PROJECT RIVER RECOVERY INTERNAL REPORT 2022/01

Godley Delta River Braids. Photo: Dave Murray

Project River Recovery Annual Report

01 July 2021 to 30 June 2022

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Department of Conservation
Te Papa Atawhai

New Zealand Government

Contents

Summary

- This report summarises Project River Recovery's (PRR) progress towards its six key objectives as identified in its strategic plan for the period from the 1st of July 2021 to 30th of June 2022.
- PRR continues to give highest priority to preventing weed invasions of the near-pristine upper rivers above the hydro lakes of the upper Waitaki basin.
  - Over 620 hectares of targeted, ground-based, and aerial spot spraying of weeds was carried out by PRR staff and contractors in nine main sites: Ōhau, Ahuriri, and Pukaki Rivers, Ruataniwha wetland, Waterwheel Wetland, Lake Poaka, Lake Ōhau, Ōhau Canal, and Twaddle's Stream, and two other small sites; Tern Island and some lizard habitat in gullies beside Lake Benmore. Again, this year traditional PRR control sites such as the Tasman, Cass and Godley Rivers and Fork Stream were sprayed by Te Manahuna Aoraki using Land Information New Zealand funding. Additionally, $34,000 was contributed to ongoing joint programmes in the Tekapō and Dobson Rivers.
- This marked the eighteenth year of trapping results from the Tasman River Predator Control Project, a joint programme between TMA, PRR and the kakī management programme.
  - Over the year, 559 hedgehogs, 148 rabbits, 421 stoats, 92 cats, 33 ferrets, 37 weasels, 10 rats, 23 possums and 11 mice were caught. An additional 5 cats were located and destroyed over four nights of spotlighting.
- The programme of intensive predator trapping around the black-fronted tern colony in the upper Ōhau River continued for the thirteenth year (the sixth year since trapping was reduced to 500m radius).
  - Over the year, a total of 71 hedgehogs, 175 rabbits, 91 ferrets, 43 cats, 17 rats, 26 possums, 11 stoats, and two weasels were caught.
  - As many as 522 black-fronted terns/tarapirohe returned to the island for breeding this year. 772 eggs were monitored and by the end of the season, at least 20 fledglings had been sighted on the island. A range of 8-310 chicks were estimated to have fledged this season.
- Walk-through riverbed bird counts were completed on the Hopkins, Dobson, and Hakataramea Rivers. This year was the second of three consecutive years of surveys in these rivers.
- PRR continued to support a nation-wide bittern/matuku hūrepo study by deploying 22 Acoustic Recording Devices in locations across the basin in 2021-22. Of those locations, six returned positive detections of bitterns.
- Ongoing Galaxiid monitoring and/or trout/koaro removal was carried out above nine constructed and two natural trout barriers at Fraser stream, Corbies Creek, Fork Stream, Hunter Hills, Waterwheel Wetland, Otamatapaio River and Omarama Station.
- Annual monitoring of robust grasshoppers was conducted by PRR across six key populations. PRR also conducted a survey of the entire length of the Tekapō River, and the Ōhau River below Lake Ruataniwha.
- PRR continued to monitor five populations of *Lepidium solandri* across the basin to better understand population trends.
- Wetland management has included weed control and water-level manipulation at Waterwheel and Ruataniwha wetlands. Our focus is to benefit threatened ephemeral plants that occur in these habitats.
- $7000 was used to facilitate University students improving our understanding of the ecology of braided river invertebrates.
- PRR spent $588,000 in the 2021-22 financial year.

1 Introduction

Project River Recovery (PRR) commenced operations in 1991 following the establishment of a compensatory funding agreement with energy providers in the upper Waitaki River which recognised the adverse impacts of hydroelectric power development on braided river and wetland ecosystems. A key focus of the programme over its 29 years of operation has been to maintain integrity of braided river ecosystems, particularly from the impacts of invasive plants. The programme has also invested considerable effort into assessing the impacts of mammalian predators on riverbed fauna and developing effective methods for their control in riverbed environments.

These and other goals are set out in the current interim strategic plan (Nelson, Maloney & Gale, 2020) which replaces the 2012 – 2019 plan. This interim strategic plan covers the renegotiation period of the compensatory funding agreement as part of the renewal of the Resource Consents for water takes for Meridian and Genesis.

This annual report summarises progress toward the six key objectives identified in the strategic plan, describes staffing, and presents financial statements for the year from the 1st of July 2021 to 30th of June 2022.

2 Staff

Dean Nelson continues to manage the project as Senior Ranger for Biodiversity Assets and PRR.

Jennifer Schori and Connor Hines continued their roles as a PRR ranger and a combined DOC/PRR weed control ranger respectively.

Samantha Turner began her role as PRR's second ranger in September. She is a graduate of Otago University's Master of Wildlife Management programme. PRR hosts students of this programme each year, and Sam is excited to be working on some of the projects she learnt about during her studies.

Tayla Hooker, Twizel's biodiversity ranger and plant expert extraordinaire, lead PRR's threatened plant work this year, and supported PRR's river bird surveys, robust grasshopper surveys, and trout removal from streams including the Forks and Fraser.

Predator control work in the Upper Ōhau River and much of the Tasman River continues to be serviced by Ecological Contracting Services Limited.

PRR continues to work closely with the kakī management programme and Te Manahuna Aoraki in the Tasman River where we jointly fund a large-scale predator-control project to protect a range of riverbed fauna.

3 Strategic plan

The strategic plan outlining the work objectives of PRR normally spans consecutive seven-year cycles, allowing regular review, reporting, and realignment. The previous strategic plan from 2012 to 2019 (Rebergen & Woolmore, 2015) has now expired, and an interim strategic plan outlining the work for the next few years has been prepared (Nelson, Maloney & Gale, 2020). Once a mitigation agreement as part of the Meridian and Genesis water re-consenting process has been agreed to, a new strategic plan for a seven-year cycle will be prepared.

4 Progress toward objectives of the strategic plan

PRR's progress towards achieving the objectives of the current interim strategic plan is summarised below. Detailed reports of seasonal results and outcomes from trials and analyses of data are recorded through PRR's internal report series and are available on request.

4.1 Objective 1: Maintain indigenous biodiversity; protect and restore terrestrial and aquatic river and wetland habitat and the ecological communities within it by controlling and where possible, eradicating invasive weeds

Ongoing riverbed and wetland weed-control programme

The total area of braided-river habitat in the large rivers of the upper Waitaki basin is approximately 32,000 hectares. PRR gives the highest priority to preventing new incursions of invasive weeds and removing newly established infestations at priority locations. Priority sites are generally still relatively 'clean' in terms of the number of weed species and the extent of their distribution.

As a result of additional funding from Land Information New Zealand (LINZ), Te Manahuna Aoraki (TMA) carried out most of the weed control within its core operational area. This included many of the key riverbeds where PRR has traditionally used contractors to control weeds that pose a threat to the habitats of native species. Towards the end of the financial year when TMA ran out of the LINZ funding, PRR stepped in to contribute over $51,000 to ensure that the willow control programme was completed in the Godley, Mistake and Coal Rivers. Additionally, PRR continued its ongoing programme of weed control in other areas outside of the TMA operational area, including removal of all vegetation from Tern Island (to benefit nesting black-fronted terns) and ongoing wilding pine, alder and willow control around Lake Poaka and waterwheel Wetland.

Some work was undertaken in the upper Ahuriri to honour agreements made with adjoining landowners to cut down dead standing willows that PRR had sprayed in the past. Aerial spraying of willows in and around the main riverbed also took place to continue the work to remove willows in the valley above the junction with Longslip Creek.

A new area of lupins was picked up in land that came to DOC from the Tenure Review of the Twin Peaks pastoral lease. The lupins occupy a stream that feeds into a wetland area locally known as Twaddle's Swamp. Parts of this wetland have been fenced with ECan funding to protect a significant population of *Galaxias macronasus*, the Nationally Vulnerable bignose galaxias. The adjoining landowners were spraying lupins on their property and were keen to ensure that the source from DOC land was controlled. The stream is relatively hard to access so consequently the lupins were sprayed aerially and while there was some Tenure Review implementation funding available, this was insufficient for the job and PRR provided $16,000 to ensure that work was completed.

$20,000 was contributed to the Environment Canterbury (ECan) led multi-year, landscape scale weed control project in the Dobson Valley. It aims to control elderberry, cotoneaster, buddleia, willows, and Russell lupin, as well as some miscellaneous garden escapees (raspberry, gooseberry, currant, and flowering cherry). PRR has been doing some work in this area as weeds like buddleia have always been priority weeds to keep out of the Mackenzie Basin. Also, the long-term aim is to remove Russell lupins from the mid part of the valley and progressively push them down valley toward Lake Ohau. PRR will continue to help fund this project as it will concentrate on willows and Russell lupins in the Dobson riverbed and associated wetlands.

PRR, ECan and LINZ continue to joint fund an integrated weed-control programme in the upper Tekapō River targeting gorse, broom, Russell lupin and willows. LINZ and ECan contractors carry out this weed control work and this season, PRR's contribution amounted to just over $14,000.

4.2 Objective 2: Test and where possible, improve the effectiveness of and implement experimental predator control for population recovery of braided river and wetland fauna

Tasman River

The Tasman project's goal is to reduce predation of braided river birds to a level where depleted populations are recovering, and large populations are in a stable state. The project takes a large-scale approach, using a wide variety of control methods that are applied throughout the year. Success of the project is assessed on achieving target increases in fledging success and population growth for a range of river birds. PRR and the Kakī Management Programme continue to implement an extensive predator control project in the Tasman Valley supported by the Te Manahuna Aoraki (TMA) partnership who have extended trap lines throughout the area.

Predator control

The 2021-22 season was the eighteenth year of operation at the site, with a total of 700 DOC-150s, 311 DOC-250s, 310 Conibear traps, and 77 Timms traps run by PRR. PRR's trapping network is supplemented by an additional 715 traps that are run and maintained by the TMA project (Figure 1). Between 1 July 2021 and 30 June 2022, PRR's trapping network removed 344 hedgehogs (*Erinaceus europaeus occidentalis*), 141 rabbits (*Oryctolagus cuniculus*), 217 stoats (*Mustela erminea*), 50 cats (*Felis catus*), 28 weasels (*M. nivalis vulgaris*), 16 ferrets (*M. furo*), 9 rats (*Rattus* spp.), 3 mice (*Mus musculus*) and 4 possums (*Trichosurus vulpecula*) from the Tasman Valley (Table 1).

The annual 10-day period of opening 530 leg-hold traps took place during May. This work specifically targets cats that may have become shy of entering the kill trap tunnels. Once again this was a successful operation, catching 27 cats, 33 stoats and 24 hedgehogs. An additional 5 cats were located and destroyed over four nights of spotlighting.

Table 1. A summary of the mammals trapped by Project River Recovery's (PRR) trapping network (including leg-hold traps) and Te Manahuna Aoraki's (TMA) extension trap lines in the Tasman Valley between 1 July 2021 and 30 June 2022.

Owner	Traps	Hedgehog	Rabbit	Stoat	Cat	Weasel	Ferret	Rat	Mouse	Possum	Total
PRR	1,389	368	141	250	77	28	16	9	3	4	896
TMA	715	191	7	171	15	9	17	1	8	19	438
Total	2,113	559	148	421	92	37	33	10	11	23	1,334

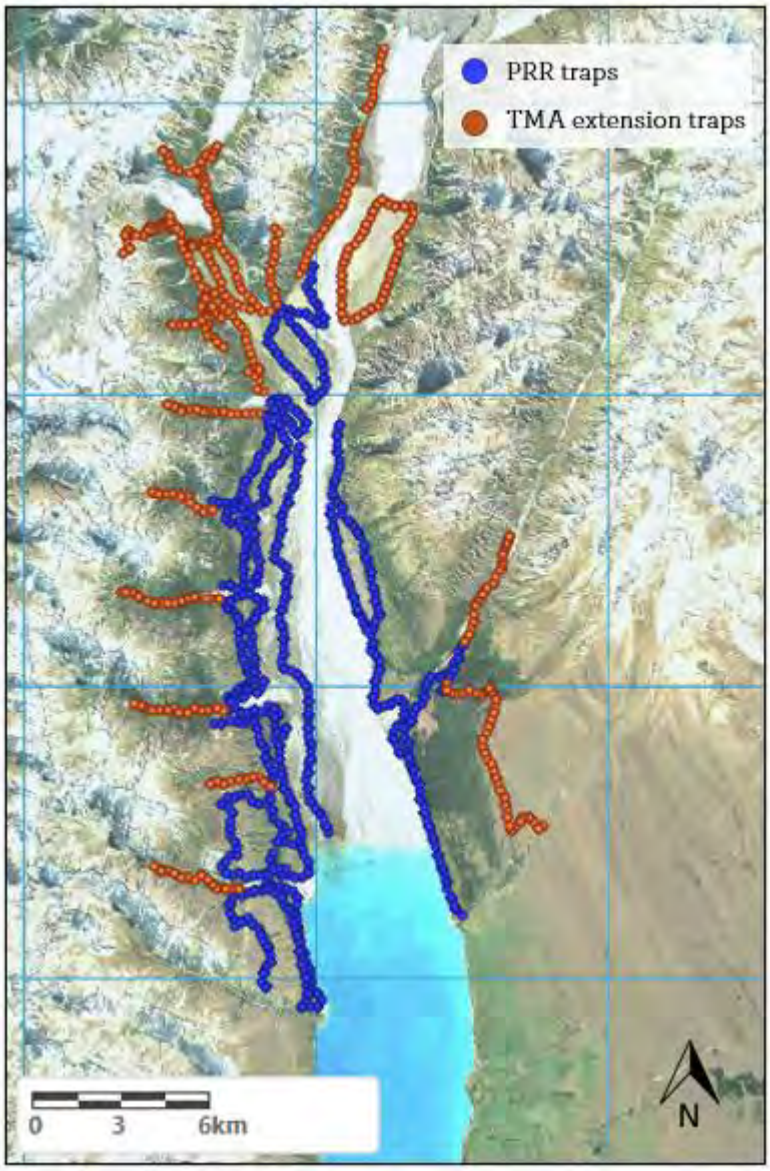

Figure 1. The trapping network in the Tasman Valley consists of traps managed by Project River Recovery (PRR; *n* = 1,389 traps) and the Te Manahuna Aoraki Project (TMA; *n* = 715).

Southern black-backed gull control

Nest camera footage collected from the Tasman over past seasons has shown that southern black-backed gulls (SBBGs - *Larus dominicanus*) are a significant predator of both eggs and chicks of other riverbed bird species. Various methods for control of SBBGs have been trialled over several years with the aim of substantially reducing their unnaturally high populations to allow for the recovery of other braided river birds especially black-fronted tern/tarapirohe (*Chlidonias albostriatus;* Nationally Endangered) and black-billed gull/tarāpuka (*Larus bulleri*; Nationally Critical).

Between 2013 and 2020, a combination of techniques including Alphachloralose operations (2013-14), ground shooting (2014-2018) and aerial shooting (2016-2020) has resulted in the successful removal of 2,311 SBBGs from the Tasman and Murchison Rivers. Aerial shooting using a small Guimbal Cabri G2 helicopter with experienced pilot and a DOC staff member as shooter has proven a successful, cost-effective combination for control.

While initial control centred on the Tasman, clearly SBBGs are very mobile species and juveniles are not recruited into the breeding population until they are four years of age. The means that control needs to be

consistently applied and extended into other areas of the Mackenzie basin to prevent immigration back into the key braided riverbeds with good breeding populations of black-fronted terns and black-billed gulls.

This year TMA did SBBG control in all the upper riverbed areas in their operational area (including the Tasman) while PRR concentrated on the couple of large colonies in the Tekapo and Pukaki Rivers as also extended into some smaller colonies in the Hopkins and Dobson Rivers.

Outcome Monitoring

Black-fronted terns

The species selected for monitoring this year was black-fronted tern/tarapirohe and outcome monitoring this season followed the breeding success of 56 nests over five colonies (Figure 2).

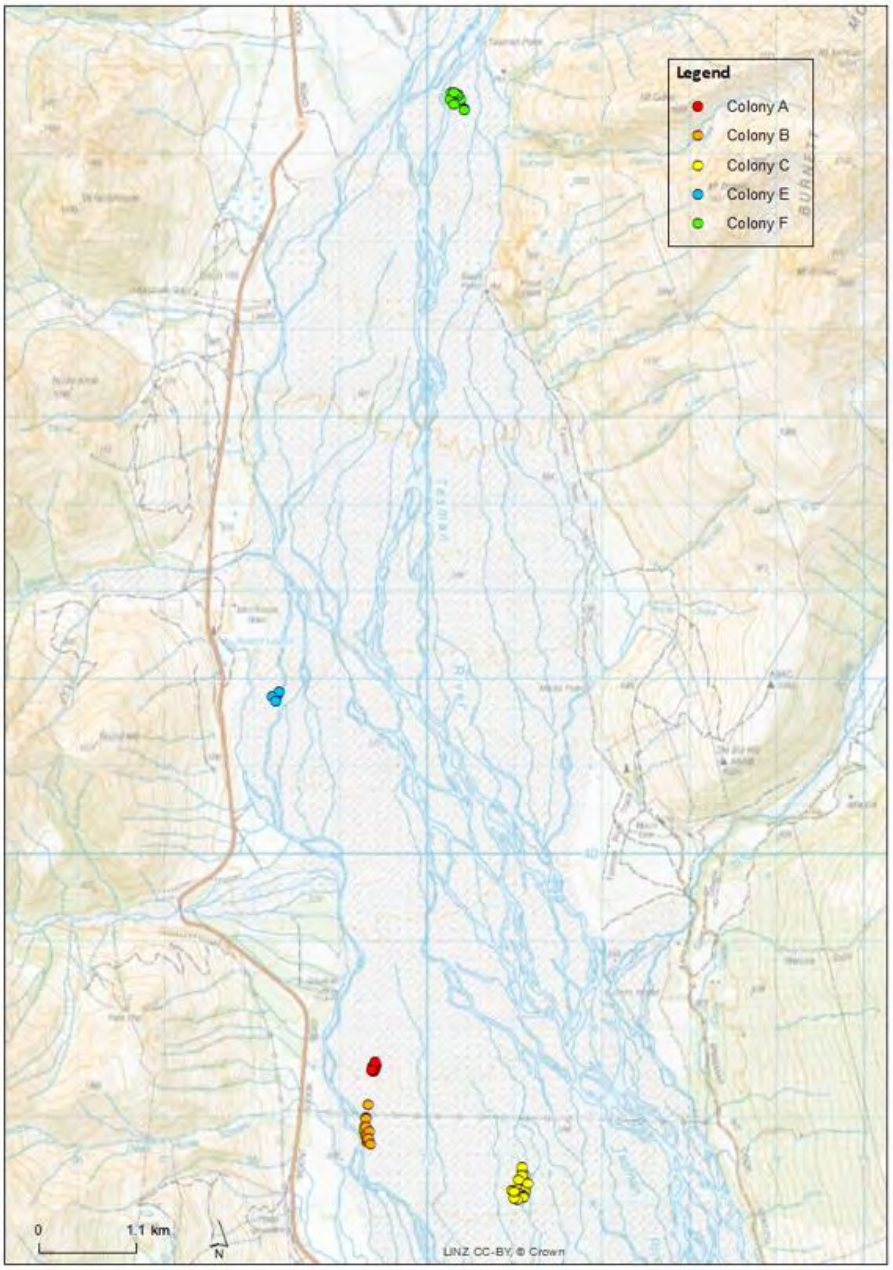

Figure 2. The locations of the black-fronted tern/tarapirohe nests and colonies monitored in the Tasman River in 2021-22. Image reproduced from O'Connor 2022.

Of the monitored nests, 88% hatched at least one chick (O'Connor, 2022). This year's hatching success was one of the highest on record, matching that recorded in 2017-18, and lower than only that of 2016-17 (Figure 3).

Between 3 and 50 chicks fledged, however, mean fledging success was down on the previous two years (0.27 fledglings per chick; Figure 3).

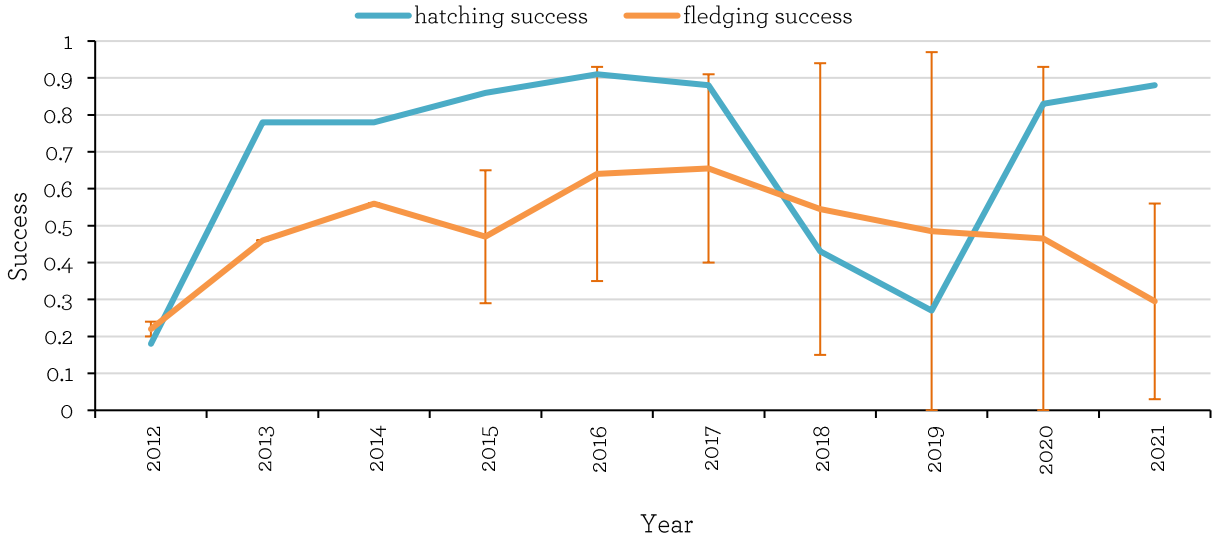

Figure 3. The hatching success (chicks hatched per nest with known outcome) and mean fledging success (number of fledglings per nest, error bars show estimated minimum and maximum) of black-fronted terns/tarapirohe nesting on the Tasman River between 2012 and 2021.

Braided river bird survey

The Tasman River bird survey is completed each year and is used as an indicator of the success of the Tasman River Predator Control Project. PRR contributes to the project by organising the survey and providing staff. The results for this season's survey conducted in November are compared with previous seasons in Table 2.

Table 2. Results of river bird surveys on the Tasman River between 1992 and 2021. Results from the three-year cycle from 1992 to 1994 and first 11 years of following commencement of the Tasman predator control project (2004-2014) are averaged. Results from the current 2021 season are highlighted in bold.

Species, threat ranking*		1992-1994 (Range)	2004-2014 (Range)	'17	'18	'19	'20	'21
Banded dotterel/tūturiwhatu,	NV	565 (523-599)	658 (395-858)	741	946	710	568	**641**
Black stilt/kakī,	NC	2 (1-5)	11 (2-32)	17	8	7	2	**6**
Black-backed gull/karoro,	NT	585 (537-609)	240 (95-413)	64	53	60	29	**51**
Black-billed gull/tarāpuka,	NC	13 (7-25)	25 (5-113)	135	218	160	60	**72**
Black-fronted tern/tarapirohe,	NE	121 (79-175)	137 (47-217)	648	245	464	192	**393**
Caspian tern/taranui,	NV	2 (2-2)	1 (0-3)	2	0	2	3	**2**
Hybrid stilt,	n/a	4 (1-9)	4 (0-10)	0	3	0	0	**4**
Pied stilt/poaka,	NT	17 (12-21	11 (0-54)	1	8	8	5	**2**
South Island pied oystercatcher/tōrea,	D	60 (46-76)	72 (52-109)	81	115	62	65	**123**
Spurwing plover,	NT	19 (17-23)	20 (5-37)	6	25	10	14	**19**
Swamp harrier/kāhu,	NT	5 (0-11)	3 (1-3)	0	4	9	0	**2**
Waterfowl and shags,	n/a	366 (334-407)	406 (177-842)	310	494	260	154	**214**
White-faced heron/matuku,	NT	2 (1-2)	1 (0-3)	1	7	0	1	**3**
Wrybill/ngutuparore,	NV	133 (120-151)	110 (32-165)	126	133	148	122	**207**

*Threat rankings, from most to least threatened: Nationally Critical (NC), Nationally Endangered (NE), Nationally Vulnerable (NV), Declining (D), Not Threatened (NT).

Lizard and wētā monitoring using ACOs (Artificial Cover Objects)

To better understand how landscape-scale predator control benefits lizard and invertebrate species, an outcome monitoring programme was established targeting Mountain stone wētā (*Hemideina maori*; Not Threatened), Southern Alps geckos (*Woodworthia "Southern Alps"*; Not threatened), and Southern grass skinks (*Oligosoma aff. Polychroma Clade 5*; At Risk – Declining; Hitchmough et al., 2021; Error! Reference source not found.).

Figure 4. A Mountain stone wētā (*Hemiandrus maori* ; left), a Southern Alps gecko (*Woodworthia* sp. 'Southern Alps'; middle), and a Southern grass skinks (*Oligosoma aff. Polychroma Clade 5*, right) located under Artifical Cover Objects during the survey of the Tasman Valley 2021-22.

The monitoring uses ACOs (Artificial Cover Objects) located in 50 places throughout the Tasman Valley. Monitoring began in 2005 and has been repeated every 5-10 years (Schori et al., 2022a). No long-term trends are evident for Mountain stone wētā or Southern Alps geckos. However, this year was the first year that Southern grass skinks were observed under the ACOs (Error! Reference source not found.).

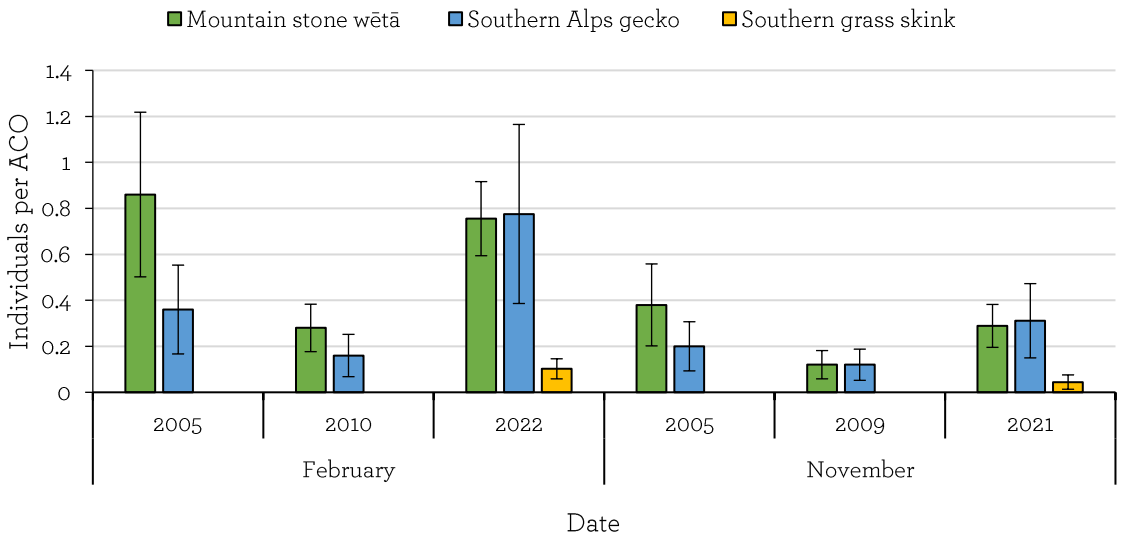

Figure 5. The mean number of individuals (± SE) of Mountain stone wētā, Southern Alps geckos and Southern grass skinks observed per Artificial Cover Object (ACO) stack at each of the monitoring dates. *N* = 50 ACOs; except November 2021 (45 ACOs); January and Febraury 2022 (49 ACOs).

Upper Ōhau River/Tern Island

Black-fronted tern/tarapirohe is a small, nationally endangered tern species endemic to New Zealand (Robertson et al., 2021). Braided river specialists, black-fronted terns breed only in the eastern and southern South Island, with recent population estimates of only 10,000 birds.

The Ōhau River is one of the many braided rivers in the Upper Waitaki Basin which support breeding colonies of black-fronted tern/tarapirohe during the summer months. They face a complex variety of interacting threats including introduced pests (Keedwell, 2005; Keedwell et al., 2002), weed encroachment of their habitat (Schlesselmann, 2018) and environmental factors such as flooding risk (Cruz et al., 2013).

Predator and Weed Control

The upper Ōhau predator control programme commenced in 2009 (Anderson, 2010) and aims to improve the breeding success of a large black-fronted tern/tarapirohe colony that nests each year on an island in the upper Ōhau River (known locally as "Tern Island"). This project has historically involved intensive predator control using a kill trap grid spanning a 1km radius from the tern colony at the core of the trapped area, targeted Norway rat (*Rattus* norvegicus) control using poison, and rabbit (*Oryctolagus cuniculus cuniculus*) control within a 1.2km radius of the same area using a mixture of night shooting and patch poisoning. The project was reviewed in 2016 with a scaled down approach to management of this area recommended (Maloney, 2016). This approach would test if black-fronted tern/tarapirohe breeding success can be maintained at the high levels seen since the project commenced while reducing operational costs (Maloney, 2016). The control area was reduced to approximately a 500m radius area surrounding the island. The number of traps, frequency of trap checks was also reduced, and rabbit night shooting was discontinued due to excessive growth of vegetation making shooting very difficult.

The 2021-22 season marks the thirteenth year of predator control operations in the upper Ōhau River. The kill trap network currently consists of 128 DOC-150s (replaced with double sets), 118 DOC-250s, 54 Twizel cat traps, 21 Belisle Super X 220 traps, 20 modified Timms, 18 Warrior traps (replaced with Trapinator traps), and 12 Goodnature A24 traps (Turner et al. 2022c; Figure 6). Traps were checked weekly during the tern breeding season (September 2021 until terns left the island in mid-January 2022) and monthly for the remainder of the year. Kill traps were run continuously throughout the year except for traps on Tern Island which were shut down for five months after black-fronted tern/tarapirohe started nesting to avoid catching their chicks. During the trapping period from 1 March 2021 to 28 February 2022, 71 hedgehogs, 175 rabbits, 91 ferrets, 43 cats, 17 rats, 26 possums, 11 stoats, and 2 weasels were caught in kill traps.

Pindone 0.5g/kg cereal baits were used again this season to control Norway rats within the trapping area. Toxin was laid in 158 bait stations from early-September 2021. The stations were checked weekly, and a supply maintained through to mid-February when terns had left the colony (Figure 6).

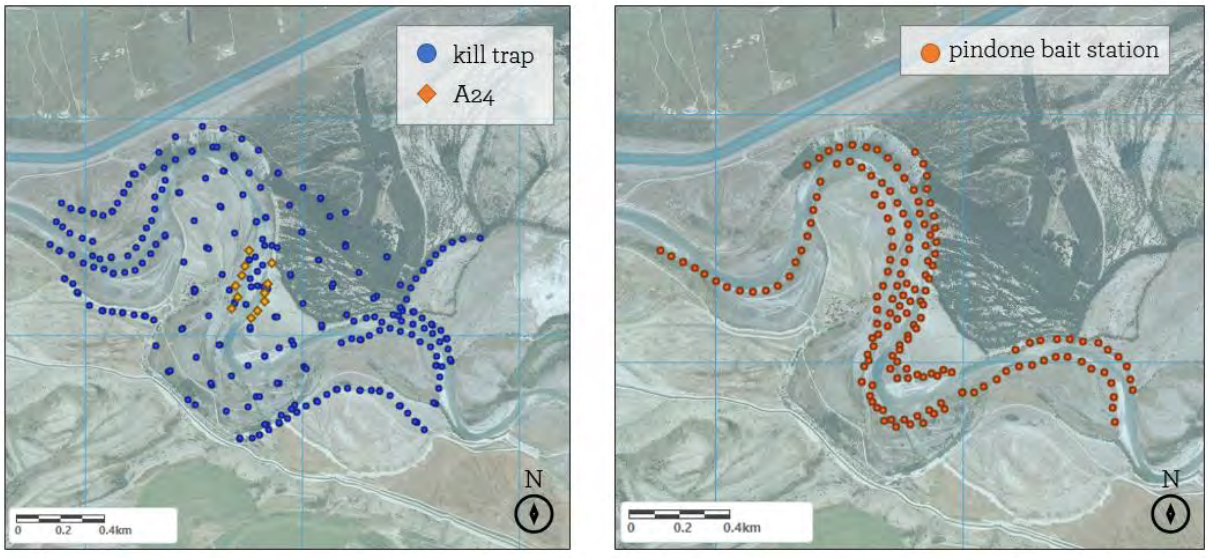

Figure 6. The network of kill traps (blue dots, left), A24s (orange diamonds, left) and bait stations (orange dots, right) established in the Upper Ōhau River to protect a population of Nationally Endangered tarapiroe/black

fronted terns. Basemap imagery sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

Additional predator control operations targeted feral cats and Norway rats. Spotlighting from August to October resulted in eight feral cat kills. No black-backed gull control was conducted this season. The rodent detection dog team searched the island and river edges up and down stream on three occasions (two days per visit) (Figure 7). The first two visits were preventative, and two rats were killed in late October. The third visit was in response to a rat incursion on Tern Island in early-December. The team located a nest on the island and killed the third rat. All rats killed were juvenile females.

Two seasons ago, an excavator removed all the vegetation from the island. Weed control targeting any regrowth was conducted twice on the island last year, before the terns arrived on the island, and at the end of the season. Weed control was conducted before the terns arrived for the 2021-22 season and after the season ended.

Figure 7. ***Left:*** **Locations of Norway rat kills (red), nests (purple), and live scent (cyan) located by Bail (Rodent dog) and handler Leona Kirk (Wildlife Protection Services) from October to December 2021.** ***Top right*****: Bail and nest located on Tern Island under a boulder.** ***Bottom-right:*** **Rat nest found by Bail (rodent dog) along the river. Photos: Leona Kirk.**

Black-fronted tern/ tarapirohe monitoring

This was the sixth season of nest monitoring on Tern Island since the trapping network scaled down in 2016 (Turner et al., 2022c). Monitoring intensity was higher this season compared to previous years with two observers surveying the island weekly.

Colony size was estimated by two methods: 1) weekly visual counts where an observer used binoculars to count birds on and in the air around Tern Island before each nest check and 2) doubling the maximum number of active nests per nest check after the season. The colony size peaked in early November (like last season) with 522 adult black-fronted terns (based on max. active nest count). A week after this peak, around 50 first years were seen on rocks in the true left channel near Tern Island (Figure 8).

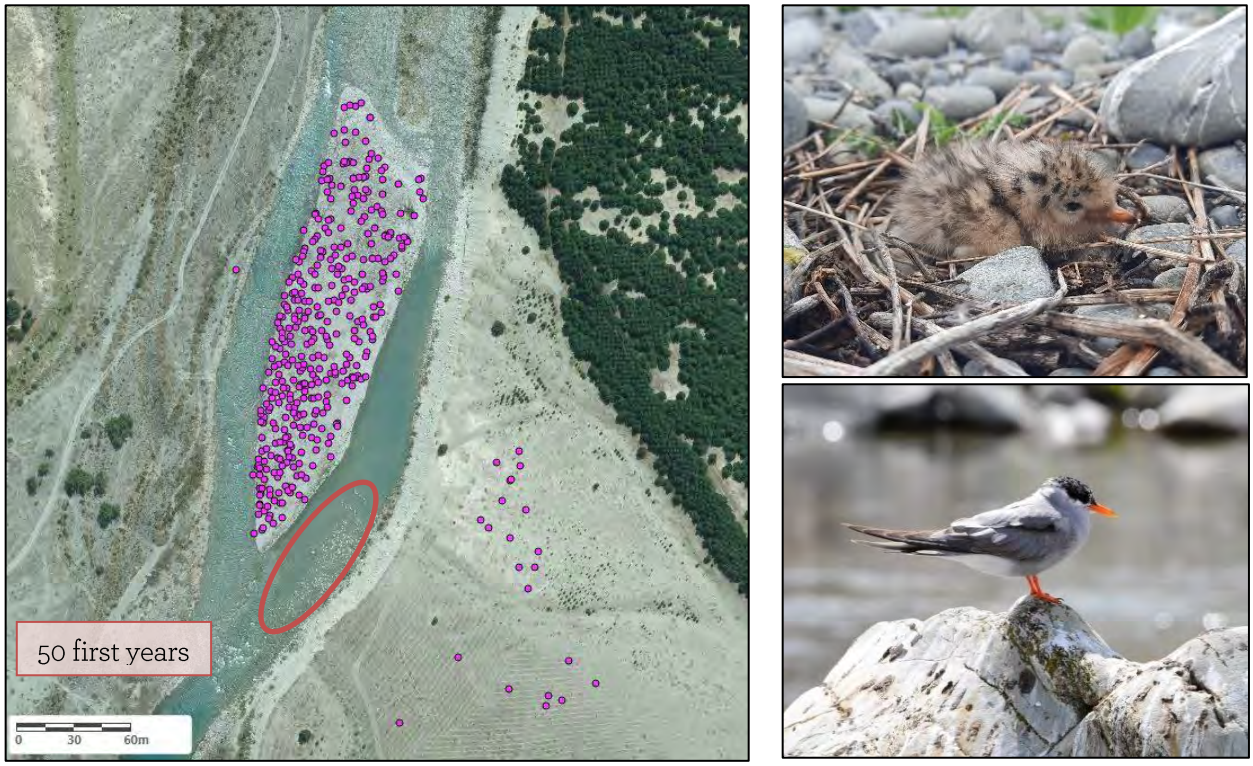

Figure 8. Left: Black-fronted tern nest locations on Tern Island (*n* = 400), true right terrace (*n* = 1), and true left upper terrace (*n* = 22) in the Upper Ōhau River in 2021 – 2022. 20 were re-clutches. Location of sighting of 50 first year terns (orange oval). Top right: Hatched tern chick. Bottom right: First year tern perched on rocks adjacent to Tern Island.

Nest monitoring involved thorough searches of the island where an observer walked half of the island (downstream to upstream) to find new nests and monitor each nest from eggs until hatching. Nests with guano present were considered as hatched. Six cameras also monitored active nests with eggs for predator surveillance and nest outcome. A total of 423 nests with 772 eggs were monitored this season. Of those nests 400 were on the island and 23 on the mainland. The hatching success rate of nests with known outcomes (295) was 68.8%, the highest since 2014 (Figure 10). A wide range of chicks were estimated to fledge (8-310) while at least 20 fledglings were seen in each nest check (Figure 9). Once chicks began to crèche, associating chicks and fledglings to nests was difficult. Chicks were found dead in nests with undetermined causes while dead fledglings were mostly predated.

Figure 9. An adult tern feeding its fledgling. Photos: Dean Nelson.

This season had the largest colony size and highest hatching success from the past six years. It was the second season since 2016 with breeding success where chicks fledged (Gale et al., 2020 & 2021a; Haultain, 2017b; Welch et al., 2018; Welch & Nelson, 2019). The addition of preventative actions, such as rodent dog visits, in combination with the established predator control network may contribute to the breeding success from the last two years.

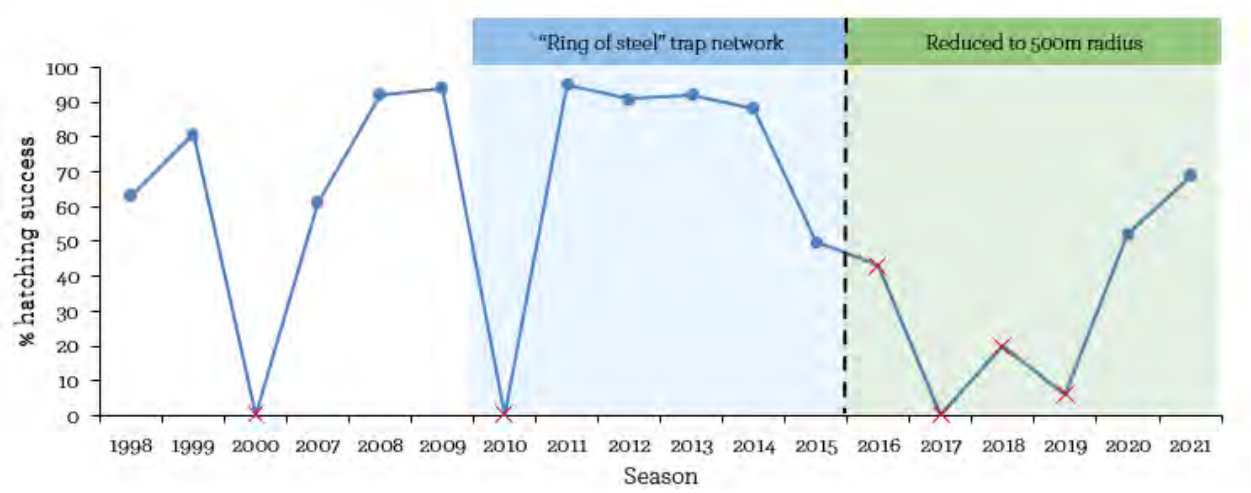

Figure 10. Hatching success of black-front terns nesting on Tern Island in the upper Ōhau river from 1998-2021. Blue: From 2010 to 2015 an intensive trapping network "Ring of steel" was set up in a 1-km radius of Tern Island. Green: In 2016 the trap network reduced 500m. *Red crosses* = colony failures. Note that monitoring effort has varied over the years.

GPS Transmitters

This season, 19 adult terns were fitted with a druid GPs transmitter harness and metal banded (Figure 11). Terns were captured using drop-catch traps set on active nests with eggs (Figure 11). PRR rangers were trained and supervised by Emma Williams on how to handle and safely attach the GPS harnesses securely.

Figure 11. Left: drop-catch trap for black-fronted terns. Right: attachment of GPS transmitter harness to an adult black-fronted tern from the Tern Island colony in the Upper Ōhau River. Photos: Dean Nelson

Lakes Skink Monitoring

Lakes skinks (*Oligosoma* aff. *chloronoton* "West Otago") are a Nationally Vulnerable taxonomically indeterminate, large-bodied lizard that inhabit the area from the Eyre Mountains in the south to the Pūkaki River in the north (Hitchmough et al., 2021). They were discovered along scree terraces in the Upper Ōhau River in 2013. Population monitoring began in 2016-17 to determine whether the population benefits from predator control established for protection of a nearby black-fronted tern colony (Lettink, 2016; Haultain 2017a; Schori et al., 2021). This year was the sixth year of population monitoring of Lakes skink at the site. Very few studies of lizard populations in New Zealand follow individuals in such detail. This dataset is also one of the longest running for lakes skinks in the world.

The population is monitored using an established line of 41 pitfall traps (spaced approximately 5m apart). This year, pitfall trapping was carried out over seven days in February. Traps were made of 4L plastic containers dug into the ground and baited with pieces of pear. To reduce thermal stress, a wet sponge and a handful of dampened moss was added to each pitfall. A wooden lid with spacers was placed on top of each trap, leaving a 2-3cm gap. Traps were opened during optimal weather windows (>12˚C, no rain) and checked daily. This season, traps were temporarily closed on day 3 due to poor weather. All captured skinks were given a temporary identification mark using a non-toxic permanent marker. This meant recaptured individuals could be easily identified. Morphological measurements were recorded and photographs of key features of each individual captured. An assessment will be made of whether natural markings can be used to identify individuals over multiple years.

A total of 47 Lakes skink captures were made over the trapping period, consisting of 42 unique individuals and 5 recaptures (of 3 individuals; Table 3). McCann's skinks (*Oligosoma maccanni*; 13 individuals) were also caught in the pitfall traps this season. Capture rates have varied dramatically in short time frames (2-4 years) while management and trapping effort has not changed (Figure 12).

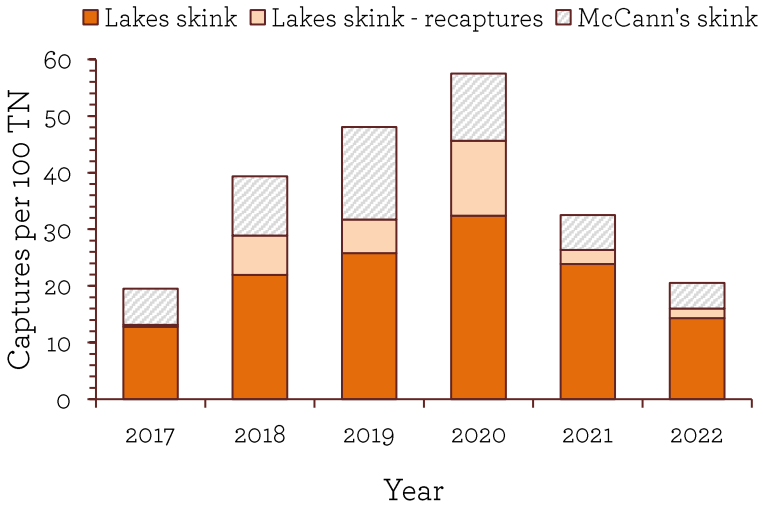

Figure 12. Left: The capture rates of unique lakes skinks (dark orange), recaptures (light orange) and other lizards (grey stripes) per 100 trap nights (TN) during pitfall trap monitoring since 2017 at the Upper Ōhau Lakes skink monitoring site. Total monitoring days were 7 for 2018-22 and 8 in 2017. Right: A lakes skink. Photo: PRR.

It was intended that the monitoring of the lakes skink population at this site would reveal whether predator control benefits this species (Haultain, 2017a; PRR, 2022). However, the lakes population now occurs on the perimeter of the predator control grid (rather than near the core) following the downscaling of the Upper Ōhau River trapping network (Turner et al., 2022a). Population monitoring will continue, and further planning will be undertaken to implement other management actions including habitat improvement and rodent-specific trapping to better understand how management actions benefit this species.

Table 3. A summary of details from annual lizard pitfall surveys in the Upper Ōhau River 2017-22.

	2017	2018	2019	2020	2021	2022
Total monitoring days	8	7	7	7	7	7
Total trap nights	328	287	287	287	243	287
Max temp(˚C)	17.3	22.7	36.5	37.7	39.6	38.2
Min temp (˚C)	6.9	8.9	10.2	1.1	4.2	5.4
Species captured	Lakes skink McCann's skink	Lakes skink McCann's skink Southern Alps gecko	Lakes skink McCann's skink Southern Alps gecko Cryptic/Grass skink	Lakes skink McCann's Cryptic skink	Lakes skink McCann's skink Southern Alps gecko	Lakes skink McCann's skink
Total captures and recaptures: All Lizards	64	114	145	167	79	60
Total unique captures: All Lizards	63	93	121	127	73	54
Total unique captures: Lakes skink	42	63	74	93	58	41
Total recaptures: Lakes skink	1	20	17	38	6	5
Other lizards	21	30	47	34	15	13
Average unique Lakes skink captures per day	5.3	9	10.6	13.3	10.3	5.9
Other lizards (per 100TN)	6.4	10.5	16.4	11.8	6.2	4.5
Lakes skink (recaptures, per 100TN)	0.3	7.0	5.9	13.2	2.5	1.7
Lakes skink (per 100TN)	12.8	22.0	25.8	32.4	23.9	14.3

Lake Alexandrina Southern Crested Grebe/kāmana

Lake Alexandrina is known as a stronghold for the Southern crested grebe/kāmana (*Podiceps cristatus*; Nationally Vulnerable). Crested grebe/kāmana generally make nests scattered around the lake and the nearby Lake McGregor on floating or semi-floating nests made of aquatic weeds and sticks, however in the 20/21 season, an unusual occurrence took place in the Lake Alexandra outlet stream. Possibly because of strong early season winds making nesting attempts unsuccessful, later in the season virtually all the population (peak of 40 nests) started breeding in a short 50 metres section of the outlet stream (Figure 13). With active nests sometimes only one metre apart in this small area, this made for an interesting visual spectacle with territorial disputes and breeding displays in regular evidence.

This season, the same behaviour took place, but it was even busier with a maximum number of 62 nests in mid-December. Once again, PRR supplied Campground Committee member, Graeme Murray with traps and bait and he maintained the servicing of the traps as well as running several of his own. Due to concerns about people's behaviour disturbing the birds, PRR installed new signage and put up a temporary fence around the area to keep people at a suitable distance. Feedback from local people was that this helped manage behaviour and although formal monitoring did not take place, numerous chicks appeared to fledge.

Figure 13. Four crested Grebe/kāmana nests within very close proximity to each other. Photo: Dean Nelson

4.3 Objective 3: Increase public awareness of braided rivers and associated wetlands within a changing environment

PRR's information resources continue to be updated and reprinted as necessary and distributed to schools, and other community groups, with the braided river multi-species poster and braided river field guide still proving to be popular.

PRR continued to support University of Otago Wildlife Management students. The students visited in April 2022 and PRR gave them practical exercises at Patersons Terrace, the Tasman River and Fraser Stream. Jen and Samantha met with children from Twizel Area School at the end of the 2021. The school group visited the Twin Lakes and looked at freshwater invertebrates and fish. The children learnt how to identify different insect orders and the diversity of insects in their local lakes. Throughout the year, PRR met with various stakeholders including Fish and Game, ECan and various private landholders.

Dean did some filming for a threatened species television series with hosts Pax Assadi and Nicola Toki. This was based around threatened galaxiid management in the Fraser Stream trout barrier site. At the time of writing this report, the screening date of this series is unknown.

Copies of the book *Rivers Rare*, written by Neville Peat in 2016 to celebrate the first 25 years of operation for PRR, are on sale in the Twizel and Tekapo bookstores and the Aoraki/Mt Cook Visitor's Centre. Due to the limited distribution of the book commercially, it is now regularly used as an advocacy tool by giving it to appropriate visitors and associates.

Stories and photos are regularly sent to Meridian Energy for social media articles (@meridianenergy on Instagram and Twitter).

4.4 Objective 4: Gain ecosystem knowledge in upper Waitaki rivers and wetlands through research and monitoring

Braided River Bird Surveys

PRR has continued its programme of riverbed bird counts. This is as part of a regular cycle of repeated surveys aimed at long-term monitoring of population trends in threatened, as well as more common braided river birds. In the early 1990s, PRR completed surveys of all the upper Waitaki rivers over three years. Currently, PRR sequentially re-surveys the rivers over three consecutive years on a rotational basis.

PRR uses standardised walk-through methodology to record counts of native (e.g., black-fronted terns, banded dotterels, wrybill) and non-native (e.g., Canadian geese) braided river birds and record GPS locations of nesting colonies and rare birds (e.g., kakī/black stilts). The standardised methodology allows the data collected to be compared directly with historic surveys, as well as other nation-wide braided river bird surveys. This allows PRR to improve the understanding of bird population changes over time in upper Waitaki rivers, as well contributing to information on species-wide dynamics at a national scale. This year, PRR surveyed the Hopkins, Dobson and Hakataramea Rivers for the second of three years (Schori, Turner & Nelson 2022a; Table 4).

Table 4. Braided river bird species recorded in walkthrough surveys of the Hakataramea, Hopkins and Dobson Rivers during the 2020 survey compared to the last time the river was surveyed. Data shows the minimum and maximum number of birds observed during the survey years.

Species, threat ranking*		Hakataramea River		Dobson River		Hopkins River	
		1982-83	2020-21	1992-94	2020-21	1992/93	2020-21
Australasian crested grebe/kāmana,	NV	0	0	0	0	0-1	0
Australasian shoveler/kuruwhengi,	NT	11-20	0	0	0	0-3	0
Banded dotterel/tūturiwhatu,	NV	80-92	2-6	9-82	51-86	1-63	38-42
Black-billed gull/tarāpuka,	NC	568-1056	0-20	0	0-20	0	4-7
Black-fronted tern/tarapirohe,	NE	42-97	7-52	2-55	30-79	1-21	52-81
Black shag/kawau,	NU	4-6	3-9	0-1	0-1	0-3	1-2
Black stilt/kakī,	NC	0	0	0	0	0-2	0-4
Black swan/kakīānau,	NT	0	0	0	0	0-22	1
Canada goose	I/N	0-9	47-79	6-47	15-28	0-175	49-55
Caspian tern/taranui,	NV	0	2	0-2	0	0-2	2-4
Grey duck/pārera,	NC	0-6	1-2	0-4	0	0-22	0-1
Grey teal/tētē,	NT	0	0	0	0	0-4	0-9
Hybrid stilt,	n/a	0	0	0-1	0	0-1	0
Indeterminate duck species,	n/a	0-20	48-52	0-5	1-3	0-41	6-14
Little shag/kawau paka,	NT	2-3	1-0	0	0	0-1	1
Mallard	I/N	140-89	9-16	0-6	2-12	0-3	0-15
New Zealand scaup/ pāpango,	NT	0	0	0	0	0-4	0
Paradise shelduck/pūtakitaki,	NT	49-120	50-56	4-52	12-36	5-61	25-26
Pied stilt/poaka,	NT	90-171	80-112	0-2	1-2	0-12	3-4
South Island pied oystercatcher/tōrea,	D	78-145	41-46	0-22	32-38	5-22	28-48
Southern black-backed gull/karoro,	NT	22-84	>100-304	3-63	56-76	5-70	247-284
Spur-winged plover,	NT	55-66	17-43	1-23	8-9	0-104	67-72
Swamp harrier/kāhu,	NT	0	6-9	0-1	0-4	0-5	0-3
White-faced heron/matuku,	NT	7-13	10-12	0	0	0	0-1
Wrybill/ngutuparore,	NV	0	0	0-17	28-36	0-54	23-34
Total number of species		16	17	16	14	23	21

*Threat ranking, from most to least threatened: Nationally Critical (NC), Nationally Endangered (NE), Nationally Vulnerable (NV), Declining (D), Naturally Uncommon (NU), Not Threatened (NT), Introduced and Naturalised (I/N).

Australasian Bittern/matuku hūrepo (*Botaurus poiciloptilus*)

The Australasian bittern/matuku hūrepo is a large, brown bird that is found throughout Australasia, including New Zealand, Australia, and New Caledonia. They inhabit wetlands and raupō-fringed lakes, feeding on fish, eels, frogs, lizards, and freshwater invertebrates including worms, spiders, insects, and molluscs. In recent decades, populations of Australasian bittern/matuku hūrepo have steeply declined, primarily because of habitat destruction but also due to pressure from predatory mammals. Up to 90% of their wetland habitat in New Zealand has been destroyed to develop farmland, and remaining wetlands are often of poor habitat quality because of water pollution or reduced food sources. Currently, Australasian bittern/matuku hūrepo are ranked as 'Nationally Critical' by the New Zealand Threat Classification System (Robertson et al., 2021; Townsend et al., 2008).

In the Mackenzie Basin, historic records from the 1930s-1970s show Australasian bittern/matuku hūrepo occurring on the shores of Lakes Benmore, Ōhau and Pūkaki, Alexandrina and Tekapō, and in the Ahuriri, Dobson and Pūkaki Rivers. Very little is known about the distribution and breeding of bitterns in the Mackenzie Basin today. Because visual observations are uncommon, the PRR team use ARDs (**A**coustic **R**ecording **D**evices;) to detect where breeding male bitterns were present. During the mating season, male bitterns produce a distinctive 'boom' (a sequence of between 1 and 10 '*wooooooom*' sounds in a row). This boom can be detected on a sound recording using specialised software. The PRR team deployed 22 ARDs to wetlands and raupō fringed lakes across the upper Waitaki Basin between October and December 2021. The acoustic recordings are being processed by the members of the National Science Team.

In 2019-20, successful detection of bittern booms was made in Ben Omar Wetlands, Temple Wetlands, and Waterwheel wetlands. In 2020-21, successful detection of bittern booms occurred in Ben Avon Wetlands Scenic Reserve., Temple Wetlands, Mt Gerald Wetlands, and Ruataniwha and Lower Ruataniwha wetlands. In 2021-22, successful detection of bittern booms occurred in Ben Avon Wetlands, Ruataniwha wetlands, Ben **Ō**hau Wetlands, McGregor Wetlands (1 & 2A) and Mailbox inlet (Figure 14).

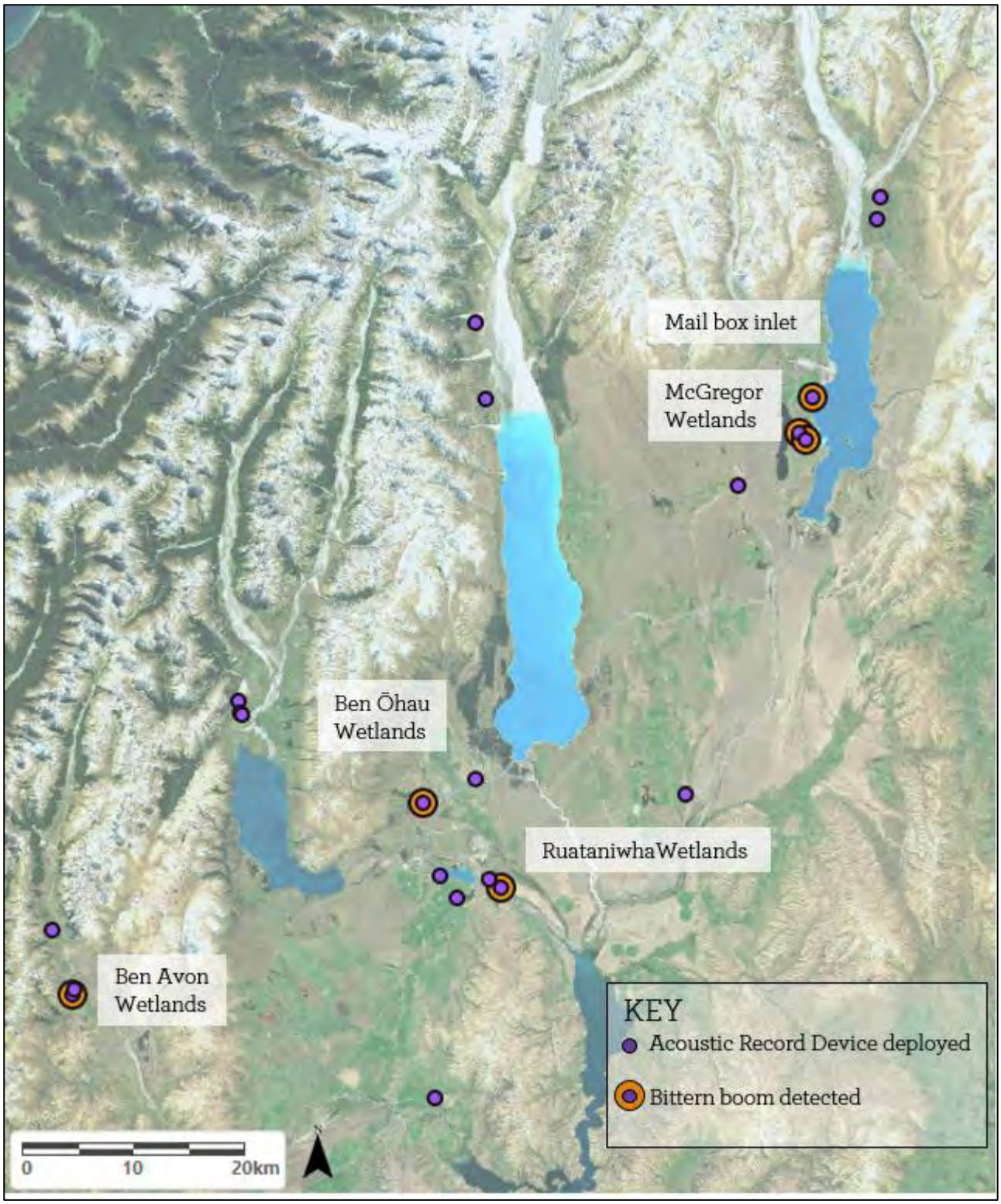

Figure 14. The locations where Acoustic Recording Devices (ARDs) were deployed (purple dot), and the six locations where bittern booms were detected (large orange dot with purple centre) across the Mackenzie Basin in 2021-22. Basemap imagery sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

Freshwater Fish

Objectives four and five include assisting with DOC's freshwater fish distributional surveys, monitoring fish populations and protection of fish species by appropriate installation of trout barriers and removal of invasive fish species.

There are three threatened fish species in the Te Manahuna Twizel district, and they are the focus of all work carried out (Nelson et al., 2022). The non-migratory, "pencil" galaxiid species are *Galaxias* aff. *cobitinis* "Waitaki", the Nationally Endangered lowland longjaw galaxias (hereafter referred to as 'lowland longjaw'); *Galaxias macronasus*, the Nationally Vulnerable bignose galaxias (referred to as 'bignose'); and *Galaxias* aff. *prognathus* "Waitaki", the Nationally Vulnerable upland longjaw galaxias (referred to as 'upland longjaw') (Dunn et al., 2017). Other species found in the district include *Anguilla dieffenbachii* (longfin eel, Declining), *Galaxias brevipinnis* (kōaro, Declining), *Galaxias vulgaris* (Canterbury galaxias, Declining), *Galaxias paucispondylus* (alpine galaxias, Naturally Uncommon) and the Not Threatened *Gobiomorphus breviceps* (upland bully) and *Gobiomorphus cotidianus* (common bully).

Galaxiids, particularly "pencil" species and juveniles, are prey of introduced species such as trout. PRR continues to maintain nine trout barriers to protect threatened native fish species across the basin. The spring-fed tributary of Fraser Stream is one site where populations of lowland longjaw and bignose galaxias are protected by a downstream trout-barrier. An electric fishing run-through in February caught a 300mm long brown trout which was rather concerning as trout had not been caught since November 2016. Due to changes in the Fraser main stem, flood waters are more inclined to back up over the trout barrier and clearly the discovery of numerous small trout in March indicated that spawning had taken place. Altogether 26 trout were removed during six visits. However, the annual monitoring in March found both populations of lowland longjaw and bignose galaxiids continuing to thrive, but macrophyte growth needs better management as it makes monitoring difficult (Figure 15).

Figure 15. *Left:* Samantha electric fishing under Dean's supervision at Otamatapiao Stream, May 2022. *Right:* Photo: Jennifer Schori. Dean removing macrophytes from Fraser stream, March 2022. Photo: Sjaan Bowie.

In March, PRR staff had two specialists from the National Freshwater Team and a Canterbury University student accompany them for a week of dedicated freshwater fish work. Work completed included the Fraser Stream annual monitoring and trout removal, Fork Stream tributaries trout removal (Figure 16) and removal of trout from a bignose site in the Otamatapaio River (Figure 15).

The Waterwheel Wetland trout barrier installed in May 2021 has now been confirmed as trout free above the barrier however as with other sites, macrophyte management in the springs is critical to maintaining the galaxiid spawning habitat. This bignose site may become a suitable candidate for translocation of lowland longjaw from the Fraser Stream site, with only 4 km separating the two sites. Also, another potential barrier site is being assessed within this spring-fed stream complex. If completed, this would double the amount of potential trout-free habitat for the galaxiid species.

Samantha began the first half of the season manning the nets before completing her electric fishing qualification in April with NIWA. She has been behind the fishing machine on recent trips and is developing her skills under Dean's guidance (Figure 15).

Figure 16. The team of netters from University of Canterbury, Environment Canterbury, and Department of Conservation during trout removal efforts at Forks stream in March 2022. Photo: Sjaan Bowie

Lake Benmore lizards

On the shores of Lake Benmore are four small gullies which hold relict populations of two species of Nationally Vulnerable skinks: Lakes skinks (*Oligosoma aff. chloronoton*) and Scree skinks (*Oligosoma waimatense*; Hitchmough et al., 2021; Figure 17). These two skink species were discovered at the gullies in 1997, and their persistence at the sites was confirmed in 2010 by herpetologist Marieke Lettink (Lettink, 2016). In 2019, significant weed control was undertaken at the site to remove a large portion of poplar (*Populus* sp.), willow (*Salix* sp.), silver birch (*Betula pendula*), and sweet briar (*Rosa rubiginosa*). These weedy species shade the gullies reducing the amount of sunlight available for skinks to bask in. They also provide cover and habitat for skink predators, and their leaf litter fills important gaps in the rocks that the skinks rely on to escape from predators.

This season was the third year of formal monitoring with the aim to obtain an index of abundance to determine the persistence of lakes and scree skinks at Lake Benmore (Marot, 2021; Turner et al., 2022b). A live-capture survey using 22 Gee-minnow traps was carried out over six days. Each Gee-minnows was baited with a small piece of tinned pear. To reduce thermal stress the bottom of the trap was covered with a small square of damp sponge and vegetation gathered from the immediate area to provide shelter and moisture. Any captured lizards were given a temporary ID using a non-toxic marker pen to determine whether we had captured them already during the trapping period. Key morphological traits, such as the body length between snout and vent, and the length of any tail that has regenerated, and weight were recorded for each lizard caught. Photographs of natural markings were also taken.

Figure 17. A Scree skink (left) and a Lakes skink (right) from the 2022 survey. Photos: Sam Turner and Jennifer Schori.

A total of 57 skinks and 3 southern alps geckos were captured this year. Total individual lakes and scree skink captures were 43 and 6, respectively (
Table **5**). The proportion of recaptured lakes skinks was higher this season compared to previous years with 11 recaptures of 8 individuals (25%), compared to 0 last year and 1 recapture in 2020 (Error! Reference source not found.). Capture rates (per 100TN) of individual lakes skinks were also higher this year, up to double previous years (Error! Reference source not found.). Tail regeneration/loss occurred in 76.7% of lakes skinks (33 individuals). Scree skink capture rates remained similar over the last 3 years (Error! Reference source not found.).

Despite the populations of lakes and scree skinks at Benmore Gullies being relatively easy to access from a management perspective, these small, isolated populations (likely relicts) are unlikely to be the best candidate for continued efforts to secure the long-term persistence of these species within the Mackenzie Basin/New Zealand. Therefore, monitoring at this site will be discontinued for now unless a purpose is identified with the lizard technical advice group.

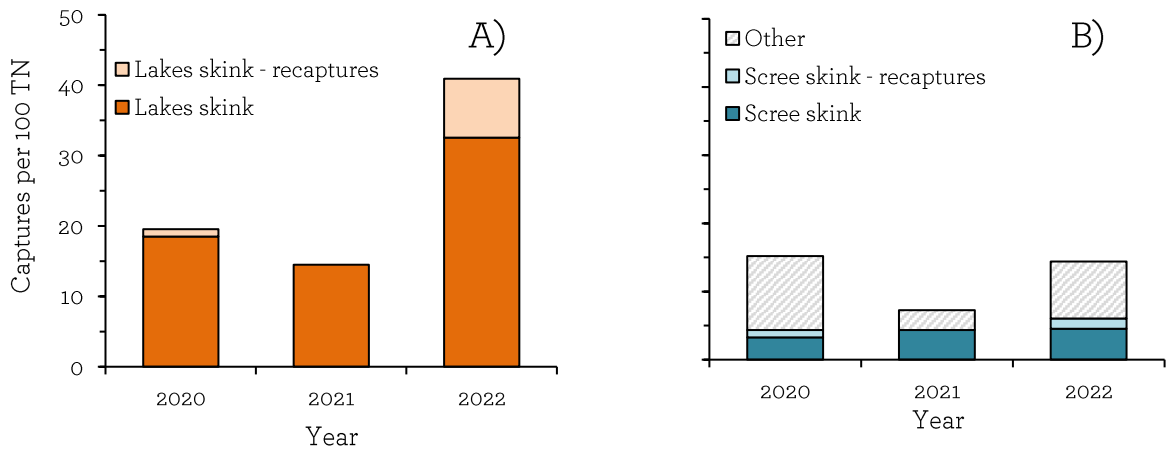

Figure 18. Gee-minow survey lizard captures per 100 trap nights (TN) at the Lake Benmore gullies sites from 2020 to 2022. A) Lakes skinks B) Scree skink and other common lizards including McCann's skink, Southern alps gecko and Southern grass skink. Trapping effort has varied since 2020 (92TN), to 2021 (69TN) and 2022 (132 TN).

Table 5. A summary of the Lakes and Scree skinks caught in Gee the Benmore Gullies in 2020 and 2021.

	2020	2021	2022
Total monitoring days	4	3	6
Gee-minnow traps (n)	23	23	22
Total trap nights	92	69	132
Lizard species caught	Lakes skink, Scree skink, McCann's skink, mokomoko/Southern Alps gecko	Lakes skink, Scree skink, McCann's skink, mokomoko/Southern Alps gecko	Lakes skink, Scree skink, McCann's skink, mokomoko/Southern Alps gecko, southern grass skink
Lakes skinks unique captures	17	10	43
Lakes skinks recaptures	1	0	11
Scree skinks unique captures	3	3	6
Scree skinks recaptures	1	0	2
Other lizards	10	2	11

Robust grasshopper (*Brachaspis robustus*)

The Nationally Endangered robust grasshopper (*Brachaspis robustus*) is a braided river specialist, found only on the gravels of riverbeds and their associated terraces in the Mackenzie Basin. This large, flightless grasshopper occurs in shades of greys and browns that blend in well to the rocks of the braided rivers (Figure 19). It is a generalist herbivore that feeds on lichens, mosses, and other leafy vegetation of the braided riverbeds.

Figure 19. A juvenile robust grasshopper basks on a lichen-covered rock in the Tekapō River. Photo: Jennifer Schori.

The robust grasshopper has been observed and monitored at various intensities by PRR and associated researchers since the 1990s. In 2017, an annual monitoring protocol was developed. It was first implemented in a collaborative effort between University of Canterbury researchers and students and Twizel DOC staff. The monitoring is conducted across six key populations of robust grasshopper, located in the Ōhau River, Forks Stream (incorporating the gravel pits and military land), Patersons Terrace, Pūkaki River, Snowy River, and Tekapō River. This year yielded some of the lowest population and adult female counts of *B. robustus* since monitoring began in 2017 (Schori, et al. 2022b; Figure 20). Each of the braided river sites, Snowy, Tekapō, Ōhau and Pūkaki Rivers, yielded fewer than 0.2 adult female grasshoppers per km (<1 individuals per 5km). The two least natural sites, Patersons Terrace and Forks, yielded the highest counts in 2021 (3.3 ± 0.3 SE and 2.3 ± 0.1 SE adult females per km, respectively), and have generally done so in previous years (Figure 20).

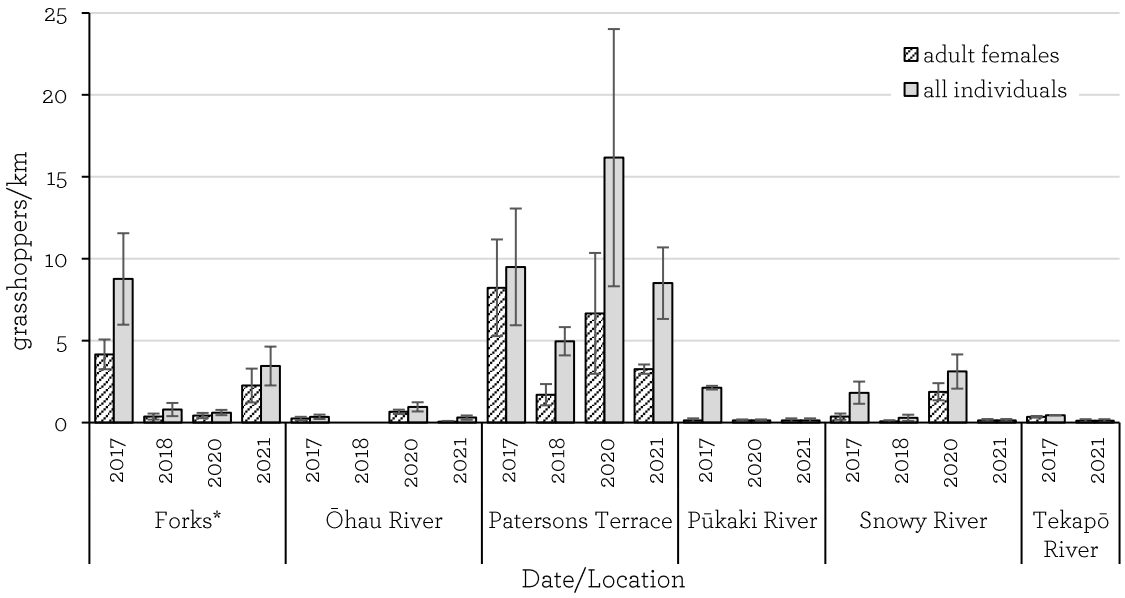

Figure 20. The mean number (±SE) of adult female and total robust grasshoppers per km at the Ōhau River, Forks (*including gravel pits and military land), Patersons Terrace, Pūkaki River and Snowy River between 2017 and 2021.

Distribution surveys were conducted in the Tekapō and Ōhau Rivers in March. These surveys involve observers walking the whole length of the river searching for robust grasshoppers to better understand distribution and how it may have changed over time. Fourteen individuals were sighted in the Tekapō River. However, for the second consecutive year none were found in the southern-most quarter of the river (of the

section surveyed between the Tekapō dam in the north and the gorge in the south). Eight grasshoppers were found in the Ōhau River, their distribution matching that of the historic known range.

Maniototo peppercress (*Lepidium solandri*)

Lepidium solandri, commonly known as Maniototo peppercress, is a unique species of dryland plant: it is dimorphic meaning that individuals are either male or female (Soza, 2014). *L. solandri*, and the closely related *Lepidium sisymbrioides*, are the only species to be dioecious in the Brassicaceae family (Soza, 2014).

In 2017, a notable decline in population sizes of *Lepidium solandri* (Maniototo peppercress) across the South Island led to a re-evaluation of its threat status to Nationally Critical (de Lange, 2017). Populations are threatened by competition from introduced weeds, browsing by mammals, and a large proportion of populations experience negative effects from the surrounding intensification of land-use, including irrigation (Allan, 2000). The largest remaining populations of *L. solandri* occur in the Mackenzie Basin, and PRR undertakes monitoring, seed collection, and propagation of this species to understand what is needed to secure its survival.

Monitoring of several key *L. solandri* populations throughout the Mackenzie Basin commenced in 2021. Five dryland sites were chosen for monitoring, based on known *L. solandri* occurrence. These sites included Ruataniwha Wetlands, Pūkaki Flats, Maryburn, Tekapō Military Reserve and Tekapō Scientific Reserve. These sites vary in their ecological composition, management, and proximity to heavily modified landscapes.

The monitoring plots were set up as 3m x 10m plots, divided into 1m x 1m quadrats (Error! Reference source not found.). In each quadrat, the percentage cover, sex, and locations of *L. solandri* plants were recorded. Percentage cover of other species and substrate types was also noted. *L. solandri* plants were counted individually to give a sum of individuals present within each plot. Overall, this study will provide us with a better understanding of *L. solandri* populations trends, and what key environmental factors are driving change.

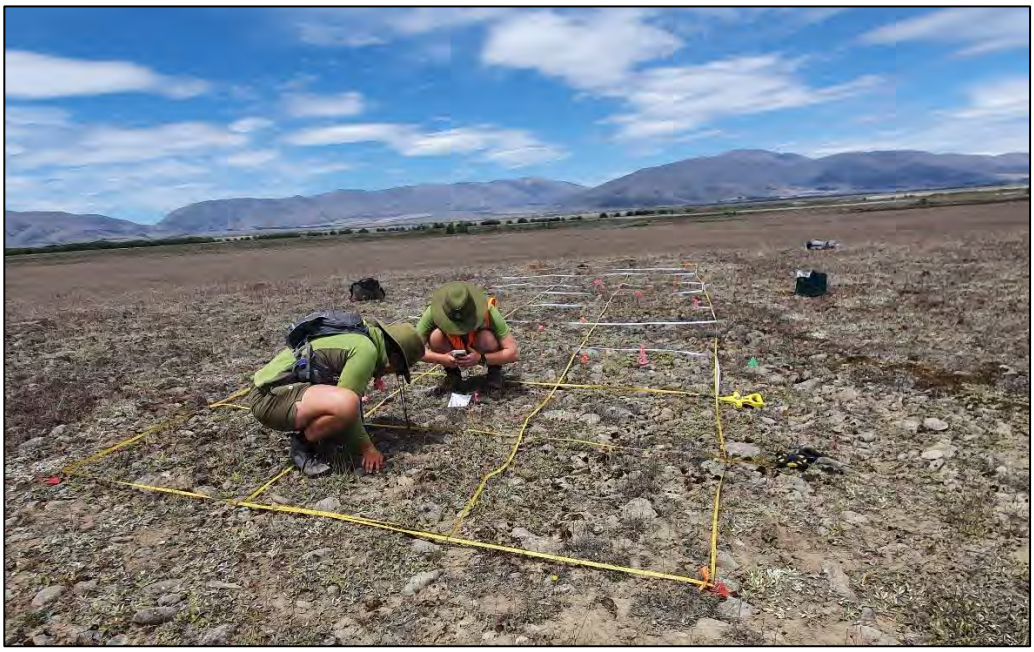

Figure 21. Tayla Hooker and Serena O'Brien monitoring one of the *Lepidium solandri* plots at Maryburn.

Additionally, this study provides an insight into the population dynamics of other threatened dryland plant species that occur within the plots. Other threatened species occurring across the five locations include the Nationally Vulnerable species *Convolvulus verecundus*, *Muehlenbeckia ephedroides* and *Raoulia monroi*, and the At Risk – Declining species *Colobanthus brevisepalus* and *Rytidosperma exiguum* (Error! Reference source not found.).

Figure 22. Top: a male *Lepdium solandri* in flower. Bottom, left to right: *Convolvulus verecundus, Raoulia monroi* and *Colobanthus brevisepalus*. Photos: Tayla Hooker.

Overall, only one more individual was found in 2022 compared to 2021 across all sites. However, populations fluctuated within site. More individuals were recorded at Maryburn and Tekapō Military in 2022 than 2021, but fewer were recorded at Pūkaki Flats and Tekapō Scientific Reserve. Ruataniwha's population remained stable across both years (Figure 23).

In 2022, a full plant inventory including percentage cover was recorded across all sites. It showed that all the sites varied greatly in their composition of native and non-native species, as well as substrate types. Observing the population trends of these native species will be important for understanding the threats, not only to *L. solandri* but the dryland ecosystem that hosts these rare plants.

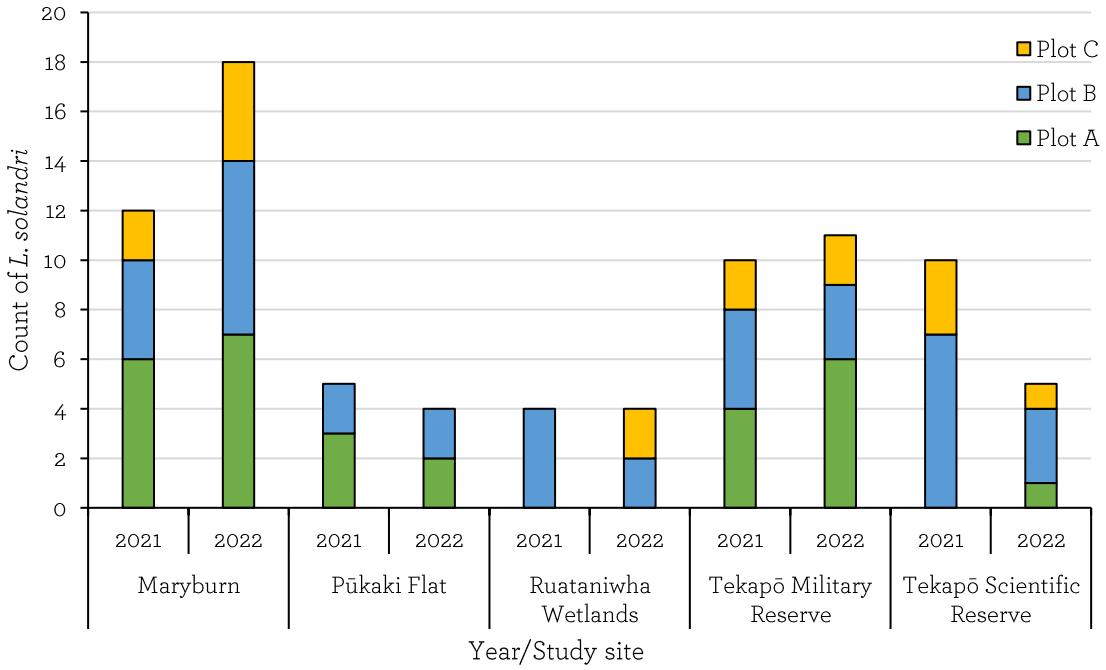

Figure 23. The number of *Lepidium solandri* individuals that were found in each plot (A, B, and C) at Maryburn, Pūkaki Flats, Ruataniwha Wetlands, Tekapō Military, and Tekapō Scientific Reserve in 2021 and 2022.

Alongside monitoring, seed collection has also been undertaken with the help of Susan Walker (Manaaki Whenua) and independent ecologist Mike Harding. Some of this seed has gone to Manaaki Whenua for the study of *Albugo*, a rust that has spread to some populations. Other seed has been collected and successfully propagated in a DOC Twizel nursery for future seed and planting trials.

The minute grasshopper (*Sigaus minutus*)

The minute grasshopper *Sigaus minutus* is a short-horned grasshopper, ranked as 'At Risk: Declining' in the New Zealand Threat Classification System (Townsend et al., 2008; Trewick et al., 2012; Figure 24). It is endemic to the Mackenzie Basin, most often found along the Ahuriri, Pūkaki and Ōhau Rivers, Edwards Stream, and around Lake Pūkaki. It prefers younger river terraces with bare, stony ground, and is associated with native cushion and mat-forming plants, lichens and mosses (Davis, 1986). It does not occur with exotic weedy species including sweet briar.

Figure 24. Three of the colour variations of the minute grasshopper, *Sigaus minutus*. Photos: Samantha Turner.

To better understand the impact that changes in vegetation cover and composition have on *S. minutus*, population and vegetation monitoring occurs at three sites in the Mackenzie Basin: the Lower and Upper Ōhau Rivers, and the Tekapō Scientific Reserve. Since 2007, the population of *S. minutus* has been surveyed annually at each site, usually in February (Schori, Turner & Nelson, 2022b). The surveys include counts of all Orthoptera seen by the observers. Vegetation monitoring at the three sites occurs every three years, usually in autumn.

This season, *Sigaus minutus* were present in the highest mean abundance at Tekapō Scientific Reserve (143 ± 6.8 SE individuals) followed by the Upper Ōhau (84.3 ± 5.0 SE) and Lower Ōhau sites (3.3 ± 2.4 SE; Error! Reference source not found.). Each of the sites monitored has different dominant vegetation cover. The Tekapō Scientific Reserve site is generally comprised of low stature and mat forming plants, the Upper Ōhau River site is mostly grey gravels with sparse cover of lichens and mosses, and the Lower Ōhau River site is dominated by rank grass. The consistently low mean counts of *S. minutus* at the Lower Ōhau River site likely reflects the poor habitat quality at that site.

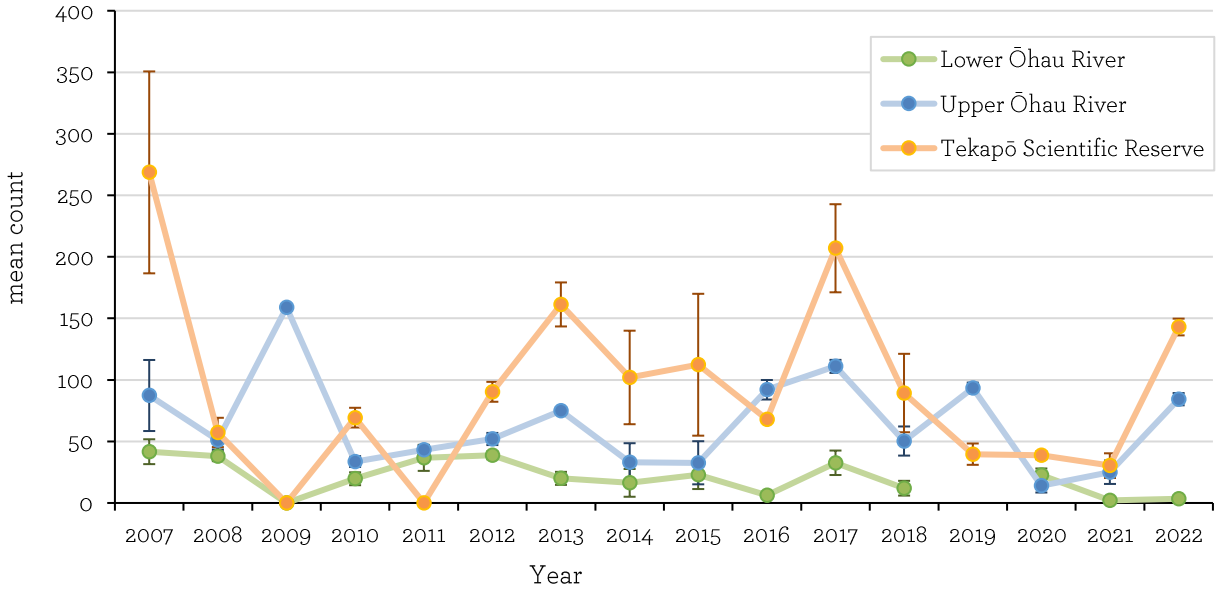

Figure 25. The mean count (± SE) of *Sigaus minutus* at the Lower Ōhau River (green), Upper Ōhau River (blue) and Tekapō Scientific Reserve (orange) during February surveys between 2007 and 2022. The Lower Ōhau site was not surveyed in 2019.

4.5 Objective 5: Protect and manage upper Waitaki wetlands

Originally, the ponds at Ruataniwha wetlands were created to provide habitat for kakī (*Himantopus novaezelandiae*) and other bird species, but management now focuses on benefiting several Nationally Threatened ephemeral plant species. Ephemeral plants are specialised to live in habitats that cycle through being dry and inundated with water, e.g., on the margins of ponds where water levels fluctuate throughout the year. Water levels within the Ruataniwha ponds are controlled by PRR: By adjusting the height of weirs at the outlet of each of pond we can manipulate the water level in each pond and manage the duration of drying and flooding events on the pond margins.

The species *Dysphania pusilla* is one of three threatened vascular plant species that occurs in the ephemeral zones at Ruataniwha wetlands. It was regarded as extinct until it's re-discovery at Ruataniwha wetlands and in parts of Marlborough in 2015 and 2016 (Clayton-Greene, 2015). It is now regarded as Nationally Endangered because most populations exist in habitats that are heavily grazed or that are susceptible to weed incursion. The population that occurs at Ruataniwha wetlands is an anomaly because the habitat is fenced off from grazing mammals, and weed incursion is managed by the fluctuating water levels.

The same year *D. pusilla* was re-discovered, the liverwort *Riccia cavernosa* was also discovered (Rebergen, 2017). This species had never been recorded in New Zealand and is currently accepted as a recent natural arrival from Australia where it resides in similar habitats to Ruataniwha wetlands (Rebergen, 2017). Currently, the population at Ruataniwha wetlands is the only known occurrence of this species in New Zealand. The other threatened species occurring in the ephemeral habitats of Ruataniwha are *Centipeda minima subsp minima* (Nationally Endangered) and *Isolepis basillaris* (At Risk – Declining).

In 2021, PRR began monitoring plants in the ephemeral zones at Ruataniwha wetlands to better understand how the changing water levels affects their distribution and abundance. Two transects were established on the wetland margins, and a third was added in 2022. At each transect, three strata (at low-, middle- and high-water levels) were monitored. The vegetation cover along each stratum was surveyed using quadrats, recording the surface cover (%), plant species cover (%), and total count of threatened plants plant species (vascular and non-vascular), water depth and/or moisture index and soil pH (where possible). Photo points were set up in strategic locations to capture a visual record of how water levels were changing in each of the monitoring sites each month (Figure 26). Our aim is to determine the optimal water level regime (i.e., the duration and timing of flooding and drying periods) in the ephemeral zones to benefit native threatened plant species.

Figure 26. An example of an image captured from one of the photopoints established at Ruataniwha wetlands in 2021 (photopoint 5).

Transect three has the highest native flora of all the three transects. The highest amount of bare ground (or 'substrate') is found on transect 1, making it the most suitable habitat for *D. pusilla*. Transect 2 is consistently the weediest of the transects, has the lowest substrate and native cover of the three transects (Figure 27).

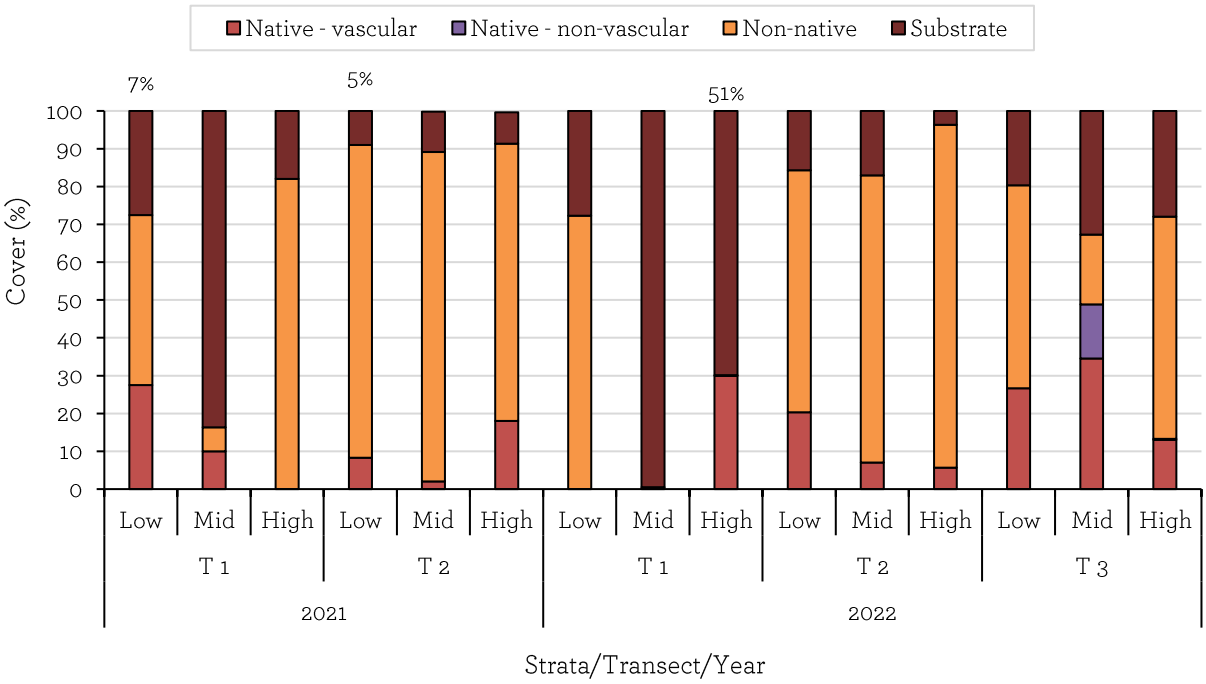

Figure 27. The mean percentage cover type (n = 3) recorded at each strata (low, mid, high) within each transect (T1-3) in 2021 and 2022. The third transect was added in 2022. The mean percentage of water cover during each survey is stated above each bar but substrate and plant cover was still recorded if under water.

The highest native diversity within the three transects was found in Transect 3, with a total of nine species, followed by Transect 1 (four species) and Transect 2 (three species;

Table 6). Identification of *Centipeda aotearana* and *Centipeda minima* subsp. *minima* is difficult, so some work needs to be done in clarifying where the species are in Ruataniwha. The highest number of threatened taxa were present on Transect 3 (namely, *C. aotearana,* Naturally Uncommon; and *I. basilaris,* Declining).

This year, *D. pusilla* and *I. basilaris* were absent from Transect 1 despite being recorded in 2021 (Gale and Hooker, 2021) and observations of *D. pusilla* elsewhere in Ruataniwha wetlands (Tayla Hooker, pers. obs.). These changes can be mainly attributed to the variations in water levels. If water levels are left too high for too long, some species may not have the chance to appear, but weed cover will be very low. On the other hand, if water levels are left low for too long, ephemeral species will develop earlier but weeds will be able to establish and will be dominant when the survey is conducted. Weed incursion is the primary threat to the ephemeral taxa at Ruataniwha, and as we continue this study, we will better understand what water management regime will result in the lowest density of weeds and the highest density of bare substrate and native flora.

Table 6. The mean percentage cover of native vascular and non-vascular plant species recorded at each stratum (low-, mid- and high-water levels) at the three transect monitoring sites (T1, T2, T3) at Ruataniwha wetlands in 2022.

Species/threat ranking*		% Cover								
		Transect 1			Transect 2			Transect 3		
		Low	Mid	High	Low	Mid	High	Low	Mid	High
Argentina anserinoides,	NT	-	-	-	2.3	-	3.7	3.3	0.3	0.7
Azolla rubra,	NT	-	-	0.3	-	-	-	-	-	-
Carex maorica,	NT	-	-	-	-	-	-	-	-	-
Carex secta,	NT	-	-	-	17.3	-	-	-	-	-
Centipeda aotearoana,	NU	-	-	-	-	-	-	1.7	2.8	0.3
Crassula sinclarii,	NT	-	-	-	-	-	-	0.3	3.0	-
Dysphania pusilla,	NE	-	-	-	-	-	-	-	-	-
Glossostigma elatinoides,	NT	-	-	-	-	-	-	-	-	-
Hydrocotyle sulcata,	NT	-	-	-	-	-	-	13.3	18.3	6.7
Isolepis basilaris,	D	-	-	-	-	-	-	6.7	-	5.3
Lemna disperma,	NT	-	-	0.5	-	-	-	-	-	-
Limosella lineata,	NT	-	0.5	0.2	-	-	-	0.3	8.3	-
Myriophyllum propinquum,	NT	-	-	-	-	-	-	-	-	-
Myriophyllum triphyllum,	NT	-	-	29.0	-	-	-	0.7	1.7	-
Pseudognaphalium luteoalbum,	NT	-	-	-	0.7	7.0	2.0	0.3	-	-
Riccia cavernosa,	†	-	-	-	-	-	-	-	14.3	0.3
Total % cover of native species		0.0	0.5	30.0	20.3	7.0	5.7	26.7	48.8	13.3
Total number of native species		0	1	4	3	1	2	8	7	5
Total number of threatened species		0	0	0	0	0	0	2	1	2

*Threat ranking, from most to least threatened: Nationally Critical (NC), Nationally Endangered (NE), Nationally Vulnerable (NV), Declining (D), Naturally Uncommon (NU), Not Threatened (NT), Introduced and Naturalised (I/N).
† Threat status not published.

4.6 Objective 6: Facilitate research by various agencies, including universities, to improve our understanding of the ecology of braided river systems

In 2016, PRR determined that funding should be used to facilitate research by University students or other researchers into relevant management issues associated with braided rivers and wetlands. To support decisions on how best to use this research fund, PRR staff are working towards developing a database of research ideas in collaboration with Richard Maloney, the DOC technical advisor for braided riverbeds. This will be a working document of approximately 50 projects which align with PRR's six strategic goals and investigate relevant management issues associated with braided rivers and wetlands or the ecology of their fauna and flora. Projects will be prioritised, allowing PRR to easily determine the most critical research to be conducted which can then be advertised to universities and independent researchers. They will vary in size and required expertise to target a range of different research levels (undergraduate through to post-doctoral).

During this year, PRR contributed to one ongoing project. Invertebrates collected and sorted as part of the Tasman River Invertebrate Study have been given to Lincoln University to hold as part of their nationally available reference collection. This year $7000 in funding was provided for a student to sort further reference specimens that were collected as part of the study.

5 Project River Recovery's relationship with the Te Manahuna Aoraki Project

November 2018 saw the official launch of the Te Manahuna Aoraki (TMA) Project – a landscape scale conservation project focusing on restoring the natural landscapes and threatened species of the upper Mackenzie Basin and Aoraki/Mt Cook National Park. The project will enhance biodiversity across 310,000 ha of land including braided river systems and alpine habitats. As such, there is some overlap with PRR on the rivers, wetlands, and lakeshores in the project area from the Ben Ōhau Range in the West to the Two Thumb Range in the East. This includes some of our major lakes and rivers including Lakes Pūkaki and Tekapō and the Tasman, Cass, Godley and Macaulay Rivers and Fork Stream. PRR will work in collaboration with TMA to gain ecosystem knowledge in overlapping areas. As part of the TMA Project, the Cass, Godley, and Macaulay River bird surveys will be conducted on an annual basis and PRR will provide support on these as required and share knowledge gained from surveys of other species undertaken in overlapping areas. PRR will also provide support in outcome monitoring of these riverbeds as required. TMA staff will endeavour provide support to PRR on river bird surveys elsewhere in the basin.

6 Project River Recovery's financial support for the Kakī programme

Traditionally kakī have not been part of the PRR programme; however, over recent years, PRR has become more involved by funding the operational cost of the Tasman Predator Control programme which was fundamentally driven by the need to secure and increase the kakī population. Results of the Tasman Predator Control programme are reported in the PRR Annual Reports. Kakī are seen as the flagship species for the protection and recovery of braided rivers in the Mackenzie Basin and if kakī are increasing in the wild, this reflects better survival of other populations of braided river bird, lizard, and invertebrate species.

In 2017, following consultation with Meridian and Genesis, PRR contributed $60,000 from its Trust Account towards the construction of a new kakī brooder facility. The new eight bay brooder facility was built to remove the current bottleneck in brooder facilities by doubling the brooder capacity and maximising the production of chicks to fully utilise the capacity of the new aviary. This new facility has been key to improved efficiency in the whole captive breeding programme. A total of 151 chicks were hatched this season from eggs gathered from wild breeding pairs or laid in captivity.

6 Project River Recovery's financial statements 1st July 2021 – 30th June 2022

Project River Recovery spent $588,421 in the 2021-2022 financial year. PRR's revenue and expenditure for the 2021-2022 financial year is itemised in Table 7.

Table 7. Project River Recovery statement of financial performance for year ending 30th June 2022.

	2022 ($k)	2021 ($k)	2020 ($k)	2019 ($k)	2018 ($k)	2017 ($k)	2016 ($k)	2015 ($k)	2014 ($k)	2013 ($k)	2012 ($k)	2011 ($k)	2010 ($k)
REVENUE													
Stakeholder Transfers from revenue in advance	588	465	554	544	539	513	528	495	516	492	499	485	472
Other revenue	0	16	0	0	0	0	0	10	18	37	0	0	0
TOTAL REVENUE	**588**	**481**	**554**	**544**	**539**	**513**	**528**	**505**	**534**	**529**	**499**	**485**	**472**
EXPENDITURE													
Personnel costs													
Salaries	139	104	113	83	44	80	125	117	138	138	140	129	119
Wages	37	13	57	15	50	51	48	39	3	0	2	1	12
Other Personnel	3	0	0	0	0	0	-3	0	1	0	-3	-2	6
Total personnel costs	179	117	**170**	**98**	**93**	**132**	**170**	**156**	**141**	**138**	**139**	**128**	**137**
Administration costs													
Accommodation	20	0	20	20	22	20	20	27	27	27	27	26	26
Total administration costs	20	0	**20**	**20**	**22**	**20**	**20**	**27**	**27**	**27**	**27**	**26**	**26**
Operating costs													
Professional fees/contracts	7	32	5	8	5	1	11	1	6	5	1	9	2
Travel	0	2	2	1	3	1	1	3	2	1	1	1	7
Vehicle expenses	28	4	36	34	35	36	36	35	39	40	41	42	38
Field operations	351	325	319	382	371	321	289	281	316	306	278	273	260
Information and publicity	3	1	2	1	1	2	1	2	1	2	1	4	6
Grants and miscellaneous	0	0	0	0	8	0	1	0	3	10	11	2	3
Total operating costs	390	364	**363**	**426**	**424**	**361**	**338**	**322**	**367**	**364**	**333**	**331**	**316**
TOTAL EXPENDITURE	**588**	**481**	**554**	**544**	**539**	**513**	**528**	**505**	**535**	**529**	**499**	**485**	**479**
NET SURPLUS (DEFICIT)	0	0	**0**	**0**	**0**	**0**	**-1**	**0**	**-1**	**0**	**0**	**0**	**-7**

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