



Braided River Regional Initiative Funding
Final Report

***Breeding movements of black-fronted terns/tarapirohe
(Chlidonias albostratus) caught on the Waiau Toa/Clarence
River during the 2021 breeding season.***



Figure 1: A tagged black-fronted tern prior to being released. Photo: E. Williams



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1. Introduction:

The scale at which protected area networks have been considered in Aotearoa New Zealand has evolved from focusing on relatively small, representative ecological areas to developing aspirational landscape-scale restoration over the last c.50 years. However, the design of landscape scale protection has yet to consider the specific requirements of mobile species. Mobile species are those that use the environment at regional and national landscape scales, moving on a seasonal basis to exploit discontinuous (i.e., patchy) foraging and breeding resources and moving across rohe, takiwā, or territorial authorities' jurisdictions.

There is a significant gap in our understanding of the extent to which threatened species are mobile at landscape scales, the threats they face, which require mitigation or management, and the challenges of accounting for their requirements in New Zealand's conservation network. Mobile species are not just vulnerable to threats on their breeding sites, but across the habitats they use throughout the year. Research is needed to describe the spatial and temporal scales and patterns at which mobile species use the landscape. This includes identifying significant flyways and important habitat networks that need to be managed over the entire lifespan of the species.

The need for Territorial Local Authorities to identify the requirements of mobile species is described in the National Policy Statement for Indigenous Biodiversity Exposure Draft (Ministry for the Environment & Department of Conservation 2022). The objective of the National Policy Statement is to protect, maintain, and restore indigenous biodiversity, which includes responsibilities pertaining to mobile species. Draft Policy 15 notes that areas outside of Significant Natural Areas (SNAs) that support specified highly mobile fauna need to be identified and managed to maintain their populations across their natural range, and that information and awareness of specified highly mobile fauna needs to be improved.

Braided river birds are particularly mobile, moving between South Island inland breeding areas and the coast and northern harbours in winter. They are also, unlikely to reside on single rivers. This study focusses on tarapirohe/black-fronted tern (*Chlidonias albostratus*) Threat classification: Nationally Endangered), which is listed in the schedule of 'specified highly mobile fauna' of the draft National Policy Statement (Appendix 2). Black-fronted terns breed only in braided river systems of the South Island and likely number fewer than 5000 mature individuals (Robertson et al. 2021). Migration routes between their breeding colonies and coastal wintering sites are currently unknown, making it difficult to provide a complete protection network for the terns. A recent study trialled new-generation miniature GPS tags to track the movements of black-fronted terns from breeding colonies in the inland Mackenzie Basin (Gurney 2022). This study indicated that tags had potential to identify important flyways and significant foraging and roosting habitats of black-fronted terns. These terns were highly mobile, foraging extensively within 25 km of their breeding colonies.

2. Objectives:

The objective of this study was to build on that of Gurney's, by studying movements in a much more northern black-fronted tern colony, closer to the coast, in spring 2021. The aim was to further understand and refine use of the GPS tags and gain insight into the movements and requirements to better conserve the species.

3. Methods and study site:

On the 20th November 2021, we tagged 20 black-fronted terns in the Fowlers Camp area of the Waiau Toa/Clarence River. This work was delivered in collaboration with Mike Bell/ and Wildlife Management International Limited's (WMIL) tern banding team. Birds were caught using a drop trap as part of pre-existing monitoring work being undertaken by WMIL. Once birds were caught, they were weighed, measured, and banded by the WMIL team before being handed to us so we could attach a Nano Druid GPS tag to the bird before release. Tags weighed no more than 2.8g, < 3 % of a bird's body weight, and were fitted to the birds like a back-pack using Rappole & Tipton's (1991) leg-loop method (Figure 1, covering page). All birds caught were mature adults with active nests in either the Top or Fowlers Camp Colony, on the Waiau Toa/Clarence River (-42.31/172.77; Figure 2). Where possible, we sought to catch and tag both partners from a nest. This was possible for 5 pairs. To retrieve movement data from the GPS tags we also installed a DRUID HUB beside the river at Fowlers Camp. This enabled data to be downloaded from the tags on birds every time they flew within 1.5 km of a HUB. Of the 20 tags deployed to date, all 20 communicated well with our HUB during the breeding season, allowing us to retrieve intensive movement data for these birds on a regular basis (Appendix 2). HUBs usually work by transmitting any data collected to a website via the cell phone network. As there was no cell phone network at Fowlers Camp, WMIL staff member Baylee Connor-McClean kindly agreed to manually download HUB data to her phone via Bluetooth on a weekly basis, so that it would automatically update via the cell phone network whenever she returned to her accommodation in Hanmer Springs. This approach worked well.

4. Outcomes of project and knowledge gained from movement data

- Almost all birds visited multiple catchments within a 50 km radius of the breeding colony (Figure 3). To assess number of catchments visited, we used Environment Canterbury's hydrological catchment as shown in their Catchment Boundaries layer (Last updated 24th June 2018). Based on this definition, a total of 18 catchments were collectively visited by the 20 tagged black-fronted terns (Figure 3a). After the main branch of the Waiau Toa/Clarence River, the catchment most frequently visited was the Waiau River (17 birds, 966 GPS fixes), followed by Pass Stream off the Waiau Toa/Clarence (six birds, 90 GPS fixes), Pass Stream off the Waiau (four birds, 16 GPS fixes), Leader Dale off the Waiau Toa/Clarence (three birds, 7 GPS fixes), an unknown catchment off the Waiau and Home Stream also off the Waiau River (three birds and three GPS fixes each) (Figures 3b, 3c). One bird fed nearly as far south as the Hurunui River (over 53 km from the breeding colony (see movements of 9455, Figure 4). Two birds have been less mobile (so far), foraging locally (i.e. 2-3 km) to their breeding colony (Figure 5).

- Individual birds often visited multiple catchments daily, meaning they were regularly making roundtrips of >60 km per day even while their nests were still active (mean distance travelled/per bird/day = 65 km; range = 0.4 - 193 km; Figure 6a). Data collected from five pairs, where both partners were tagged, showed that these long trips were usually being made by one partner, while the other remained at or near the nest, Figure 6a). Most long-distance trips were made at night (Figure 6b), sometimes with multiple birds from the colony travelling to the same location together or at similar times (presumably to roost together) (Figure 6c).
- In some cases, partners would take turns making long distance trips (Figure 6d), while for others it appeared to always be the same partner (Figure 6e)*. Sites most frequently visited at night from the breeding colony included: Waiau River/Rotherham area (13 birds), Waiau River/Grantham area (five birds), Lake Tennyson (eight birds) and the Acheron River via the Bowscale Tarns area (one bird). Sites most frequently visited during the day were Waiau River/Rotherham area (6 birds), Lake Tennyson (four birds), upper Wairau River (three birds), and the Bowscale Tarns area (one bird) (Figure 7a, b, c, d & e).
- Birds visiting the Waiau River at night (the most common time these sites were visited) were not foraging along the river. Instead, these birds were largely specific in their movements, choosing to directly fly to the Grantham River (Figure 7c) and Rotherham areas (Figure 7b) from the nesting colony. These movement patterns lead us to suspect that these terns were using the area to roost rather than forage. In contrast, the movements observed at the Bowscale Tarns area, Lake Tennyson, and Upper Wairau River were more scattered (regardless of whether the visit was diurnal or nocturnal), suggesting birds may be using these areas to forage rather than roost (Figure 7e, f & g).

* Please note that our sample sizes are particularly small – we were only able to collect data from four pairs (eight birds) and to determine these behaviours both tags on both birds of a pair needed to be working well. Tag performance decreased over time, particularly with birds that made long distance trips at night. As such, such we were only able to analyse movements from the first three days post capture.

5. Preliminary Management and Monitoring Recommendations

- **Monitoring:** Caution needs to be exercised when interpreting results from braided river bird counts and estimating local population sizes given that black-fronted terns can use multiple rivers on any one day. Further work is needed to calibrate the extent to which birds move among rivers and potentially develop suitable correction factors for river bird counts.
- **River significance assessment:** Traditionally, biodiversity assessments for rivers have been undertaken on a river-by-river or reach-by-reach basis. Such assessments need to begin considering the significance of river networks as a unit that supports threatened species populations. Firstly, more detailed data on which rivers form networks for populations needs to be obtained.
- **Threats away from breeding colonies:** Black-fronted terns are likely to be at risk at their night roosts where large numbers of breeding birds appear to congregate. Roosting groups are likely at risk from nocturnal predators and disturbance. Unless these roosting sites are identified on all rivers important for black-fronted terns, it is also possible that significant habitats may be lost or modified before they are identified. In addition, movement data are beginning to identify important foraging habitats off-river. Comprehensive evaluation of these habitats is needed to verify their significance.
- **Developing new infrastructure projects:** Consideration of flyways and off-river foraging habitats needs to be accounted for when deciding on locations of new infrastructure projects (e.g. roads, windfarms, transmission lines, etc). Movement data, including height data and nocturnal activity, are valuable resources to establish potential risks to black-fronted terns (e.g. risk of collisions with wind turbines).

6. Recommendations for future research

- Continue monitoring tagged terns in the Waiau Toa/Clarence River. Re-deploy recording hubs in the study area in spring 2022 to determine if any terns with still-operating tags return to the river and/or download winter movement data. Add a monitoring hub on the mid-Waiiau River to increase the chance of encountering terns and downloading additional data.
- Deploy new tags in different rivers to continue to improve knowledge of movements and to identify significant roosting sites and foraging habitats (e.g., lower Rakahuri/Ashley River). Continue to develop an understanding of how behaviour and breeding/foraging requirements vary among different catchments. Identifying the

locations of significant night roosts, and the threats birds face at these, is a high priority.

- Undertake detailed analyses of habitat use patterns to identify significant habitat types. Identify potential threats at foraging and roosting sites and develop strategies for improving habitats and mitigating threats.
- Build a regional network of receiving hubs to improve knowledge of winter movements and foraging/roosting requirements. The range of receiving hubs is currently limited (< 1.5 km). Therefore, it is easy for birds to pass hubs but miss being recorded. Increasing the density and spread of hubs markedly, will improve the probability of terns encountering hubs.
- Trial catching black-fronted terns on their wintering grounds to improve knowledge of winter (June-September) movements. Currently, the capacity of tags to store data is limited, and so far we have no data on winter habitat use and movement.
- Monitor any developments in GPS tag technology. Tracking technology is constantly improving, so tags that have better storage, greater range, and smaller sizes could potentially improve data collection.

7. Acknowledgements:

Thanks to Fraser Gurney for writing the original proposal and funding grant. As outlined in the original proposal, the project was intended to be delivered by Fraser as an extension of his Masters Thesis, with the Department of Conservation providing technical support. However, Fraser asked the Department of Conservation if it could take over project delivery in September 2021, after recognising he needed to focus more on thesis writing and other paid work commitments. Despite this, he has remained a team member throughout and provided advice and support as and when needed. We are also grateful to Richard Maloney for his advice on study sites and for linking us to Mike Bell/the WMIL team and Nick Ledgard from the Ashley-Rakahuri Rivercare Group; Mike Bell for his support in catching birds and Baylee Connor-McClean and Hinewai Bell for help in the field and in moving hubs around the country. Tagging of birds as part of this project was approved by the Department of Conservation's Animal Ethics Committee - Permit number AEC 381 (DOCDM 6434233).

8. References:

Catchment Boundaries Feature GIS layer. Last updated: 24 July 2018 by Canterbury Regional Council. Web address: <https://opendata.canterburymaps.govt.nz/search?collection=Dataset&q=Major%20Catchment%20Boundaries>

Gurney, F.E. 2022. Breeding Movements and post-breeding dispersal of black-fronted terns/tarapirohe (*Chlidonias albostratus*) in the Mackenzie Basin. Thesis submitted in partial fulfilment of the requirements for the Degree of Master of Science. Lincoln University, Lincoln.

Ministry for the Environment & Department of Conservation 2022. National Policy Statement for Indigenous Biodiversity Exposure Draft. Ministry for the Environment & Department of Conservation, Wellington.

Rappole, J. H., & Tipton, A. R. (1991). New harness design for attachment of radio transmitters to small passerines. *Journal of Field Ornithology*, 62, 335-337.

Robertson, H.A.; Baird, K.; Elliott, G.P.; Hitchmough, R.A.; McArthur N.J.; Makan, T.D.; Miskelly, C.M.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A.; Michel, P. 2021. Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 pp.

9. Figures and Tables:

Figure 2. Study site. A total of 20 black-fronted terns were caught in drop traps while on their nest in the Fowlers Camp tern colony or the Top tern colony on the Waiau Toa/Clarence River on the 20th November 2021. Red dots show nest locations for 18 of the 20 birds. Note that only 12 nests are visible because both partners were caught at five of the nests.

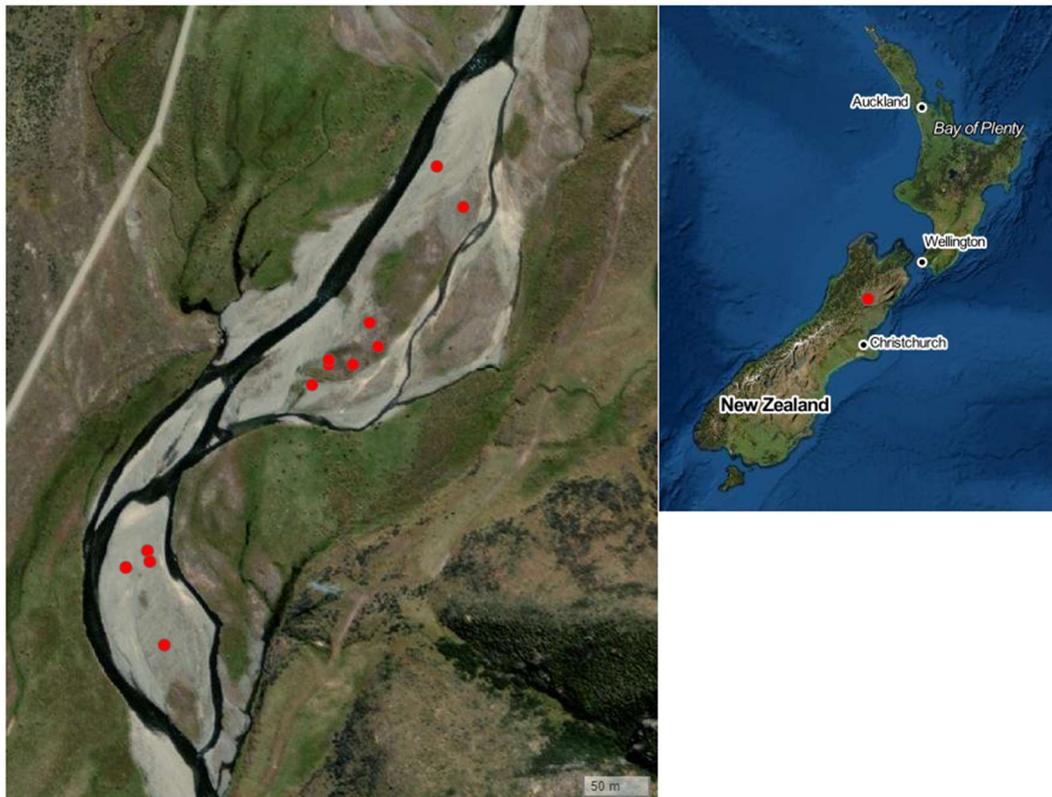


Figure 3a. All locations captured by 20 tagged black-fronted terns during the 2021 tern breeding season. Locations show movements were largely within 50 km of the nesting site at Fowlers Camp or Top colony, along the Waiiau Toa/Clarence River, which is where birds were captured.

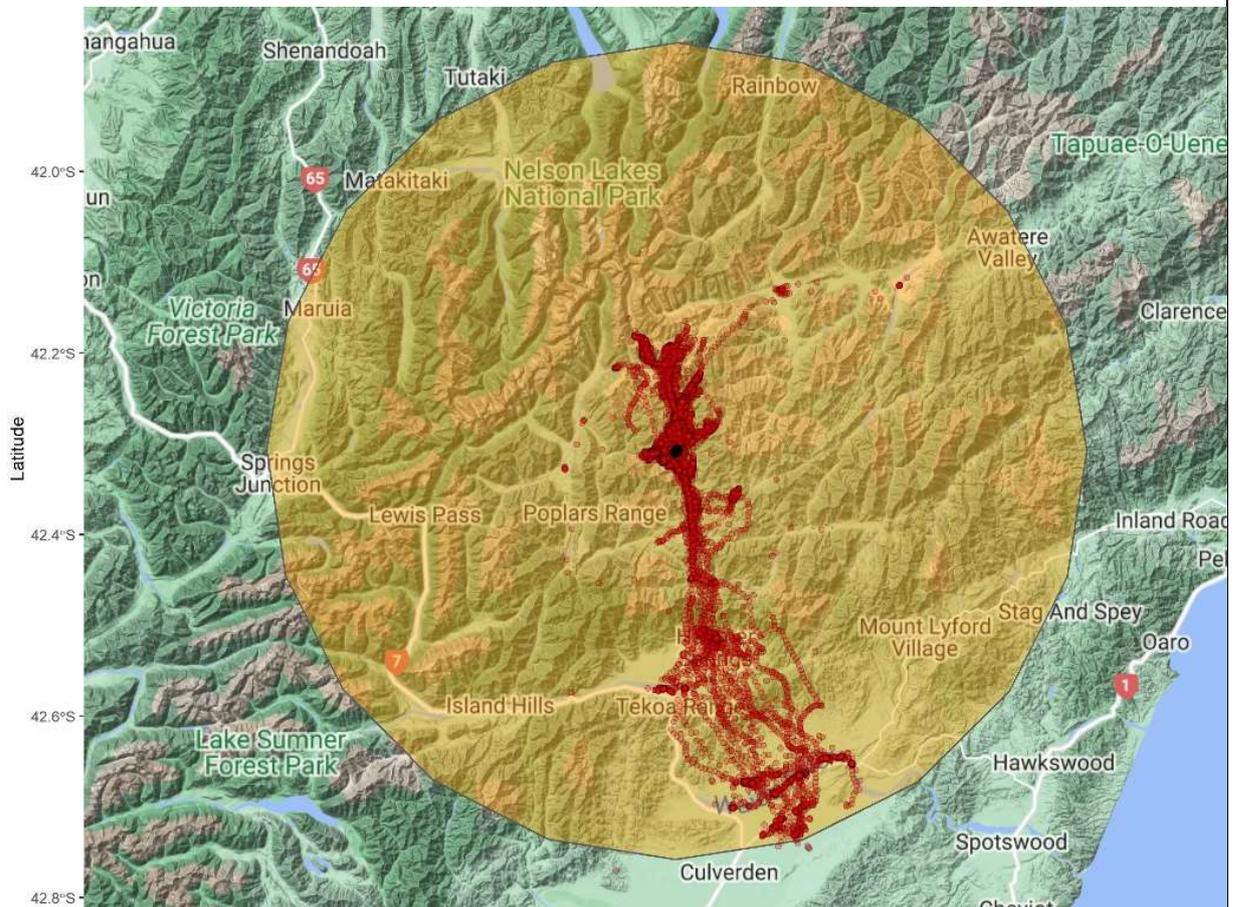


Figure 3b. Catchments visited regularly by 20 tagged black-fronted terns while nesting at Fowlers Camp or Top colony along the Waiau Toa/Clarence River.

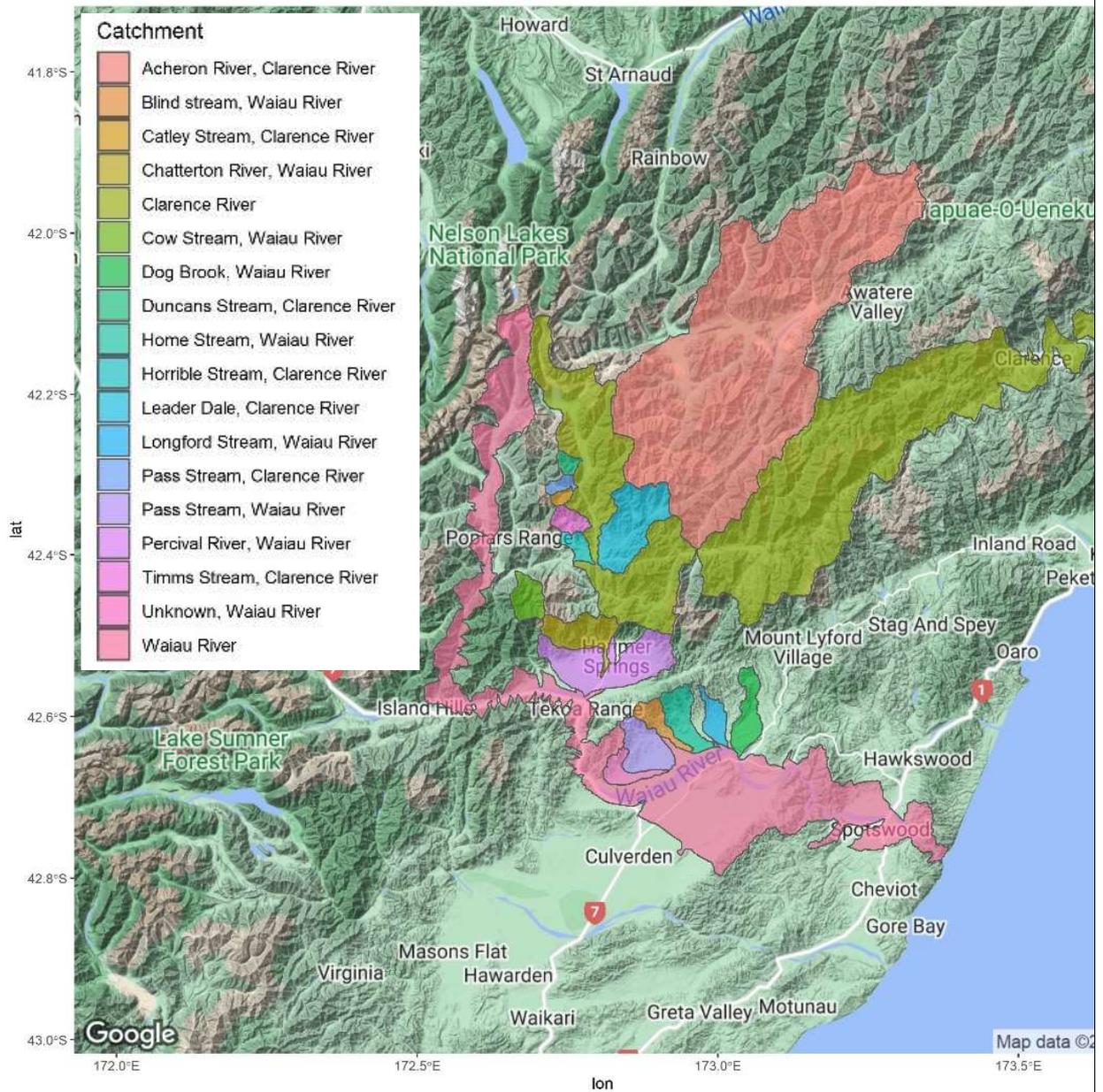


Figure 3c. Table showing catchment visitation rates of tagged black-fronted terns caught at Fowlers Camp and Top colony along the Waiau Toa/Clarence River.

Catchment	Number of birds	Number of Locations	Land cover or habitat type
Clarence River	20	4086	Tall Tussock Grassland
Duncans Stream, Clarence River	1	5	Tall Tussock Grassland
Pass Stream, Clarence River	6	90	Tall Tussock Grassland
Leader Dale, Clarence River	3	7	Tall Tussock Grassland
Catley Stream, Clarence River	2	11	Tall Tussock Grassland
Timms Stream, Clarence River	1	1	Tall Tussock Grassland
Horrible Stream, Clarence River	1	1	Tall Tussock Grassland
Cow Stream, Waiau River	1	1	Tall Tussock Grassland
Chatterton River, Waiau River	2	2	Indigenous Forest
Percival River, Waiau River	1	1	High Producing Exotic Grassland
Dog Brook, Waiau River	2	2	High Producing Exotic Grassland
Home Stream, Waiau River	3	3	High Producing Exotic Grassland
Blind stream, Waiau River	2	2	Low Producing Grassland
Longford Stream, Waiau River	1	1	High Producing Exotic Grassland
Pass Stream, Waiau River	4	16	High Producing Exotic Grassland
Waiau River	17	966	High Producing Exotic Grassland
Acheron River, Clarence River	2	28	
Unknown, Waiau River	3	17	High Producing Exotic Grassland

Figure 4. Longest distance travelled by a tagged black-fronted tern in one trip (non-return) was 53 km (yellow lines on map; Fowlers Camp to an area just north of the Hurunui River). This bird (Tag 9455) was caught on a nest at the Top colony breeding site, along the Waiiau Toa/Clarence River on the 20th November 2021. All other coloured lines are examples of individual trips made on different days, suggesting the bird regularly made trips of similar lengths during the first 10 days tagged.

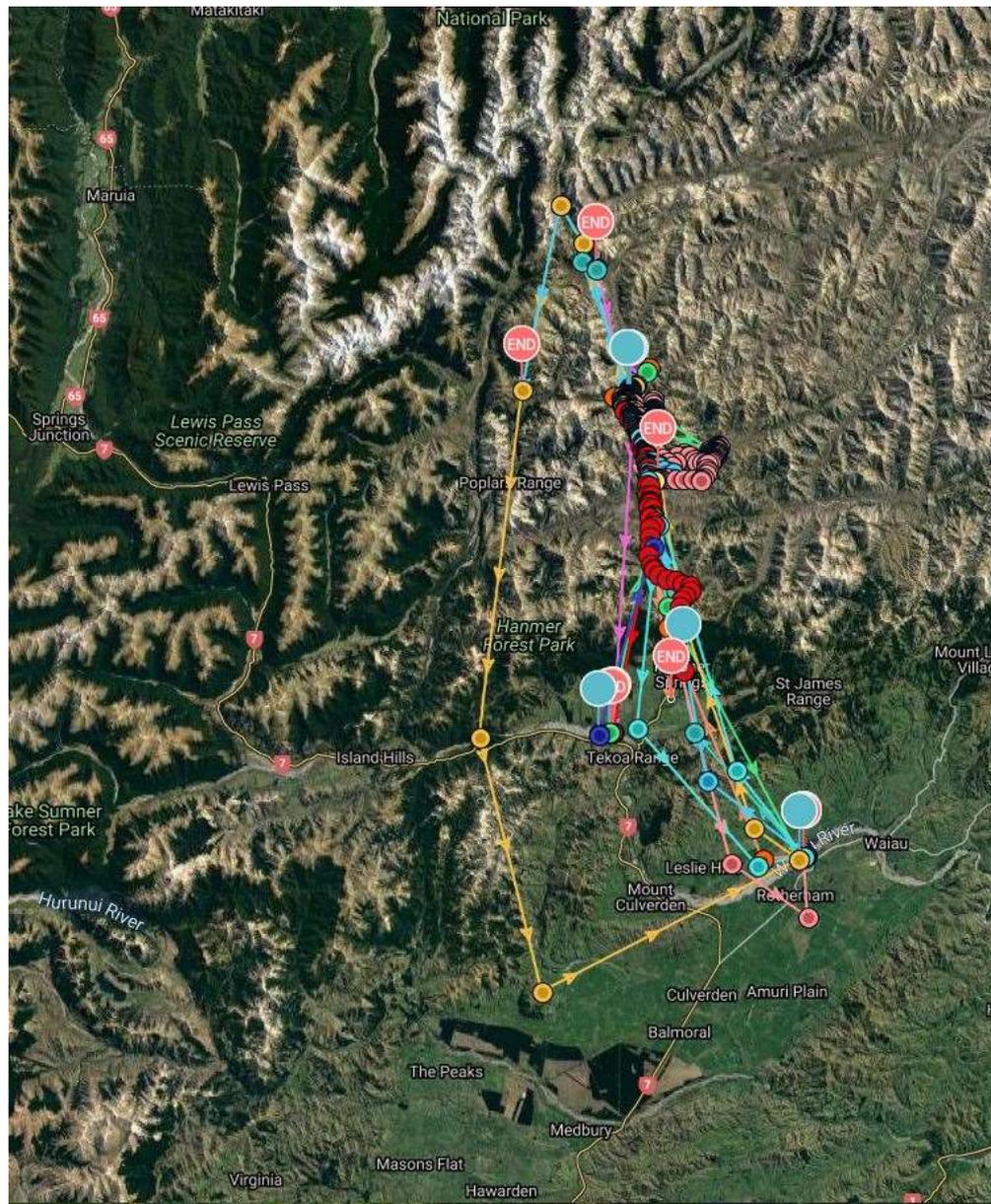


Figure 5. Movements of the two birds that were the least mobile (so far). These birds foraged locally (i.e. 2-3 km) to their breeding colony throughout the breeding season.

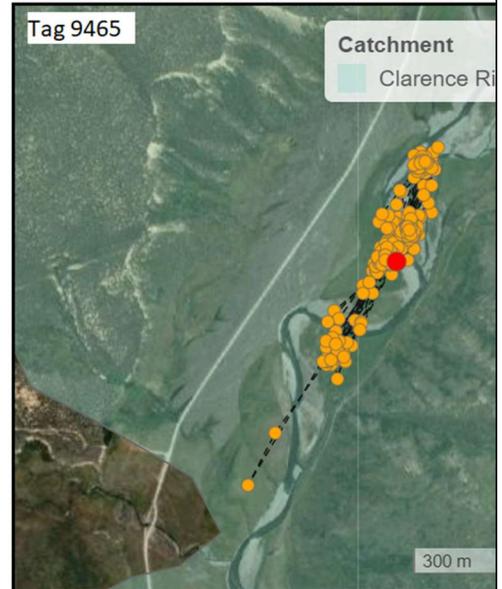
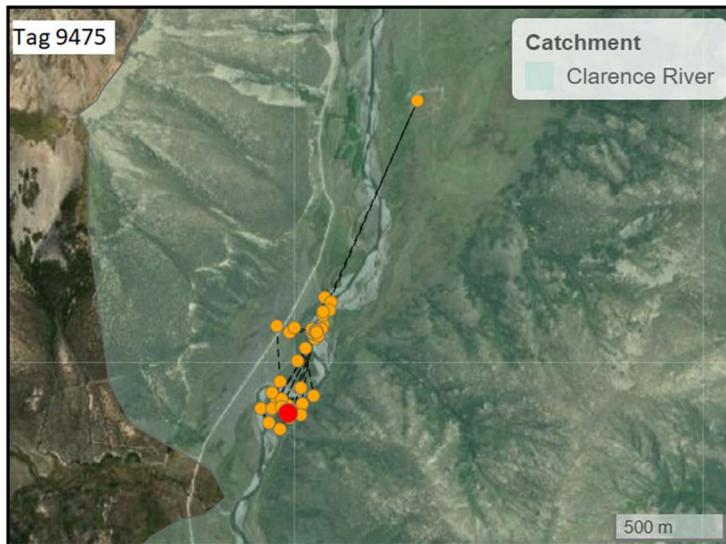


Figure 6. Example of the daily movements and distances travelled by individual black-fronted terns within a day (Tag 9455). In this example the bird moved 185 km within a 24-hour period.

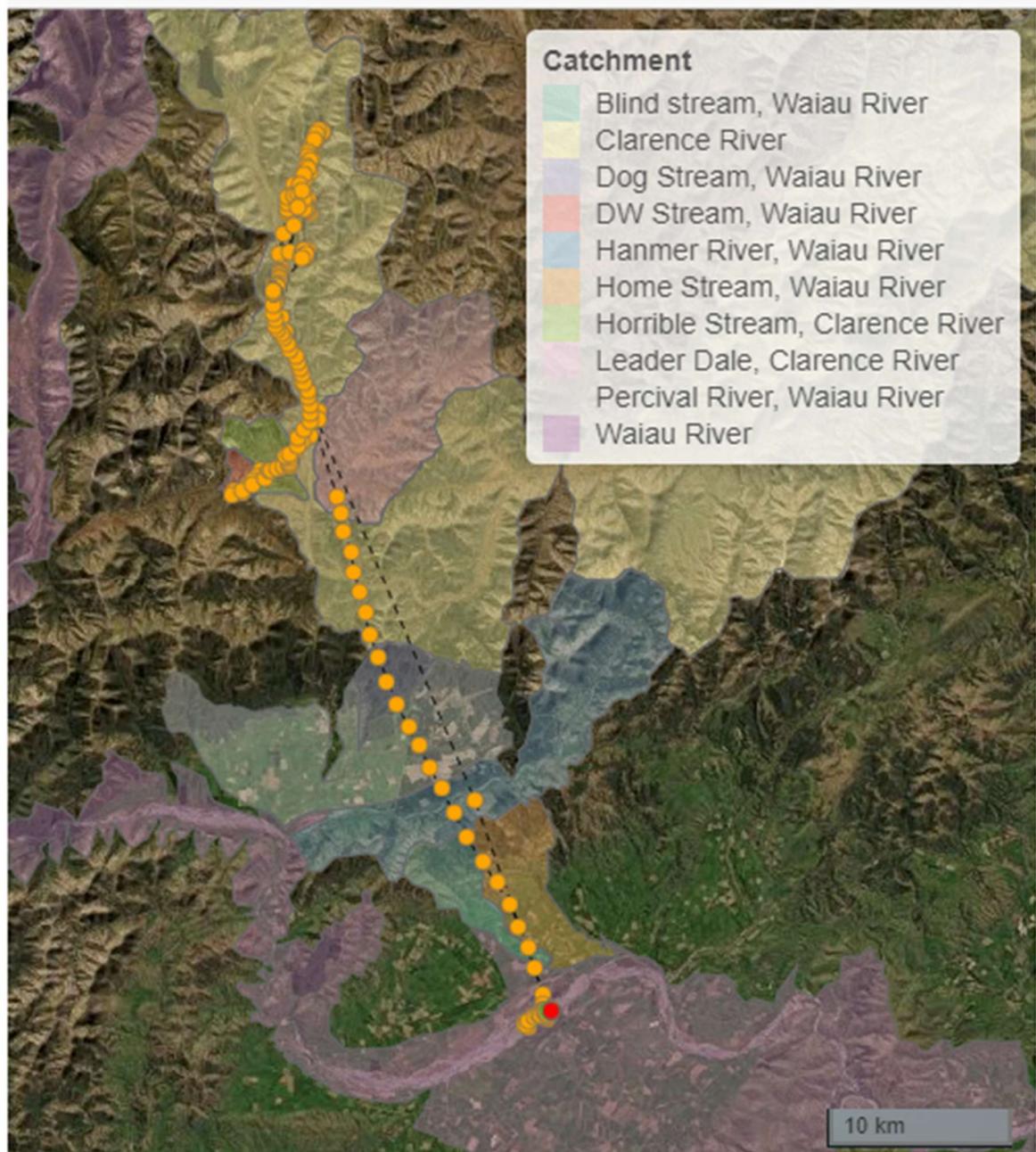


Figure 6a. Example of distance travelled from the nest by both partners while the nest was active. There is a clear bidaily pattern, with one partner traveling long distances at night, while the other partner remains close to the nest; and both birds remaining close to the nest during daylight hours.

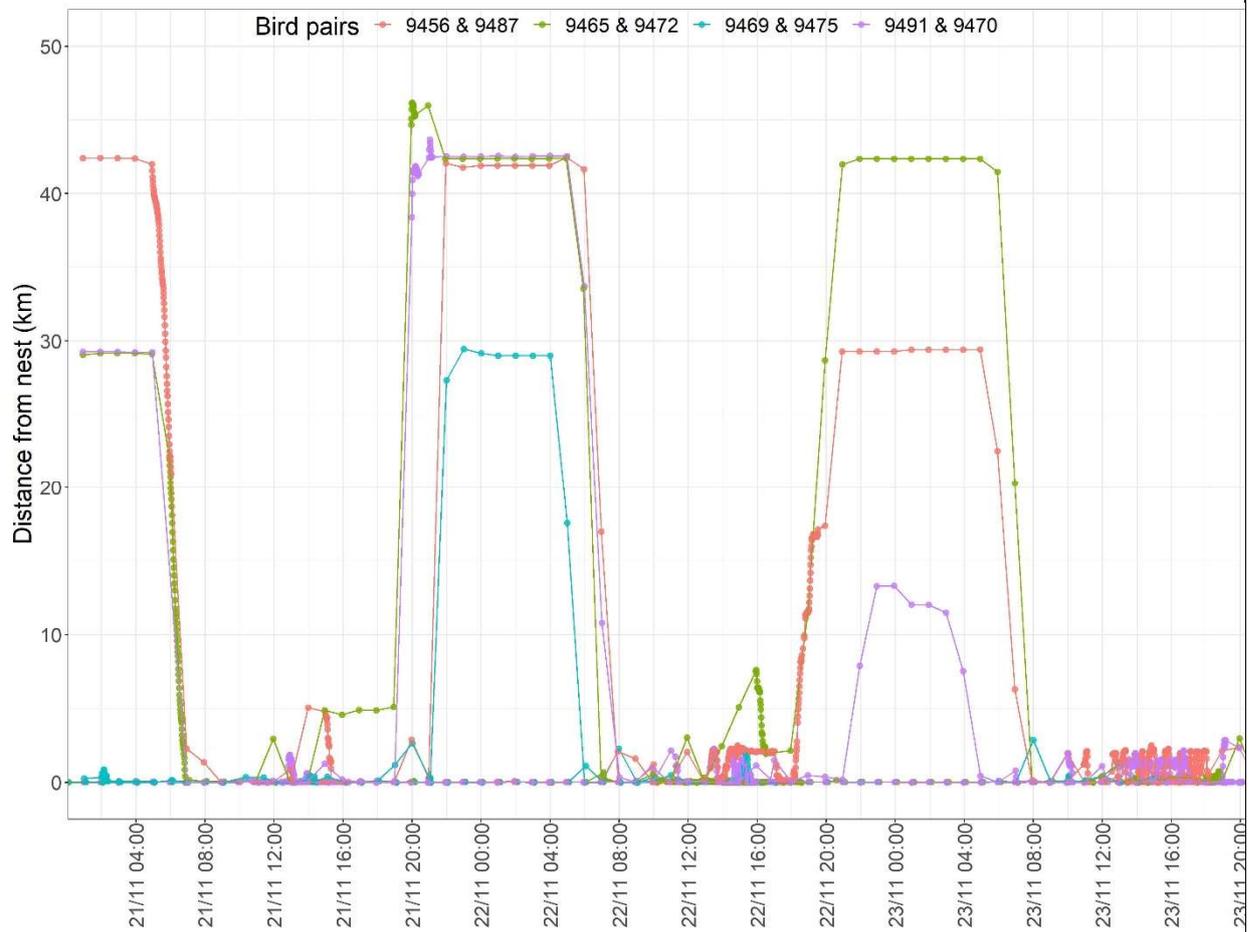


Figure 6b. Long-distance trips were usually made after sunset or before sunrise, suggesting birds were travelling to roost. Hour on the x-axis is hour of the day/night, with distance travelled from the nest on the y-axis.

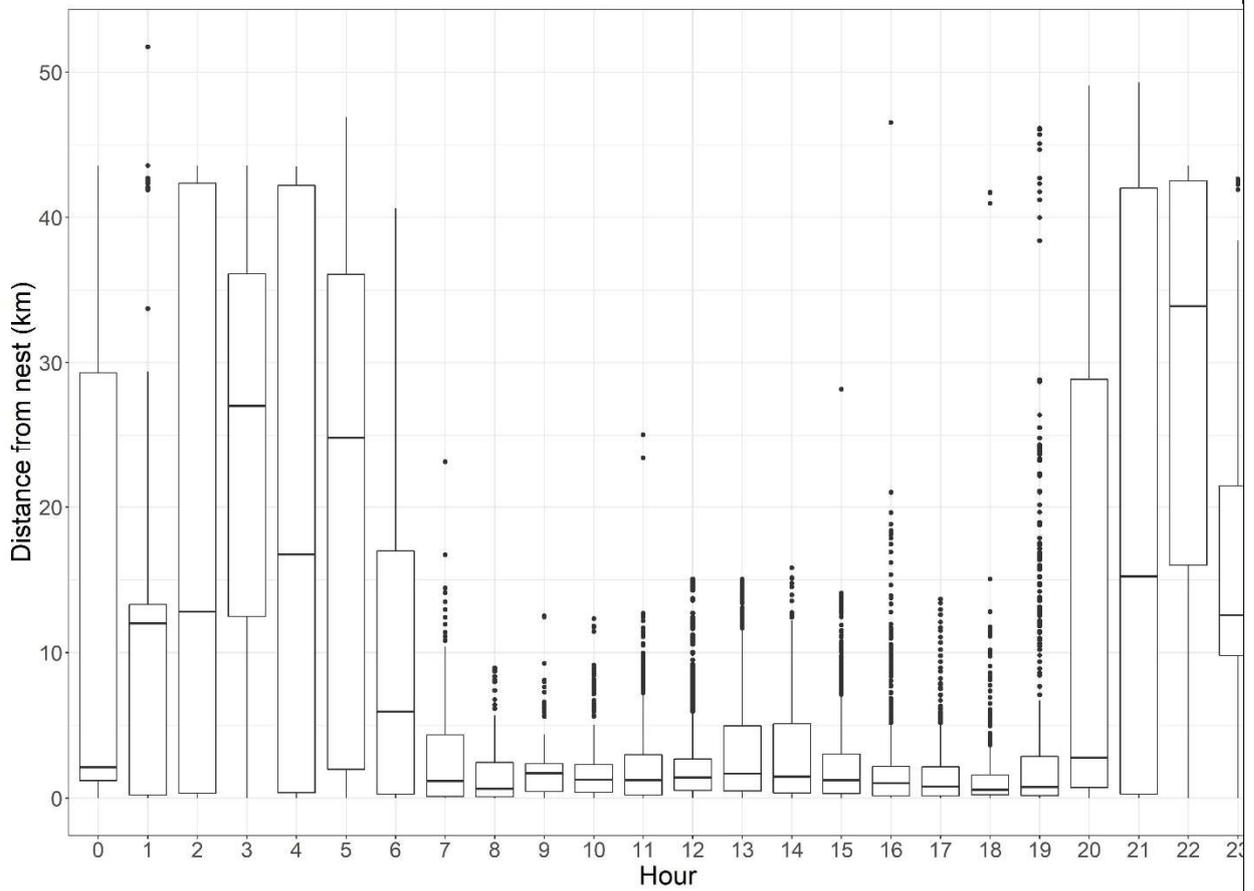


Figure 6c. Location data show that of those black-fronted terns that were making long-distance trips, several travelled to the same roosting locations on the same night. Red circles show birds that travelled to roosting sites along the Waiau River near Rotherham (> 40 km from the nesting site; Figure 7b), green circles show birds that travelled to roosting sites along the Waiau River near Hanmer Springs (27 km from the nesting site; Figure 7c), and the blue circle shows birds that travelled to Lake Tennyson (c. 13 km from the nesting site; Figure 7d).

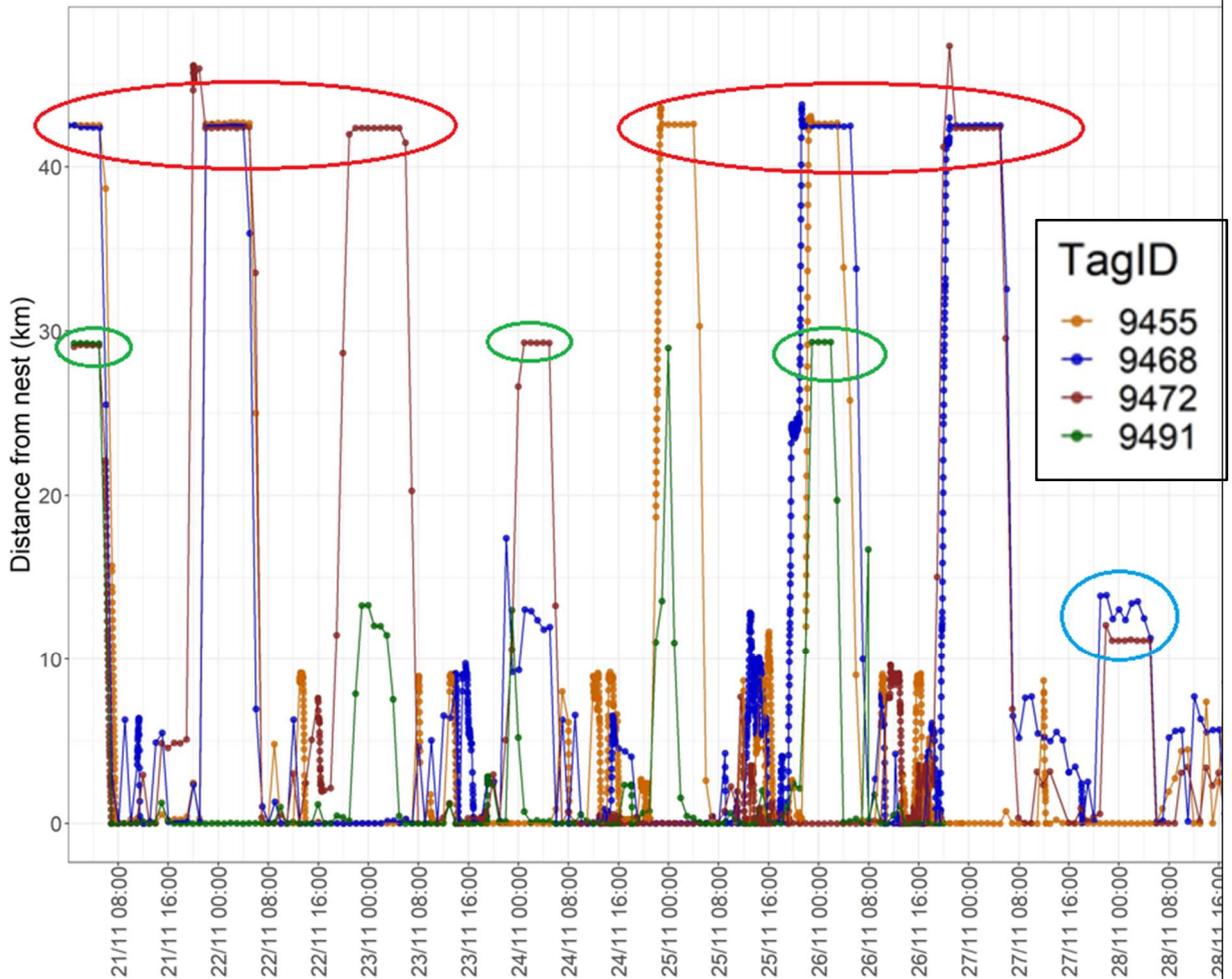


Figure 6d. Example of movements from both partners of the same nest. Here both partners take turns visiting distant roosting sites.

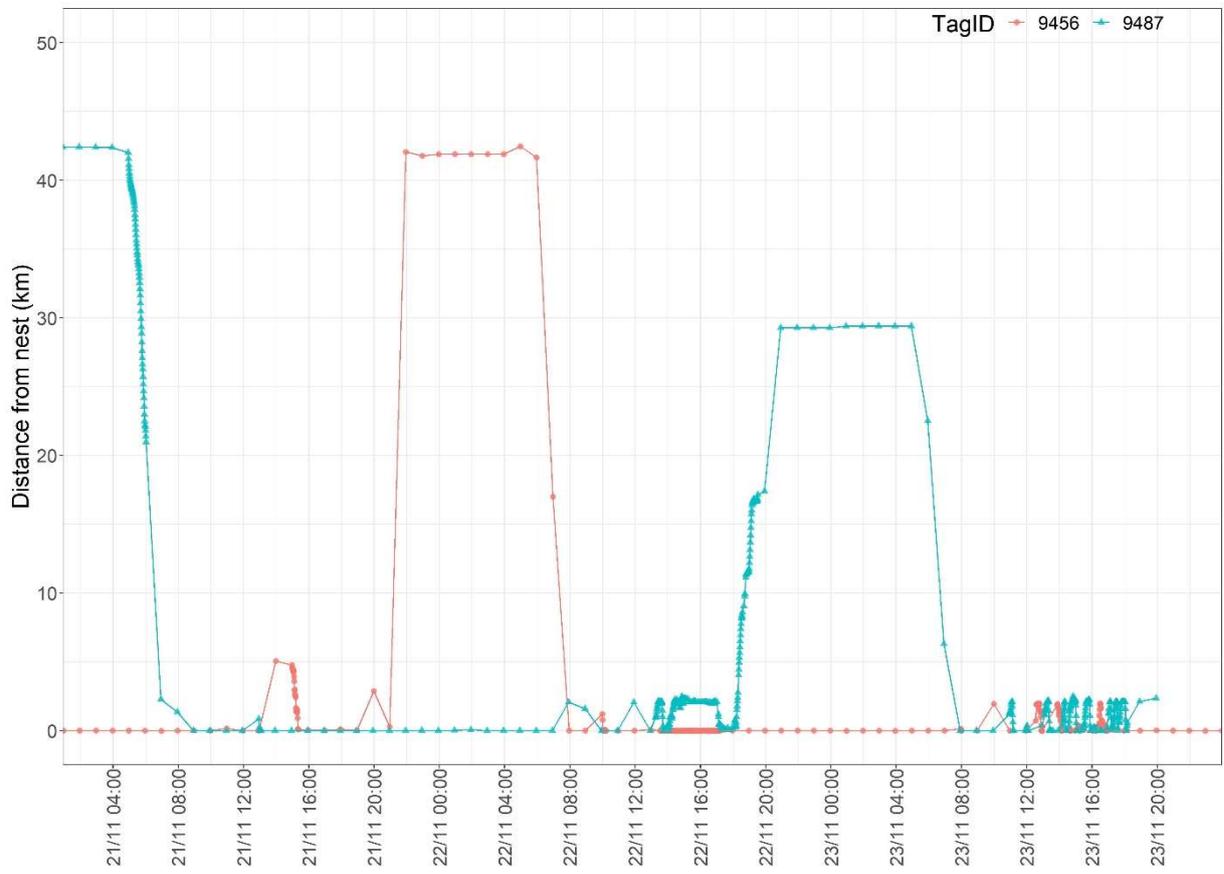


Figure 6e. Example of movements from both partners of the same nest. Here one partner appears to visit the roosting site every night, while the other partner stays on or close to the nest.

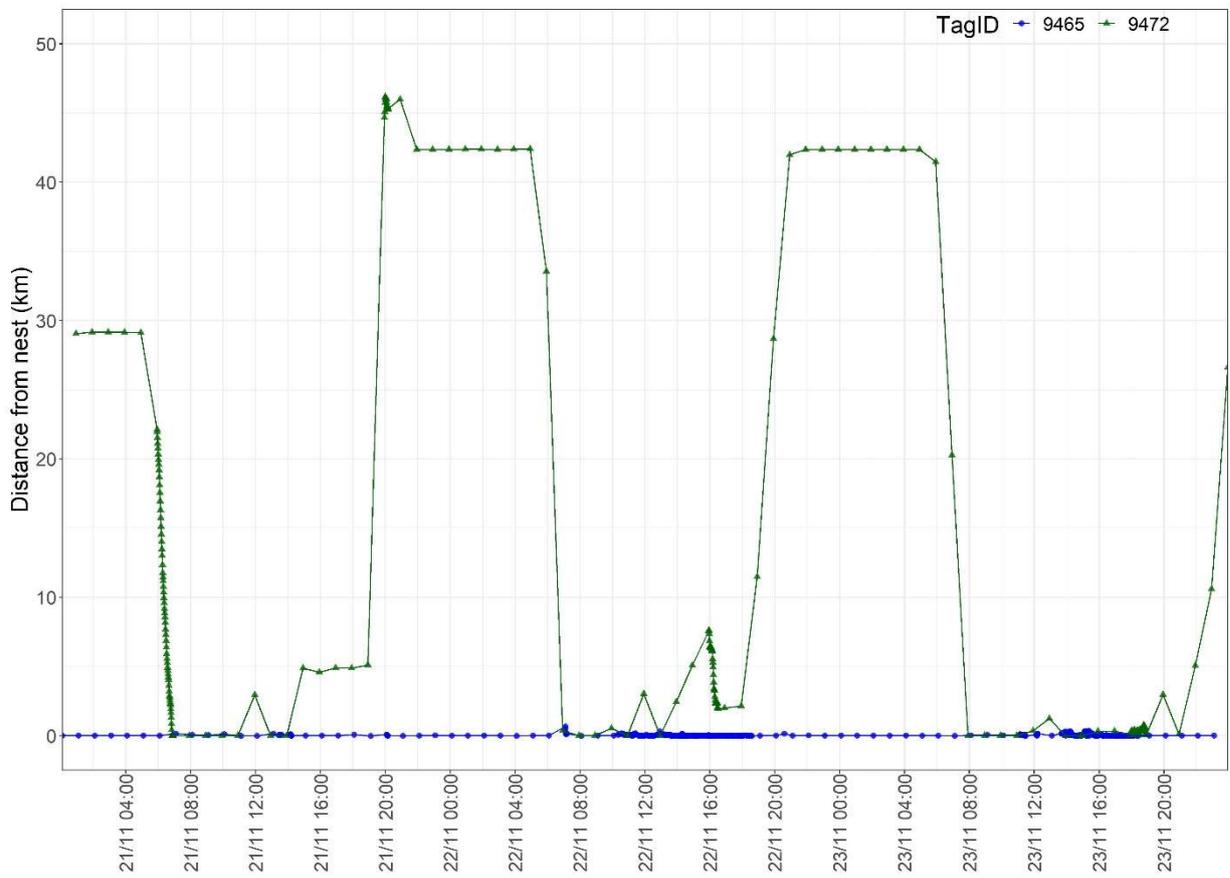


Figure 7a. Overview of sites visited by black-fronted terns at night. Purple = Lake Tennyson, red = Waiau River near Hanmer Springs (just below the confluence with the Grantham River), orange = Waiau River near Rotherham, yellow = upper Wairau River, blue = Bowscale Tarns area, and green = Acheron River.

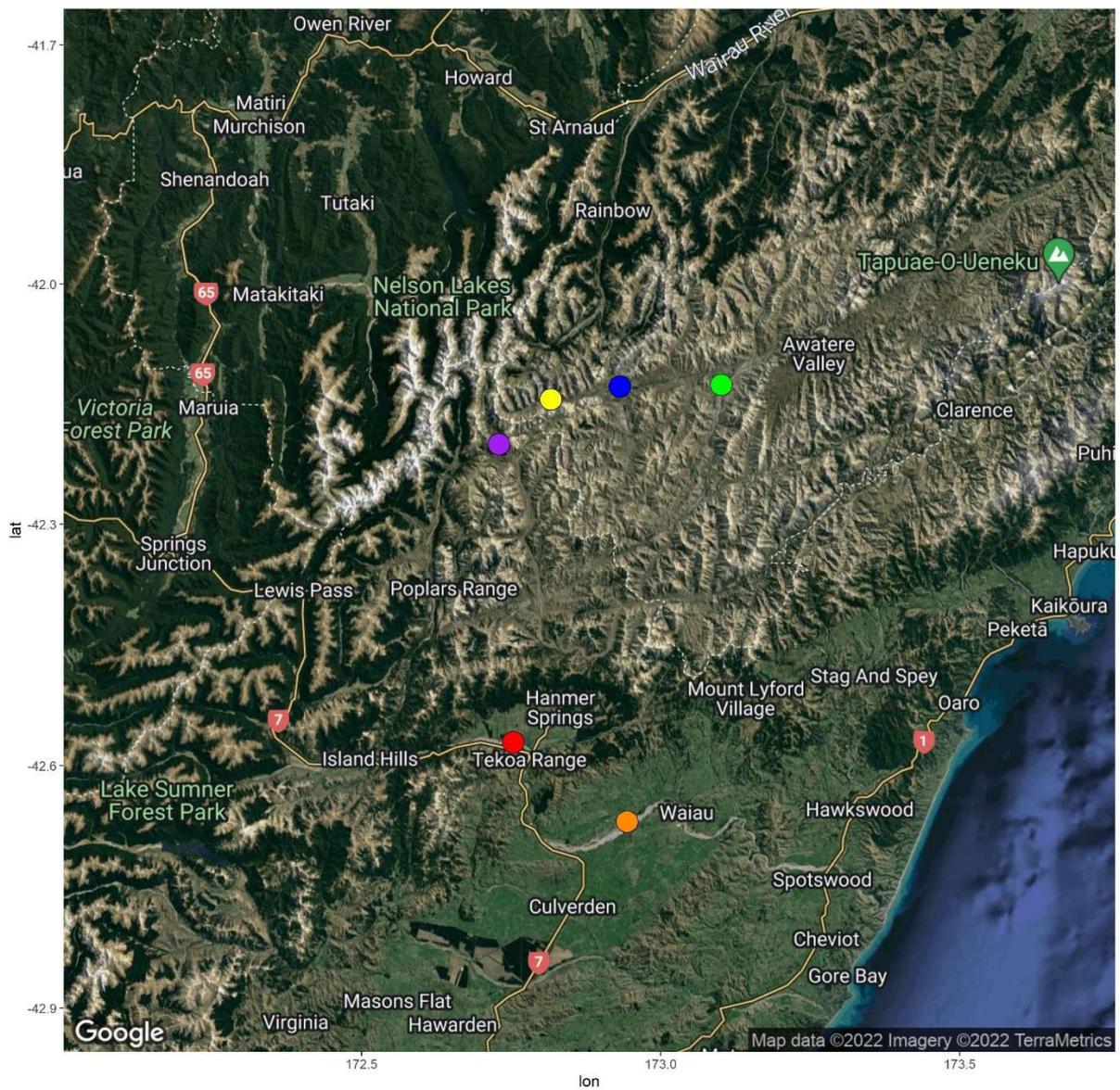


Figure 7b. Roost locations near Rotherham along the Wairau River. These sites were frequently visited by 13 out of 20 black-fronted terns. All birds were tagged on 20th November 2021 while on active nests at Fowlers Camp or Top colony breeding sites, along the Waiau Toa/Clarence River.

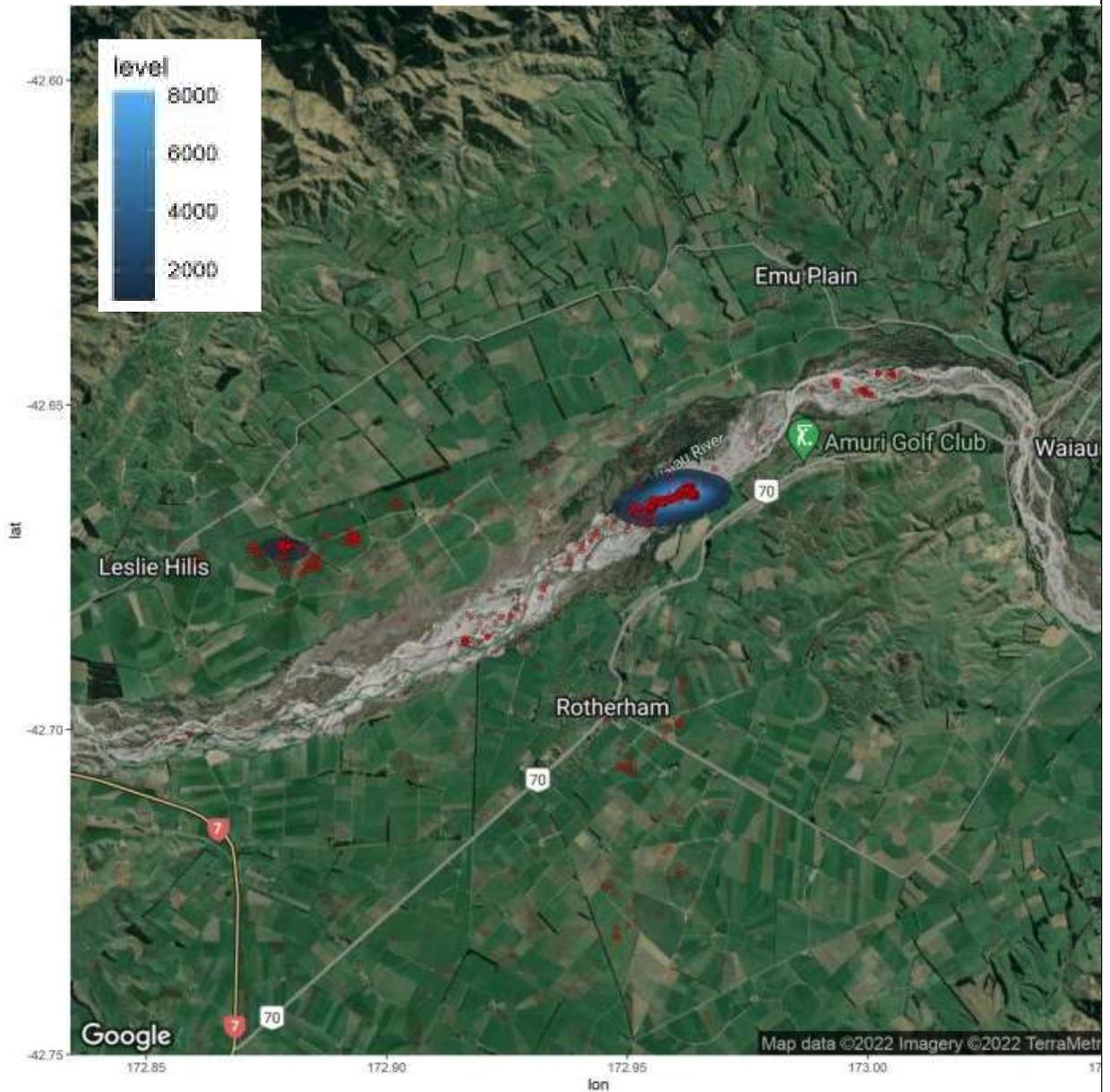


Figure 7c. Roost locations near Hanmer Springs along the Wairau River (just below the confluence with Grantham River). These sites were frequently visited by five out of 20 black-fronted terns. All birds were tagged on 20th November 2021 while on active nests at Fowlers Camp or Top colony breeding sites, along the Waiau Toa/Clarence River.

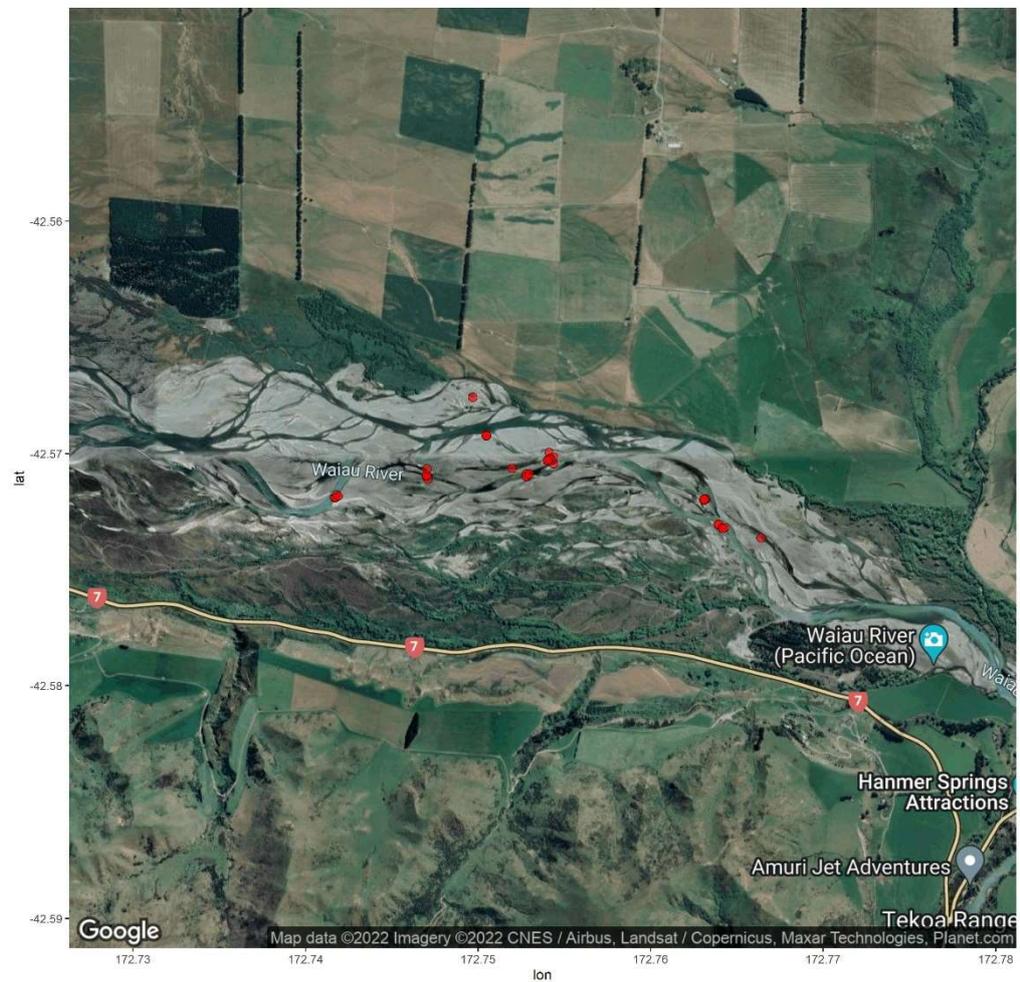


Figure 7d. Night-time locations on Lake Tennyson. These sites were frequently visited by eight out of 20 black-fronted terns. All birds were tagged on 20th November 2021 while on active nests at Fowlers Camp or Top colony breeding sites, along the Waiau Toa/Clarence River.

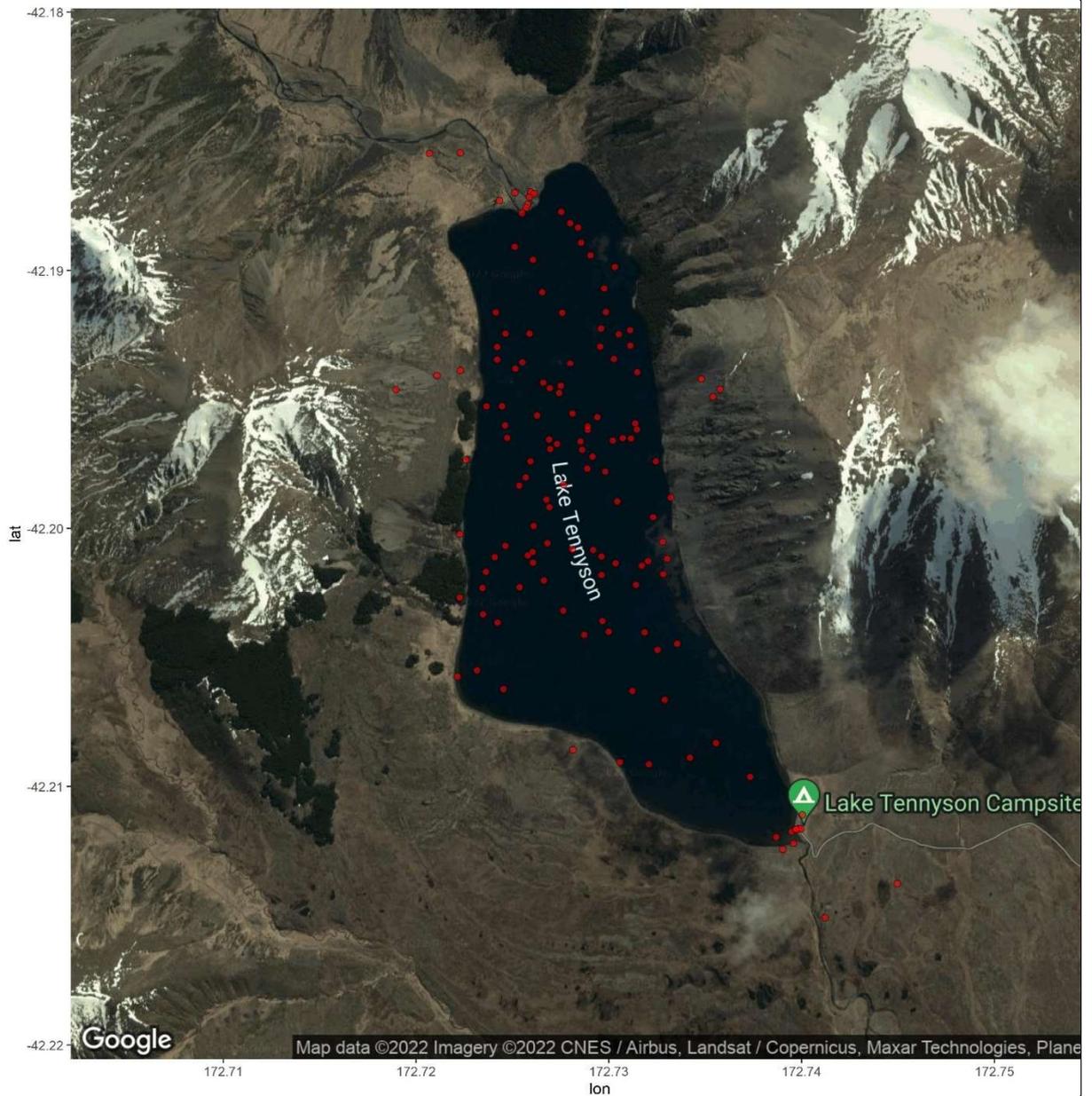


Figure 7e. Scattered diurnal locations made by three tagged black-fronted terns along the upper Wairau River. All three birds were tagged on 20th November 2021 while on active nests at Fowlers Camp or Top colony breeding sites, along the Waiau Toa/Clarence River.



Figure 7f. Scattered diurnal locations made by a single tagged black-fronted tern in the Bowscale Tarns area. This tern was tagged on 20th November 2021 while on an active nest, along the Waiau Toa/Clarence River.

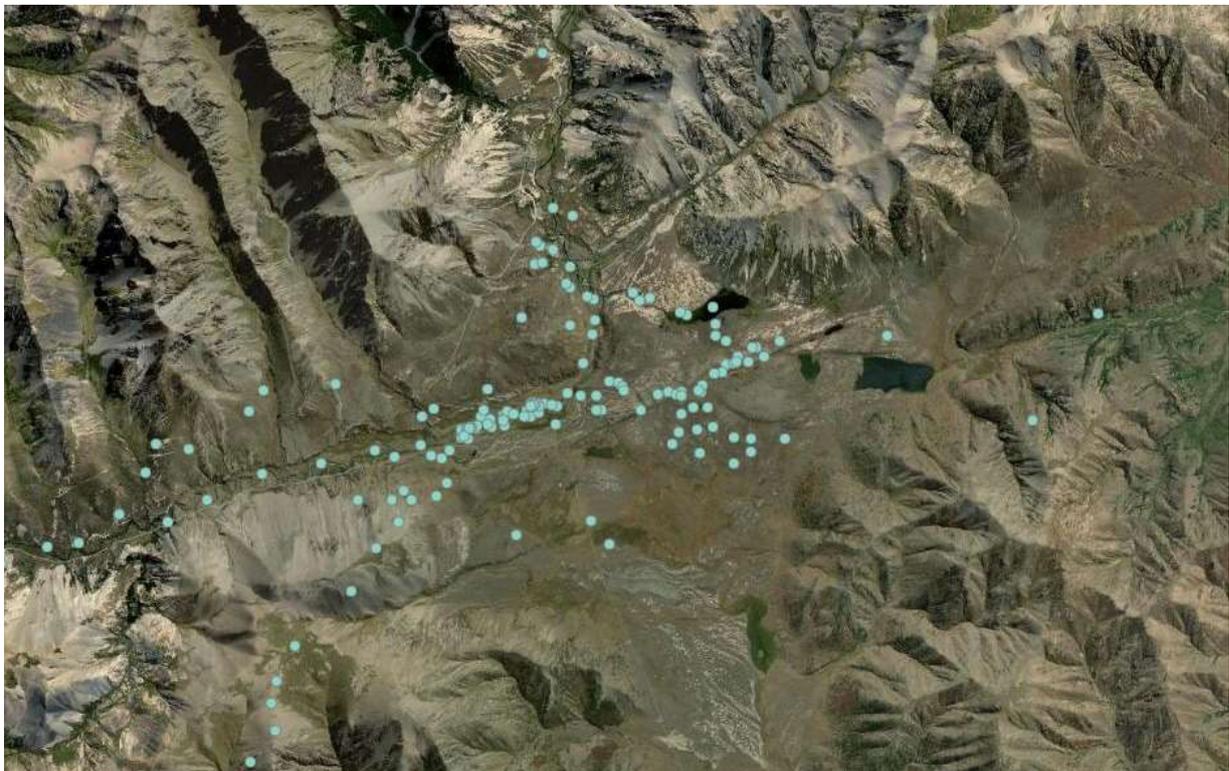


Figure 7g. Scattered nocturnal locations made by one tagged black-fronted tern along the Acheron River. This bird was tagged on 20th November 2021 while on an active nest along the Waiau Toa/Clarence River.



10. Costs of project

Contribution from Braided River Regional Initiative Funding

- 29 x Druid Tech., Ltd. NANO devices at \$379.90 each (\$10,930.10 total)
- 1 x Druid Tech., Ltd. HUB devices at \$1,524.165
- 29 x Yearly data plan subscriptions for NANO devices at \$73.23 a year (\$2,123.67 total)
- 1 x Yearly data plan subscriptions for HUB device at \$182.9 a year
- Shipping and handling fee \$184

TOTAL = \$14,944.84

Contributions from other organisations:

- 40 hours Science Advisor time organising and tagging birds (Paid for by the Department of Conservation)
- Use of 1 x 4 WD vehicle – 1 week (Provided by Department of Conservation)
- Accommodation 1 week (Provided by WMIL)
- Assistance trapping birds, as well as maintaining and moving HUBs around Marlborough (Mike Bell, Baylee Connor-McClean, and Hinewai Bell; WMIL)

APPENDICES

Appendix 1 - Changes made from original project proposal and justification

In the original funding application, we proposed that this work take place in 2021 at the Ashley/Rakahuri River mouth in collaboration with the Ashley-Rakahuri Rivercare Group. A similar study was also being proposed by us for 2022 at winter sites or the Waiau Toa/Clarence River. Funding for the latter study was being provided by the Department of Conservation's Threatened Species Research Workstream.

As the field season progressed, the Ashley-Rakahuri Rivercare Group advised us that there may not be enough nests for the tagging to take place at their study site, and suggested we postpone the work to the following year. Unfortunately, a postponement is difficult because the batteries of tags have short-shelf lives, and therefore become less effective if deployed 12 months later. As such, a decision was made to switch projects so that the tags purchased using the Braided River Regional Initiative Funding could be used to deliver the black-fronted tern study in the Waiau Toa/Clarence River in 2021, with the intent that work at the Ashley River mouth will recommence in collaboration with the Ashley-Rakahuri Rivercare Group in 2022 using tagged funded by the Department of Conservation's Threatened Species Research Workstream. Permission to make this site switch was sought (and approved) from funding coordinators Frances Schmechel (ECAN coordinator for the Braided River Regional Initiative Funding), Ellery Mayence (DOC coordinator for the Braided River Regional Initiative Funding), and Colin O'Donnell (DOC coordinator for the Threatened Species Research Funding) in November/December 2021.

Appendix 2 – Summary of birds tagged and data collected

Metal Band	Flag	TagID	Colony	First Location	Latest Location	Number of locations recorded
CP14701	YSB	9455	Top Colony	21/11/2021 0:58	25/12/2021 18:58	2721
CP14702	YSD	9502	Top Colony	21/11/2021 0:03	21/11/2021 19:03	20
CP14703	YSF	9468	Top Colony	21/11/2021 0:01	25/02/2022 16:26	2162
CP14704	YSV	9474	Top Colony	21/11/2021 0:02	27/11/2021 21:02	517
CP14705	YSZ	9497	Top Colony	21/11/2021 0:02	23/11/2021 4:02	160
CP14706	YSY	9466	Top Colony	21/11/2021 1:00	5/12/2021 15:59	1965
CP14707	YSN	9500	Top Colony	21/11/2021 0:03	26/11/2021 19:04	79
CP14708	YSE	9477	Top Colony	21/11/2021 0:56	3/01/2022 13:57	333
CP14709	YSP	9491	Top Colony	21/11/2021 0:55	1/12/2021 13:56	172
CP14710	YSJ	9495	Top Colony	21/11/2021 0:04	26/11/2021 16:05	626
CP14711	YSU	9505	Upper Fowlers	21/11/2021 0:57	5/12/2021 6:57	1371
CP14712	YTP	9456	Upper Fowlers	21/11/2021 0:56	10/01/2022 20:56	5934
CP14713	YTU	9487	Upper Fowlers	21/11/2021 0:55	23/11/2021 19:55	610
CP14714	YTF	9489	Upper Fowlers	21/11/2021 0:58	27/11/2021 11:58	736
CP14715	YTJ	9469	Upper Fowlers	21/11/2021 0:59	28/11/2021 10:59	1037
CP14716	YTB	9475	Upper Fowlers	21/11/2021 0:03	22/11/2021 10:03	63
CP14717	YTT	9465	Upper Fowlers	21/11/2021 0:05	24/11/2021 17:04	561
CP14718	YTD	9472	Upper Fowlers	21/11/2021 0:55	10/01/2022 20:46	3267
CP3582	YSK	9470	Top Colony	21/11/2021 0:58	4/01/2022 14:00	2774
CP3597	YKY	9511	Top Colony	21/11/2021 0:00	27/11/2021 6:00	961