two reserve. For these reasons it was decided to try and eliminate the unlikely possibility of a separate subpopulation in Brown River Reserve by using free-standing harp traps. Over three nights, using three free-standing harp traps with the use of a lure (used one evening and twice in the hours of greatest recorded activity before dawn), only two bats were caught at the Brown River Reserve site of the most recorded bat activity. This was also the same site that had been used in prior seasons at Brown River reserve, including season 1 when all of the 14 bats were caught there. These two bats were repeat captures and had been caught the very same night emerging from a roost in Carluke Reserve.

4.4 Demographics of captured bats

123 captures of 45 individual bats occurred in the Rai Valley during Season 5. 121 captures (including 40 new, only five recaptures, and 76 repeat captures) occurred at seven roosts (four in Carluke Reserve, and three in Ronga Reserve). Two captures were also made using free-standing harp traps (both repeat captures) (Table 1).

Table 1. Number of long-tailed bat captures (new, repeat captures within the same season, and recaptured between seasons) using free-standing harp traps away from roosts and trapped at roosts in the Rai Valley, Marlborough, 12 Jan - 3 Feb 2023.

Trapping method	New	(Repeat captures)	Recaptures	Total Captures
Free-standing harp trap	40	(76)	5	121
Roost harp trap	0	(2)	0	2
	40	(78)	5	123

Only five bats were recaptured from previous seasons (one from Season 1 that was a juvenile female, none from Season 2, one from Season 3 that was an adult male, another from Season 3 that was a juvenile male, another from Season 3 that was a breeding female, and one from season 4 that was a non-breeding female). All of these recaptured bats were previously caught and banded in Carluke Reserve. Given that the repeat capture rate this season was very high, and no recaptures were made from the 15 bats that had previously been banded in Brown River Reserve, and only five recaptures were made from the 15 bats that had previously been banded in Carluke Reserve, and how the free-standing harp traps in Brown River Reserve only caught repeat captures - albeit over three nights - it seems likely that the mortality rate at the Rai Valley subpopulation is high.

By concluding the mark-recapture fieldwork before the latter part of February determining the the age and breeding status of the bats was more reliable than in previous seasons, allowing for accurate categorising of the bats into demographic groups (Table 2).

Table 2. Number of individual long-tailed bats caught in each demographic group (sex and age-class), and total captures (new, repeat captures within the same season, and recaptured between seasons) in the Rai Valley, Marlborough, 12 Jan - 3 Feb 2023.

Demographic group	Total individuals	Total captures	New	Recaptures	(Repeat capture)
Adult female, breeding	13	32	10	3	(19)
Adult female, not breeding this year	3	7	3	0	(4)
Adult female, never bred	4	9	4	0	(5)
Juvenile female	4	21	4	0	(17)
Adult male	9	13	7	2	(4)
Juvenile male	12	41	12	0	(29)
	45	123	40	5	(78)

There were some concerning results from the demographics that also contrasted with the results from the last season at PBSR. Even with a very high repeat capture rate there was only four juvenile females captured (9% of the total number of individual bats caught), whereas there were three times as many juvenile males (27%). Why is there such a skewed juvenile ratio of females to males, and with such a low recruitment of females to this subpopulation this will limit its potential recovery rate. These juvenile bats combined made up 36% of the total number of individual bats caught - with a high overall repeat capture rate. Last season at PBSR there was not such a skewed juvenile ratio, however the captures were two thirds from free-standing harp traps and the repeat capture rate was much lower. Only one adult male (1/50 or 2% of the total individuals captured) could be reliably categorized last season, with three at most (6%), similar to the low number of adult males caught in previous seasons. This was discussed in the Season 4 report (Dennis 2022) as being due to differences in capture probability between sexes (O'Donnell & Sedgely 1999; O'Donnell 2001), or a demographic skew resulting from a lower annual survival rate in males (Pryde *et al.*, 2005). In contrast, nine adult males (20% of the total individuals captured) were captured this season, and 121 of 123 captures were made at "maternity roosts" this season. The two bats captured in the free-standing harp traps were both repeat capture juveniles, one male and one female.

A shocking event was the mortality of two bats that were captured at the first roost of this season. These two bats appeared to be fine when they were removed from the harp trap bag along with all the other bats, but they passed away while being in the same bat bag. This happened despite following best practice protocols. It was not a cold night and these bats were just the ninth and tenth bats processed for the night, so hypothermia should not have been an option. These bats appeared dead (not moving/vibrating) when removed from the bat bag but they had no visible injuries. The cause of death is still unknown, but perhaps they died due to acute stress - possibly elevated by being caught for the first time and this population rarely being trapped - which is very unusual when capturing long-tailed bats but not so for certain species of bats in other countries (e.g. sword-nosed bats in Panama). The mortality of these two bats means the minimum number of individual bats in the Rai Valley subpopulation is now 43.

Of the 45 individuals captured during Season 5, 14 bats were captured only once (including the two that passed away), 10 were captured twice, five were captured three times, nine were captured four times, four were captured five times, and three were captured six times. This is not a normal distribution, perhaps suggesting that despite the high number of repeat captures overall there are still several bats that evaded capture this season - more likely to be adults, as the average number of times that the surviving juveniles were captured was 4.1 (61/15), whereas the average number of times that the surviving adults were captured was just 2.1 (60/28). Of the adults expected to have evaded capture, these would more likely be males as the average number of times that adult males were captured was only 1.4 (9/13), compared to 2.5 (47/19) for the surviving adult females, and even less likely to be breeding adult females as average number of times that the surviving breeding adult females were captured was even higher at 2.6 (31/12).

4.5 Roost Trees

A total of 16 maternity roosts were confirmed in Season 5, including for the first time on record in Ronga Reserve (nine in Ronga Reserve, five in Carluke Reserve, and two in Brown River Reserve - one of which was the first roost found four years ago at the start of this project) (Figures 5, 6 & 7). These maternity roosts are arguably the type of roosts most in need of protection from invasive mammalian predators as the bat subpopulation is at its most vulnerable when there are pups in these roosts.



Figure 5. All roosts located within Ronga Reserve during Season 5 (Jan-Feb 2023): yellow stars=confirmed maternity roosts; red stars=likely maternity roosts; blue circles=confirmed single roosts, green circles=likely single roosts, and pink triangles=unidentified roosts.



Figure 6. All roosts located within Carluke Reserve during Season 5 (Jan-Feb 2023): yellow stars=confirmed maternity roosts; red stars=likely maternity roosts; blue circles=confirmed single roosts, green circles=likely single roosts, and pink triangles=unidentified roosts.



Figure 7. All roosts located within Brown Reserve during Season 5 (Jan-Feb 2023): yellow stars=confirmed maternity roosts; red stars=likely maternity roosts; blue circles=confirmed single roosts, green circles=likely single roosts, and pink triangles=unidentified roosts.

Three further likely maternity roost sites and one likely single roost (exact trees/roosts not found) were in Ronga Reserve, and one confirmed single roost in Brown River Reserve. Beyond the reserves was one roost site in a private forestry plantation between Brown and Ronga, although this may have been an unusual decision by the bat due to the stress of having a transmitter attached the same night. The other detected roost sites outside of the reserves were all in Mount Richmond Forest Park (Figure 8 & 9). One was up the Opouri Valley on the south side and up high near the tops (5km from Ronga Reserve), and the same bat returned to this location (“triangulated” from the Opouri rd) two days later after roosting in Carluke Reserve for a day in between. Two other locations up the Ronga Valley were used by another bat but on different sides of the valley (5km and 3.5km from Ronga Reserve) after also having a day in a reserve (Brown) in between. Unfortunately all of these roosts outside of the reserves were classed as unidentified because the crossing of private land would have been necessary and the landowner contact details were unknown.

The cumulative number of days that the seven transmitters were known to have been working effectively were 44, and on eight of these occasions transmitters were undetected (18%). Subtracting three “sulky roosts” - where bats may well have behaved unusually and not chosen a normal roost location due to the stress of having a transmitter attached during the same night - this still leaves 11% of days where effectively working transmitters were not detected. On these occasions these bats with transmitters were unlikely to have been in any of the three reserves and were more likely roosting beyond the reach of the OMNIs that are surprisingly receptive to detecting transmitters even high and far up the slopes of the main valleys. However, on some occasions a roost inside a very thick trunk or a curled up aerial could weaken the signal of an otherwise detectable transmitter. As suggested in last season’s report (Dennis 2022), the use of a drone fitted with radio-tracking equipment may be useful for locating the “missing” bats, and has been used in other studies to identify remote roost locations.

In addition, we still don’t yet have any information about the roosting sites used by the bats outside of the breeding season. The other time of the year when the bats are expected to be most vulnerable is during the winter when they spend a much higher percentage of their time in torpor and less able to defend themselves or escape from the invasive mammalian predators - including nights when these predators are most active.

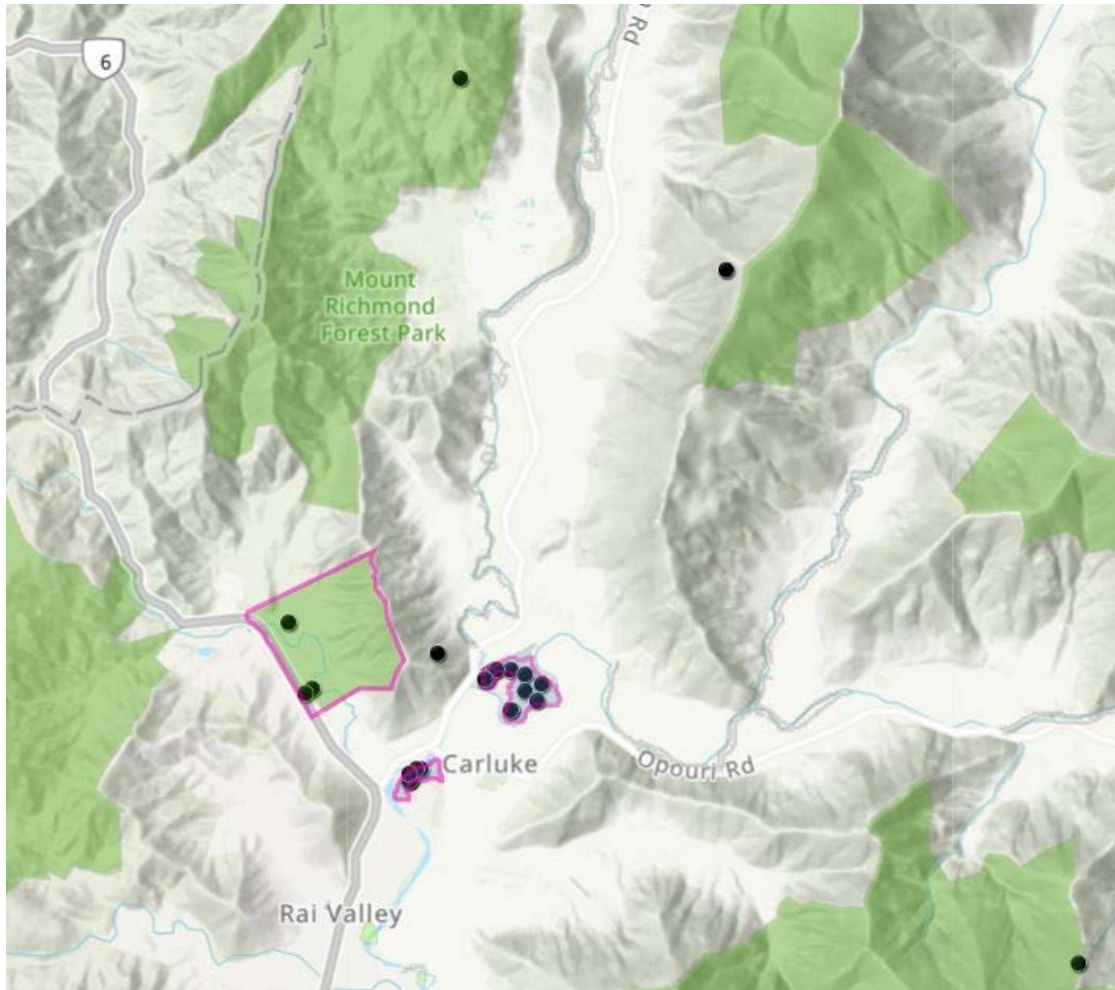


Figure 8. All roosts located in the Rai Valley during Season 5 - within and outside of the reserves of Ronga, Carluke, and Brown River (Jan-Feb 2023).

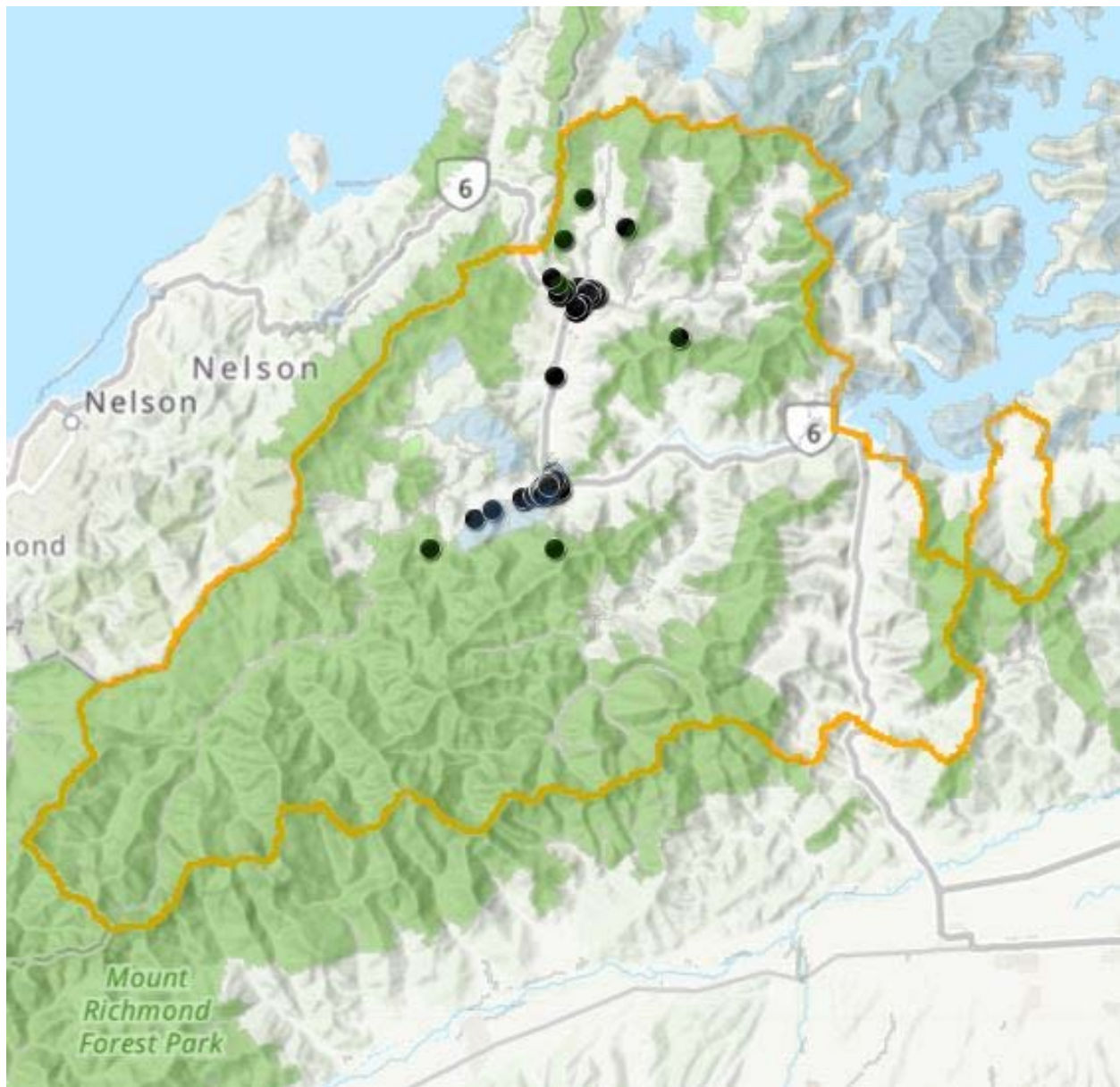


Figure 9. Locations of all long-tailed bat roosts identified to date within the Te Hoiere Pelorus catchment during their breeding period (Seasons 1-5, Dec. 2018-Feb. 2023).

All of the confirmed maternity roosts in Season 5 were in matai/miro trees and with a minimum DBH of 0.6m, a maximum DBH of 1.18m, and an average of 0.84m. Tree heights for these roosts ranged from 18-30m, with roost heights ranging from 8-20m. All of these trees with confirmed maternity roosts were still alive, with eleven of these roosts in branches, three in the trunk, and one unknown. Three of these roosts had 2 known exit holes, whereas the other roosts were only known to have one hole. All of these confirmed maternity roosts have been marked with yellow triangles, and have had their photos taken - as well as many thermal photos and videos - to complement their completed roost forms. Five of these roosts are recommended as candidates for trunk protection from invasive mammalian predators (wrapping with tin or plastic), as they are isolated above the base of their trunks. Such protection would also benefit the trees by preventing possums from browsing and also competing for these roosts. All of these candidate trees are in Ronga Reserve. Predator control in the reserves of Rai Valley is highly and urgently recommended, especially Carluke Reserve and Ronga Reserve that were the most used for maternity roosts this season. These two reserves are also the smallest, making them the most economical to control for predators given scarce conservation resources.

4.6 Emergence Counts

A thermal imaging device (infra-red) was used in Season 5 for the first time of the Te Hoiere Pelorus Bat Recovery Project. This greatly improved the ability to identify roosts - and their exits. This insight also greatly improved the assessment of the potential of the tree for trapping, which when combined with complicated ropes skills and slingshot ability, enabled a high number of often difficult roosts to be trapped during a relatively short fieldwork season (Figure 10). The first roost (Cover page), which enabled the deployment of transmitters to begin and it also had the most captures from a roost this season, probably would not have been found without the use of this thermal device.



Figure 10. Harp trapping at some difficult roosts in Season 5. (Photos Grant Maslowski).

Reliable emergence counts - usually with the help of a thermal imaging device - were achieved for the 16 confirmed maternity roosts this season on twenty-two evenings (four roosts on two evenings, and one roost on three evenings (Table 3). The fact that at least six roosts of the 16 known maternity roosts were being used on multiple consecutive nights, and how at least two roosts were being returned to after a break for more than a week seems to suggest that there is a lack of suitable roosts in the Rai Valley even for the small subpopulation. None of the roosts that were trapped this season were known to be used again this season - likely due to the memory of the stress of being trapped and handled.

Emergence counts can provide information on minimum subpopulation size, although these counts usually underestimate the actual subpopulation size since a subpopulation is likely to be spread among several roosts on any one day. The maximum total from emergence counts this season was 44 (from roosts of 30 and 14 bats). These counts were days after the two bats had passed away, so there were at least 44 bats surviving in the subpopulation on the 23rd Jan. 2023.

Table 3. Reliable counts of long-tailed bats emerging from roosts in the Rai Valley, Jan.-Feb. 2023.

Date	Roost #	# Bats emerging	# Bats caught	# Exits	Thermal used during emergence count?	Max # bats emerging from multiple nights	Reserve
12/01/23	90 (1)	32	31	1	Yes	32 (from 1 count)	Carluke
15/01/23	91 (2)	12	-	1	Yes	25 (from 2 counts)	Ronga
16/01/24	91 (2)	25	19	1	Yes	25 (from 2 counts)	Ronga
18/01/23	92 (3)	17	-	2	Yes	17 (from 1 count)	Ronga
18/01/23	93 (4)	11	-	1	No	19 (from 2 counts)	Ronga
18/01/23	94 (5)	11	-	1	No	11 (from 1 count)	Brown
19/01/23	93 (4)	19	16	1	Yes	19 (from 2 counts)	Ronga
20/01/23	95 (7)	17	-	1	Yes	17 (from 3 counts)	Ronga
22/01/23	96 (8)	31	-	2	Yes	31 (from 2 counts)	Carluke
23/01/23	96 (8)	30	-	2	Yes	31 (from 2 counts)	Carluke
23/01/23	97 (9)	14	-	1	No	14 (from 1 count)	Ronga
24/01/23	98 (10)	11	-	1	No	26 (from 2 counts)	Carluke
25/01/23	98 (10)	26	21	1	Yes	26 (from 2 counts)	Carluke
26/01/23	99 (11)	11	-	1	No	11 (from 1 count)	Ronga
28/01/23	95 (7)	3	-	1	No	17 (from 3 counts)	Ronga
29/01/23	100 (12)	6	-	1	Yes	6 (from 1 count)	Ronga
29/01/23	101 (13)	10	-	1	No	10 (from 1 count)	Ronga
30/01/23	95 (7)	15	13	1	Yes	17 (from 3 counts)	Ronga

Date	Roost #	# Bats emerging	# Bats caught	# Exits	Thermal used during emergence count?	Max # bats emerging from multiple nights	Reserve
31/01/23	1 (6)	18	-	1	Yes	18 (from 1 count)	Brown
31/01/23	102 (14)	3	-	1	No	3 (from 1 count)	Ronga
2/02/23	103 (15)	16	6	2	Yes	16 (from 1 practical count)	Carluke
3/02/23	104 (16)	16	15	1	Yes	16 (from 1 count)	Carluke

4.7 Night tracking

Night tracking was frequently done before dawn to track bats before they had chosen a roost for the night. This was useful for bats that had not been detected during the day(s), informing on whether the transmitters should continue to be tracked or abandoned. Tracking bats just before dawn also has the potential to lead to roosts by seeing them “swarming” just before they enter the roost. Only on one occasion this season was a roost directly seen while bats were swarming around it, but this was arguably the most important one as it was the first for the season and allowed for transmitters to be attached as well without the need for using free-standing harp traps.

5.0 Recommendations

5.1 Recommended sites for predator management

Bats are at their most vulnerable from invasive mammalian predators when they are roosting, especially when they have pups in their maternity roosts during Dec/Jan, and over winter when they are frequently in torpor - low metabolism with a compromised ability to defend themselves or escape from predators. The finding of confirmed maternity roosts during the breeding season in all three reserves of the Rai Valley shows how important predator control will be in these reserves for the survival of the long-tailed bat subpopulation in the Rai Valley. Most urgently prioritized for predator control of these reserves are Carluke and Ronga, as these reserves had the most confirmed maternity roosts this season and would also be the most economical to control as they are the smallest - less traps to use for the same given density of predator control, less time to check the traps, although higher circumference to area ratios.

Five of the 16 confirmed maternity roosts from this season are recommended as candidates for trunk protection from invasive mammalian predators (wrapping with tin or plastic), as they are isolated above the base of their trunks. Such protection would also benefit the trees by preventing possums from browsing and also competing for these roosts. All of these candidate trees are in Ronga Reserve. A video using a thermal imaging device was recorded of one of these trees, showing two rats up the same tree as the roost, and one of the rats crawled to within a meter of the roost and watched the exit of the roost as bats flew out.

Intensive predator control will also complement the progress made by the weed control team, greatly benefitting the many other species of birds, plants, insects, lizards etc in the reserves of the Rai Valley, and will also make for wonderful recreational areas for people to enjoy.

The three other roosting locations found in Mount Richmond Forest Park between 3.5-5km from Ronga Reserve would ideally have predator control too, but with scarce conservation resources, the three reserves in the Rai Valley should take priority given how small they are and how it is known that the roosts in the reserves had at least 16 confirmed maternity roosts this season. Predator control on private land should also be encouraged, which could help roosting locations such as the one located in exotic pine forestry between Brown River Reserve and Ronga Reserve.

5.2 Further recommendations:

This was written in last season's report about PBSR (Dennis 2022): "As yet, insufficient numbers of bats have been marked and recaptured to enable estimates of annual survival for the local population, but this remains a key objective." Given how successful this season was by harp-trapping seven maternity roosts in just over three weeks of mark-recapture with a very high percentage of repeat captures, it is suggested that next season should focus on PBSR once again. With the use of a thermal imaging device and the same - or similar - bat team members, and what is known from the previous seasons of fieldwork at PBSR, it is expected that enough recaptures would be made to enable estimates of annual survival, population size and trends of the PBSR subpopulation. Ongoing mark-recapture could then alternate between seasons at Rai Valley and PBSR, as discussed briefly with DOC Technical Advisor Moira Pryde.

Perhaps, as suggested in last season's report (Dennis 2022), the use of a drone fitted with radio-tracking equipment may be looked into as one could be useful for locating "missing" bats (not found with ground-based telemetry), and has been used in other studies to identify remote roost locations. Cost would be an important consideration.

Equipment to buy/acquire before the start of next season:

- One 100m static climbing rope
- Two 50m static climbing ropes (different colours ideally, but not essential)
- Five 100m rolls of black string (Cordall is the brand, 2.5mm)
- Buy smaller circlip pliers
- Two slings for making anchors - much easier to ascend/descend harp-traps smoothly and securely especially when using the big ones
- Two more pear-shaped caribeners - high quality ones that screw to close and don't lock tight
- One pulley large enough for the tree climbing ropes, & with a swivel - to prevent ropes twisting
- More bat bags - for the big roosts that we may trap
- AA battery charger
- 9v battery charger
- epi-pens

Things to do before the start of next season:

- Fit two baluns on the yagi aerials
- Wash bat bags with trigene
- Get landowner permission for crossing private land to track down transmitters to find their roosts, e.g. forestry plantation between Brown River Reserve and Ronga Reserve.

6.0 Volunteer participation in monitoring and survey work

The bat team this season was comprised of three paid people: Grant Maslowski, Jen Waite and Nick Eade. One member from the weed team, Connor Wallace, filled in for Nick while she was away for a week. Approximate hours for this season were: Grant 267 - got carried away with this report, Jen 230, Nick 130, Connor 65.

Three competent field workers are all that are required for bat work on this Te Hoiere Bat Recovery Project, until the bat subpopulations increase significantly. Volunteers will be welcome next year, especially people who already have good field skills and are looking to not only invest at least a week or more but also are keen to do ongoing bat fieldwork in years to come. The volunteers who have been doing the predator control at Pelorus over the years are the real heroes and they would be most welcome to join the bat monitoring in future seasons, with the roost trapping being the most exciting times.

Jen and Nick will complete the catchment-wide survey over a few days this March.

7.0 Advocacy

The BBC NHU Digital - Our Frozen Planet may allocate a few minutes of screen time to the Te Hoiere Bat Recovery Project.

Radio NZ went to air for several minutes about the Te Hoiere Bat Recovery Project.

The annual BBQ at PBSR was resumed - cancelled previously due to COVID-19 restrictions.

The bat team members engaged with visitors during casual encounters at the reserves in the Rai Valley to talk about the bat monitoring and advocate bat conservation.

8.0 Health and Safety

Wasps at PBSR were identified to be in high abundance in Season 4, and a few nests were stumbled upon in Brown River Reserve this season. If PBSR is to be monitored again for Season 6 then supplying epi-pens to staff members - and volunteers if working alone - could be prudent.

9.0 Acknowledgements

There are many people and organizations who have contributed to this project over many years. Special thanks to:

- Moira Pryde (DOC Technical Advisor) and Phil Clerke (DOC Sounds Senior Biodiversity Ranger) for resolving the permit issue just in time for the mark-recapture to be done this season. Without this intervention this season would likely have had to be abandoned. The problem was that the permit needed to be amended to include the new bat lead, Grant

- Maslowski, who had the required trainer certification. Also, Moira helped to trap the first roost for this season, which was very much appreciated, and she loaned an acoustic bat lure.
- Mandy Noffke (Manager National Conservation Projects Forest & Bird) for organizing this season of fieldwork, trusting in the new bat lead and for being so enthusiastic and so very helpful
 - Jen Waite for being such a great bat team member, with her field skills, natural bat handling skills, and for supplying the maps in this report
 - Nick Eade for also being such a great bat team member, with her field skills and continued bat handling skills, and for all the time and effort she has put into this project over many years
 - Pelorus Bat Recovery Project volunteer trappers who are the real heroes for their dedication and hard work that makes the PBSR a safer place for bats and other biodiversity
 - DOC & Marlborough District Council Early Win Funding supporting the Te Hoiere Pelorus Catchment Restoration project
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 - Pelorus Café and campground managers Paula Kerslake and Jonathan Hodges for their interest in and on-going support for the project
 - Forest and Bird National Office staff and National Projects Team
 - Debs Martin, previous Forest & Bird Regional Manager for Top of the South, for her dedication to and support for the Bat Recovery Project over more than 10 years
 - Brian Lloyd for completing ground-work in the form of extensive presence/absence surveys in the Rai and Pelorus areas (2009, 2015-2017)

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