PROJECT RIVER RECOVERY INTERNAL REPORT 2021/01

Godley Delta River Braids. Photo: Dave Murray

Project River Recovery Annual Report

01 July 2020 to 30 June 2021

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Department of Conservation
Te Papa Atawhai

New Zealand Government

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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 2020 to 30th of June 2021.
- 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 2132 hours of targeted, ground-based spot spraying of weeds was carried out by PRR staff and contractors in eleven main sites: Tekapō, Ōhau, Ahuriri, and Pukaki Rivers, Ruataniwha wetland, Lake Poaka, Lake Ōhau, Ōhau Canal and three other sites; Tern Island, Lindis Pass and some lizard habitat in gullies beside Lake Benmore. However 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.
- This marked the seventeenth 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, 419 hedgehogs, 318 rabbits, 257 stoats, 116 cats, 23 ferrets, 21 weasels, 20 rats, 16 possums and 11 mice were caught. An additional 27 cats and four possums were located and destroyed over eight nights of spotlighting.
- The programme of intensive predator trapping around the black-fronted tern colony in the upper Ōhau River continued for the twelve year.
  - Over the year, a total of 99 hedgehogs, 163 rabbits, 73 ferrets, 36 cats, 18 rats, 13 possums, nine stoats, and two weasels were caught.
  - As many as 330 black-fronted tern/tarapirohe returned to the island for breeding this year. 318 eggs were monitored and by the end of the season, at least 53 fledglings had been sighted on the island. At least a total of 111 chicks were estimated to have fledged this season.
- Walk-through riverbed bird counts were completed on the Hopkins, Dobson, and Hakataramea Rivers. This is the first time that these rivers had been surveyed in 26, 27 and 38 years respectively.
- PRR continued to support a nation-wide bittern/matuku hūrepo study by deploying Acoustic Recording Devices in 20 locations across the basin. In 2020-21, seven of those locations returned positive detections of bitterns.
- Ongoing Galaxiid monitoring and/or trout removal was carried out above the trout barriers at Fraser stream, Corbies Creek, Fork Stream and Omarama Station. A new Environment Canterbury funded trout barrier was installed in the true right of Waterwheel Wetland spring-fed stream this year to protect bignose galaxias.
- 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.
- PRR established annual monitoring plots at five populations of *Lepidium solandri* across the basin.
- Wetland management has included weed control and water-level manipulation at Waterwheel and Ruataniwha wetlands.
- Nearly $44,000 was used to facilitate research into improving our understanding of the ecology of braided river systems. Projects included braided river invertebrates, hedgehogs, and black-fronted tern/tarapirohe.
- PRR spent $481,000 in the 2020-21 financial year. This is less than previous years for reasons outlined in the report below.

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 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 2020 to 30th of June 2021.

2 Staff

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

Sam Gale continued in her role as PRR's biodiversity ranger until June 2021. She was responsible for delivering much of PRR's biodiversity work this year, including monitoring the black-fronted tern/tarapirohe in the upper Ōhau River, organising the braided river bird surveys and the lizard monitoring, and initiating a multi-faceted approach for *Lepidium solandri* conservation. Recruitment for Sam's replacement has been completed and another Sam (Samantha Turner) joins the team.

Jennifer Schori joined PRR as the second biodiversity ranger in September 2020. She brings a background in threatened insect conservation and managed this season's grasshopper work.

Connor Hines joined PRR as the combined DOC/PRR weeds control ranger in November 2020. He brings with him more than three years of weed control experience.

Marianne Marot continues to support PRR's work. She helped conduct the skink monitoring at the Benmore Gullies and Upper Ōhau River and had a key role in establishing and maintaining the *Lepidium solandri* nursery.

Predator control work in the Upper Ōhau River and much of the Tasman River continues to be serviced by Ecological Contracting Services Limited. Larger scale weed control was again undertaken by contractor OK Vegetation Control.

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

4.1.1 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. The rationale for selection of priority sites and their locations are set out in PRR's weed control plan (Woolmore, 2004).

As a result of additional funding from Land Information New Zealand (LINZ), Te Manahuna Aoraki (TMA) carried out all 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. Consequently, PRR continued its ongoing programme of weed control in other areas outside of the TMA operational area, however this reduced spend on contractors contributed a significant amount to the overall underspend this year.

$15,000 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 $20,000.

As follow-up to the PRR, ECan and Fish and Game joint project to control alder and willow, further alder spraying was undertaken by contractors and a large area of dead standing trees was machine mulched. Partly this was to allay concerns that floods in the Twizel River might cause dead branches to be carried down and block the culvert under the canal but also to compare the recovery of the area in the mulched block versus areas with dead standing trees. The area mulched was on dry land whereas much of the remaining area of dead standing trees has streams and wetlands running through it which would be significantly impacted by the mulching machine.

Following the arrival of false tamarisk (*Myricaria germanica*) in early 2016 DOC staff and contractors have been controlling scattered plants on the Tasman, Cass, and Godley Rivers, returning to previously GPS'ed sites in the first instance. Not previously known to occur south of the Rangitata River, false tamarisk is a problem weed as it prefers braided riverbeds and, like many other weeds, it can alter or reduce the habitat in these areas for nesting birds. False tamarisk is highly invasive as it can tolerate flooding and may even thrive

during these periods by spreading to new areas. It has fluffy, wind-borne seeds which can easily disperse and PRR will aim to prevent its spread in the upper Waitaki.

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

4.2.1 Tasman River

4.2.1.1 Predator control

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. 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.

The 2020-21 season was the seventeenth year of operation at the site, with a total of 700 DOC150s, 311 DOC250s (Figure 1), 310 Conibear traps, and 77 Timms traps. Between 1 July 2020 and 31st May 2021, 401 hedgehogs (*Erinaceus europaeus occidentalis*), 318 rabbits (*Oryctolagus cuniculus*), 203 stoats (*Mustela erminea*), 73 cats (*Felis catus*), 21 weasels (*M. nivalis vulgaris*), 19 ferrets (*M. furo*), 20 rats (*Rattus* spp.), 11 mice (*Mus musculus*) and three possums (*Trichosurus vulpecula*) were caught by the extensive trapping network. Between 30th April and 29th May, the trapping network was supplemented with 530 Victor leg-hold traps which are checked on a daily basis. Theses traps caught 54 stoats, 43 cats, 18 hedgehogs, 13 possums and 4 ferrets. An additional 27 cats and four possums were located and destroyed over eight nights of spotlighting.

Figure 1. DOC 250 trap set on the Tasman River. Photo: Dean Nelson

4.2.1.2 Southern Black-backed gull control

Nest camera footage collected from the Tasman over recent 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 (Figure 2). 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. Not all SBBG colonies are found in riverbeds, with significant colonies controlled over the last couple of years on Maryburn and the Wolds Stations and inside New Zealand Defence Force (NZDF) land in the head waters of Irishman Creek.

In the 2020-21 season, as part of it's brief around predator control, TMA controlled SBBGs in the Tasman, Murchison, Cass, and Godley Rivers, Fork Stream, on the Wolds Station and NZDF land, and around Lake Alexandrina (1056 SBBGs destroyed). PRR did SBBG control in the Tekapō and lower Pūkaki Rivers (804) and the Hopkins, Huxley, and Dobson Rivers (159).

Figure 2. Wrybill/ngutuparore, one of the braided river species being protected by black-backed gull control. They frequently look upwards to check for avian predators. Photo: Dean Nelson

4.2.1.3 Outcome Monitoring

The species selected for monitoring this year was black-fronted tern/tarapirohe and outcome monitoring this season followed the breeding success of 35 nests. Of the monitored nests, 68.6% hatched at least one chick.

This year's hatching success (0.83) was the highest since 2017-18. Between 0 and 38 chicks fledged. Mean fledgling success was on par with the previous year (0.465 vs. 0.485 in the previous year), whilst mean breeding success was the highest of the previous two years (0.385 vs. 0.13 and 0.23 in 2019-20 and 2018-19 respectively).

4.2.2 Upper Ōhau River/Tern Island

Black-fronted tern/tarapirohe is a small, nationally endangered tern species endemic to New Zealand (Robertson et al., 2016). 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).

4.2.2.1 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 to test if black-fronted tern/tarapirohe breeding success can be maintained at the high levels seen since the project commence, 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 2020-21 season marks the twelve year of predator control operations in the upper Ōhau River. The kill trap network currently consists of 127 DOC 150s (double sets), 118 DOC 250s, 54 Twizel cat traps, 21 Belisle Super X 220 traps, 20 modified Timms, 18 Warrior traps and 12 Goodnature A24 traps (Gale et al. 2021; Figure 3). Traps were checked weekly during the tern breeding season (September 2020 until terns left the island in early February 2021) 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 2020 to 28 February 2021, 99 hedgehogs, 163 rabbits, 73 ferrets, 36 cats, 18 rats, 13 possums, 9 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 late-August 2020. The stations were checked weekly, and a supply maintained through to mid-February when terns had left the colony (Figure 3).

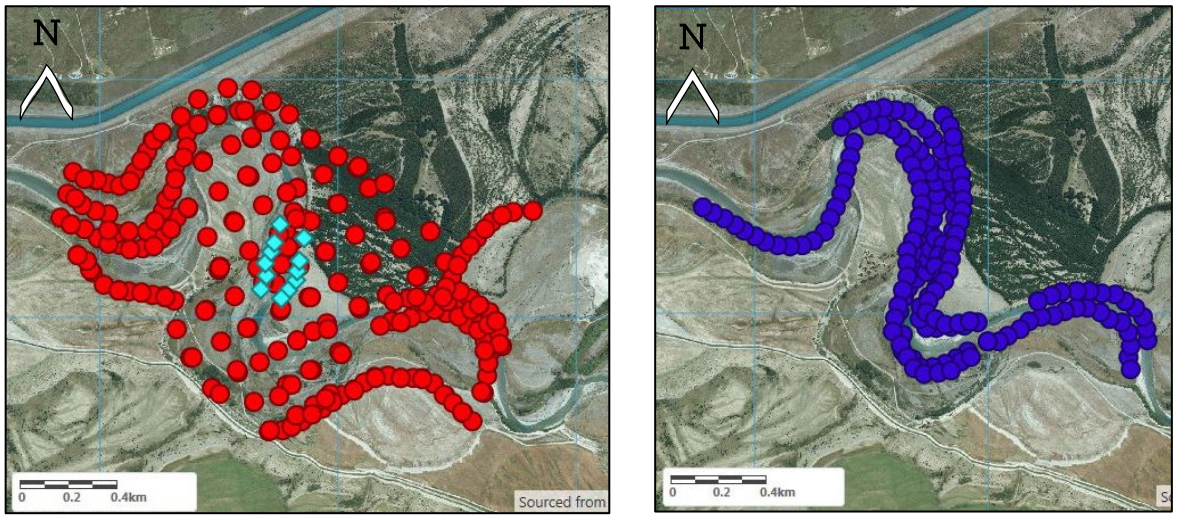

Figure 3. The network of kill traps (red dots, left), A24s (teal diamons, left) and bait stations (blue dots, right) established in the Upper Ōhau River to protect a population of Nationally Endnagered tarapiroe/black fronted terns. Basemap imagery sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

Additional shooting operations targeting feral cats and SBBG took place from September to February, and September to December respectively. Ten cats, and seven gulls were culled. Different teams of predator detection dogs targeting rats, and mustelids (specifically stoats) were deployed on five occasions between mid-September and late December (Figure 4). The dogs found a total of 20 rats, including two active rat nests. All rats were Norwegian rats and were euthanised when found. The dogs also detected one stoat den on the bank adjacent to Tern Island.

Following the use of an excavator last season to remove all vegetation from the island, weed control targeting any regrowth was conducted twice on the island this year, before the terns arrived on the island, and at the end of the season.

Figure 4. The rodent dogs from Wildlife Protection Services searching for evidence of Norwegian rats around the upper Ōhau River. Photo: Leona Kirk

4.2.2.2 Black-fronted tern/ tarapirohe monitoring

This season followed a less intensive monitoring method as recommended in the 2016 review of the project (Haultain, 2017b; Maloney, 2016; Welch et al., 2018). The total number of birds present on tern island was counted during weekly (± 3 days) visits from the beginning of August, with any notable behaviours recorded (e.g., courtship, nest building, nest behaviour). Counts included the total number of birds on the ground and in the air and were completed with a single sweep of the island using binoculars from the centre rock on the island. Counts were mostly undertaken by a single observer.

A sample of nests on the island were selected for intensive monitoring throughout the season and were checked on weekly visits to the island. Reconyx Hyperfire™ Professional PC900 trail cameras were set up at nests to determine some nest outcomes. Ground truthing the number of nests on the island to estimate the total number of nests across the season was not undertaken this year, because it was too difficult to clearly identify individual scrapes due to the large number of nest scrape remnants and guano.

This year was the most successful breeding season of the past five years (Gale et al., 2021). Birds started arriving at the island in early August, with eleven birds present during a visit to the island on 11th August. By early November, this number had peaked at 330 adult terns. This was the largest number of adult terns observed at the island in the past three years.

Where possible, each nesting attempt was monitored closely. However, by mid-November there were too many nesting attempts, and a sub-sample of five new nests per week were included for intensive monitoring. A total of 176 nesting attempts on the island were monitored, which was 169% more nests than were monitored in the previous year. 318 eggs were monitored, of which 52% hatched. This was greatest hatching success since 2014, when 82% of eggs hatched. It was difficult to estimate the number of tern chicks on the island, because the chicks can hide themselves extremely well in the boulders. At least 53 fledglings were seen and in total, 111 were estimated to be present (Figure 5). This was the first time that chicks have fledged in the past four breeding seasons (Gale et al., 2020; Haultain, 2017b; Welch et al., 2018; Welch & Nelson, 2019). The number of adult terns on the island began to decline in late December, and by the start of February all terns had left the island.

Figure 5. A black fronted tern/tarapirohe fledgling at Tern Island. Photo: Sam Gale.

4.2.2.3 Lakes Skink Monitoring

Lakes skink (*Oligosoma* aff. *chloronoton* "West Otago"; Nationally Vulnerable; Figure 6) monitoring was undertaken within the upper Ōhau predator control area again this year to assess whether the predator control is having a positive benefit on species other than black-fronted tern/tarapirohe (Haultain, 2017a). This was the fifth year of monitoring this species at this site (Schori et al., 2021a). Lakes skinks are a taxonomically indeterminate, large-bodied lizard that inhabit the area from the Eyre Mountains in the south to the Pūkaki River in the north.

In a section of scree slope within the control area, forty-one pitfall traps spaced at five metre intervals were left open for seven consecutive days of surveying in February 2021. Traps were baited with pieces of pear (canned in syrup), contained a handful of wet moss gathered from the surrounding area to reduce thermal stress to captured animals, and were covered with wooden lids (20cm x 20cm square) leaving an opening of approximately 2-3cm between the lid and top of the trap at ground level. All skinks captured were temporarily

marked with a non-toxic permanent marker (allowing recaptures within the survey period to be easily identified, Figure 6), had their morphological measurements recorded, and were photographed to assess the potential of using natural markings for identification of individuals among seasons (Figure 6).

Figure 6. The dorsal surface of the Lakes skinks (top) and the side of the head (bottom right) showing the patterning of spots that is thought to be unique to each individual, and an example of the temporary number written on the belly of each of the caputed lakes skinks (bottom left) used to identify whether the skink has been previously caught in the survey period. Photos: Marianne Marot and Sam Gale

A total of 64 Lakes skink captures were made over the trapping period, consisting of 58 unique individuals and six recaptures (of five individuals; Table 1). A range of size classes were captured, indicating a healthy population structure and regular births. McCann's skinks (*Oligosoma maccanni*; 14 individuals) and Southern Alps geckos (*Woodworthia* sp. 'Southern Alps'; 1 individual) were also caught in the pitfall traps this season.

With natural body markings being unique among individuals, we are investigating the plausibility of using a series of photographs taken of each individual captured (left, right and posterior sides of the head) to identify recaptures among seasons (Haultain, 2017a). While natural markings are stable within the survey period, their stability among seasons is uncertain and requires further investigation. If natural markings do remain stable among seasons, this would be useful for future mark-recapture survey work and help in making estimates of the size of the upper Ōhau population. This is the only population of Lakes skink currently being studied and one of the few studies of lizard populations in New Zealand looking at individuals in such detail.

Continued monitoring at the upper Ōhau River site is recommended to improve our understanding of the relative abundance and population trends for this species. This population is unique in that it is a relatively accessible site with abundant Lakes skinks. Ideally, monitoring should be introduced at another similar un-trapped site nearby (a "control" site) to determine how predator control may be influencing the upper Ōhau population specifically, however to date, no other population has been found. To allow for future monitoring at the site to be easily carried out, pitfall traps are left in place with fitted lids secured to prevent skinks entering outside the survey period and filled with rocks to allow escape should the lids become dislodged.

Table 1. Comparison of the lizard cature data within the Upper Ōhau predator control site for the previous five years of monitoring using pitfall traps.

	2021	2020	2019	2018	2017
Total monitoring days	7	7	7	7	8
Maximum temperature (°C)	39.6	37.7	36.5	22.7	17.3
Minimum temperature (°C)	4.2	1.1	10.2	8.9	6.9
Species captured	Lakes skink, McCann's skink, Southern Alps gecko	Lakes skink, McCann's and Grass skink	Lakes skink, McCann's skink, Southern Alps gecko, Grass skink	Lakes skink, McCann's skink, Southern Alps gecko	Lakes skink, McCann's skink
Total captures (all lizard types and recaptures)	79	167	145	114	64
Total unique captures (all lizard types)	73	127	121	93	63
Total unique Lakes skink captures	58	93	74	63	42
Average unique Lakes skink captures per day	10.29	13.28	10.57	9	5.25
Lakes skink recaptures	6	38	17	20	1

4.2.3 Lake Alexandrina Southern Crested Grebe/kāmana

Lake Alexandrina is known as a stronghold for the Southern crested grebe/kāmana (*Podiceps cristatus*; Nationally Vulnerable; Figure 7). 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 an unusual occurrence took place this season 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 started breeding in a short 50 metres section of the outlet stream. On 22nd January there were 15 nests, and they reached their peak of 40 nests in early February and then finished off in mid to late March. 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.

Figure 7. Southern crested grebe/ kāmana on nest. Photo: Dean Nelson

Concern from local batch owners about the number of ferrets and stoats in the area led to PRR staff installing six double-set DOC 150 traps and up to ten DOC250 traps in the vicinity of the stream. Weekly trap checks were conducted, and time was spent talking to interested observers and photographers. Later, a campground

Committee member, Graeme Murray took over the servicing of the traps as well as running several of his own. Interestingly while regular sightings of stoats were seen in the area, only one was caught and this was after the birds had finished nesting, possibly due to the abundance of rabbits for food in the area. However trapping over 17 weeks resulted in 28 ferrets, 18 Norway rats, 25 hedgehogs, 1 weasel, 1 stoat and 1 cat being caught.

While formal monitoring of the nests was not carried out, staff observations noted numerous fledged chicks, and this should result in a significant boost to the population.

4.2.4 Para-aminopropiophenone (PAPP) bait field trials

DOC is working with project partner Connovation Ltd to develop ways to use the toxin PAPP as a landscape control tool to remove stoats and feral cats. PRR provided staff support to field test non-toxic chicken and rabbit sausage baits in the Pukaki River area. Baits were hand laid in June and trail cameras were positioned to capture which animals ate the baits. Initial indications were that cats ate the baits, however ongoing issues with particle size of the raw PAPP, which is affecting possibly both palatability and efficacy, has put a hold on further field trials.

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 the annual University of Otago Wildlife Management student visit in April 2020 by giving them practical exercises at the Fraser Stream freshwater fish site and in the Tasman River. In May, Jennifer visited Tekapō Kindergarten to teach the children about the robust grasshopper. Throughout the year, PRR met with various stakeholders including Fish and Game, ECan and various private landholders.

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

4.4.1 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, and while the resources to continue re-surveying in this way are not currently available, groups of generally two rivers are being sequentially re-surveyed over three consecutive years on a rotational basis.

PRR surveys of riverbed birds use standardised walk-through methodology, allowing the data collected to be compared directly with other riverbed bird surveys around the country. 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 (Gale, Schori, & Nelson, 2021). This was the first time these rivers have been surveyed by PRR for 26, 27 and 38 years respectively. The Dobson River continued to have the greatest bird diversity of all three rivers, with 19 unique species observed

(compared to 15 and 14 unique species observed in the Hakataramea and Hopkins Rivers respectively; Table 2). It also supported the greatest number of Threatened (inclusive of species ranked Nationally Critical, Nationally Endangered and Nationally Vulnerable) and At Risk (inclusive of species ranked Naturally Uncommon and Declining) bird species compared to the other two rivers surveyed. Unfortunately, the Dobson River had the greatest loss of general bird diversity when compared to the diversity recorded in the last survey (loss of four species (17% diversity) compared to two (12%), and one (6%) in the Hopkins and Hakataramea Rivers respectively). Pest species have increased substantially in abundance in the Hopkins (namely, Canada geese) and Hakataramea Rivers (namely, Canada geese and SBBG). These rivers will be surveyed again for the next two years, to complete the three-year survey cycle. Until the survey cycle is complete, and trends observed, any conclusions remain preliminary.

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 which PRR is a major contributor to (Figure 8; see section 4.2.1). PRR staff organise this survey and the results for this season's survey conducted in November are compared with previous seasons in Table 3.

Figure 8. Black-fronted tern/tarapirohe counted as part of the Tasman River bird survey. Photo: Dean Nelson

Table 2. 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 by PRR. Historic data shows the minimum and maximum number of birds observed.

Species, threat ranking*		Hakataramea River		Dobson River		Hopkins River	
		1982-83	2020	1992-94	2020	1992/93	2020
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	6	9-82	51	1-63	38
Black-billed gull/tarāpuka,	NC	568-1056	0	0	20	0	4
Black-fronted tern/tarapirohe,	NE	42-97	7	2-55	30	1-21	52
Black shag/kawau,	NU	4-6	9	0-1	1	0-3	2
Black stilt/kakī,	NC	0	0	0	0	0-2	4
Black swan/kakīānau,	NT	0	0	0	0	0-22	1
Canada goose	I/N	0-9	79	6-47	28	0-175	49
Caspian tern/taranui,	NV	0	2	0-2	0	0-2	4
Grey duck/pārera,	NC	0-6	2	0-4	0	0-22	1
Grey teal/tētē,	NT	0	0	0	0	0-4	9
Hybrid stilt,	n/a	0	0	0-1	0	0-1	0
Indeterminate duck species,	n/a	0-20	52	0-5	3	0-41	14
Little shag/kawau paka,	NT	2-3	0	0	0	0-1	1
Mallard	I/N	140-89	9	0-6	12	0-3	0
New Zealand scaup/ pāpango,	NT	0	0	0	0	0-4	0
Paradise shelduck/pūtakitaki,	NT	49-120	56	4-52	36	5-61	26
Pied stilt/poaka,	NT	90-171	80	0-2	1	0-12	3
South Island pied oystercatcher/tōrea,	D	78-145	46	0-22	32	5-22	28
Southern black-backed gull/karoro,	NT	22-84	304	3-63	56	5-70	284
Spur-winged plover,	NT	55-66	17	1-23	9	0-104	72
Swamp harrier/kāhu,	NT	0	9	0-1	4	0-5	3
White-faced heron/matuku,	NT	7-13	10	0	0	0	0
Wrybill/ngutuparore,	NV	0	0	0-17	28	0-54	23
Total number of species		16	15	16	14	23	19

*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).

Table 3. Bird survey results on the Tasman River 1992-2020. 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 2020 season are highlighted in bold

Species, threat ranking*		1992-1994 (Range)	2004-2014 (Range)	2017	2018	2019	**2020**
Banded dotterel/tūturiwhatu,	NV	565 (523-599)	658 (395-858)	741	946	710	**568**
Black stilt/kakī,	NC	2 (1-5)	11 (2-32)	17	8	7	**2**
Black-backed gull/karoro,	NT	585 (537-609)	240 (95-413)	64	53	60	**29**
Black-billed gull/tarāpuka,	NC	13 (7-25)	25 (5-113)	135	218	160	**60**
Black-fronted tern/tarapirohe,	NE	121 (79-175)	137 (47-217)	648	245	464	**192**
Caspian tern/taranui,	NV	2 (2-2)	1 (0-3)	2	0	2	**3**
Hybrid stilt,	n/a	4 (1-9)	4 (0-10)	0	3	0	**0**
Pied stilt/poaka,	NT	17 (12-21	11 (0-54)	1	8	8	**5**
South Island pied oystercatcher/tōrea,	D	60 (46-76)	72 (52-109)	81	115	62	**65**
Spurwing plover,	NT	19 (17-23)	20 (5-37)	6	25	10	**14**
Swamp harrier/kāhu,	NT	5 (0-11)	3 (1-3)	0	4	9	**0**
Waterfowl and shags,	n/a	366 (334-407)	406 (177-842)	310	494	260	**154**
White-faced heron/matuku,	NT	2 (1-2)	1 (0-3)	1	7	0	**1**
Wrybill/ngutuparore,	NV	133 (120-151)	110 (32-165)	126	133	148	**122**

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

4.4.2 Australasian Bittern/matuku hūrepo (*Botaurus poiciloptilus*)

The Australasian bittern/matuku hūrepo is a large, stocky brown bird that is found throughout Australasia, including New Zealand, Australia, and New Caledonia (Figure 9). 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., 2016; Townsend et al., 2008).

Figure 9. The Australasian bittern/matuku hūrepo in flight (left; photo by Peter Langlands/Wild Capture ©). The Acoustic Recording Device (ARD) deployed on the shore of Lake Ruataniwha, where an Australasian bittern boom was recorded in October and November 2020 (right; photo by Sam Gale).

Australasian bittern/matuku hūrepo are shy birds and as they tend to move slowly through their habitat, their plumage blends in excellently with the wetland reeds and raupō. When disturbed, they will either retreat silently, or will stand completely still with their neck and beak pointing straight up towards the sky. In this pose, they blend extremely well into their habitat. These birds are rarely sighted, in part because their habitat is often difficult to access, but also because of their secretive behaviour.

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; Figure 9) 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 20 ARDs to wetlands and raupō fringed lakes across the upper Waitaki Basin between October and December 2020. The acoustic recordings are being processed by the members of the National Science Team.

In 2019-20, successful detection of bittern booms were 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 (Figure 10).

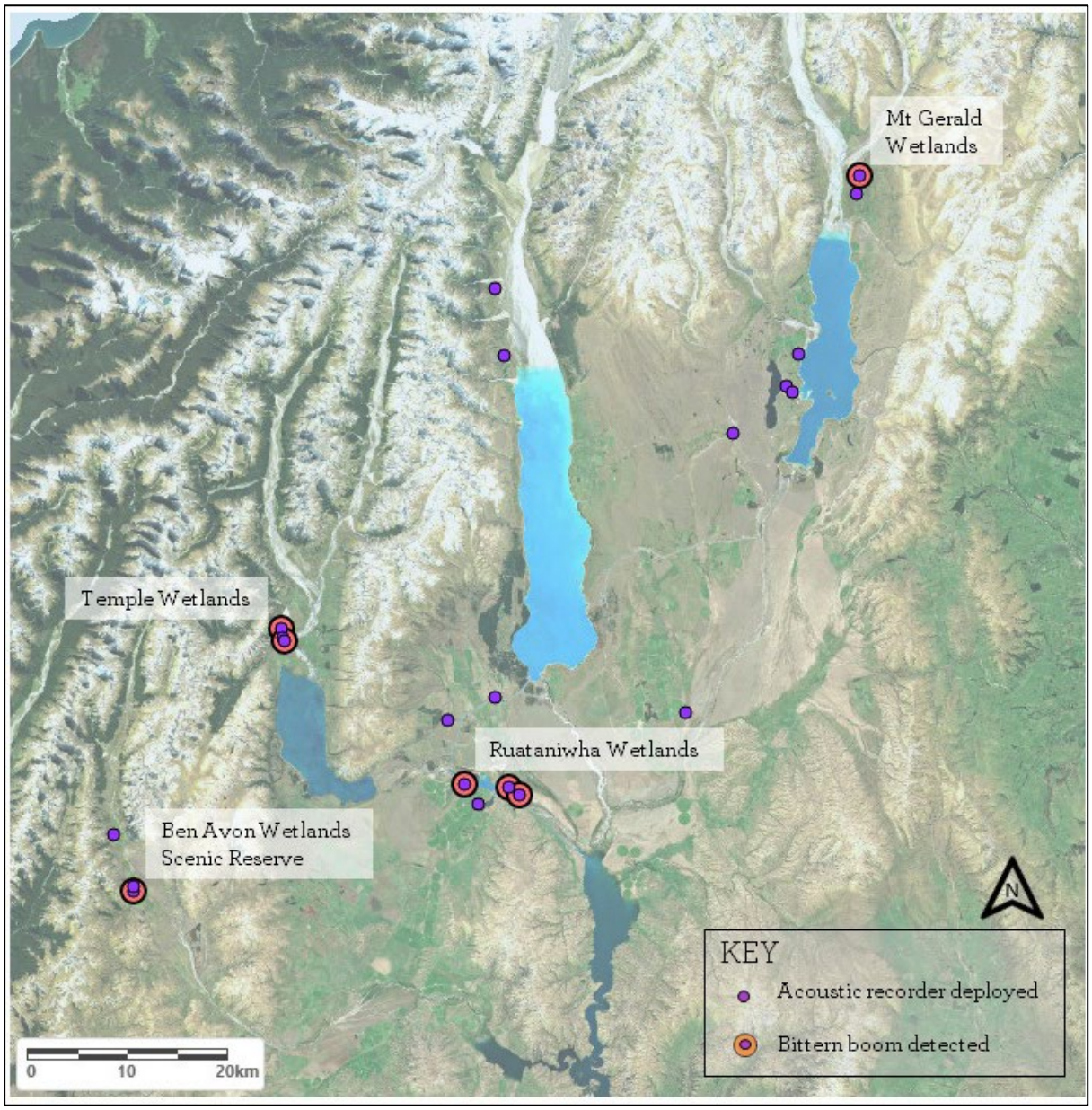

Figure 10. The locations where Acoustic Recording Devices (ARDs) were deployed (purple dot), and the seven locations where bittern booms were detected (large orange dot with purple centre) across the Mackenzie Basin in 2020-21. Basemap imagery sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

4.4.3 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., 2021). 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'). 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).

The freshwater fish season began with both PRR rangers gaining their electric fishing qualifications. They were trained and examined by Richard Allibone and developed their skills during the year.

In March, PRR staff accompanied a team of five specialists from the National Freshwater Team for a week of dedicated freshwater fish surveys in the Mackenzie Basin. The work conducted included the annual monitoring of the Fraser Stream site (lowland longjaw and bignose), re-surveying Edward Stream for lowland longjaw and bignose, upland longjaw surveys in the Hopkins and Dobson Rivers and a visit to the Chain Hills spring-fed system (lowland longjaw and bignose). Water levels in the Edward stream were low, and several spring sites with historic records of lowland longjaws had dried up. Only a few lowland longjaws were found in any of remaining historic sites, however bignose were caught at several sites. Both species of fish have the ability to burrow down in the gravel to survive in the underlying water table, so this survey needs to be undertaken again when water levels are higher in the catchment.

Upland longjaws were found in both the Hopkins and Dobson Rivers with averages of 2.53 and 8.63 upland longjaws caught per site fished respectively. Chain Hills was surveyed for the first time since December 2015. The team found this site difficult to fish because of the density of macrophytes and the depth of water and mud. Despite the challenges, the team found 10 bignose across four fished sites, and sighted some other galaxiids. The team ran out of time to fish the main stem but will return next season to fish the lower reaches and control macrophytes in the numerous spring heads.

Galaxiids, particularly "pencil" species and juveniles, are prey of introduced species such as trout. PRR continues to install and maintain 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. Annual monitoring found both populations continuing to thrive, but macrophyte growth needs better management as it makes monitoring difficult.

Several hundred fry were seen upstream of the trout barrier at Corbies Creek, however the site was severely overgrown with macrophytes. PRR visited the site to remove macrophytes twice over the summer. Omarama Station has a perched culvert barrier to protect lowland longjaws and bignose in a spring-fed stream feeding into the Ahuriri River, and the fencing around the spring area was recently extended to exclude livestock from more habitat. Gee-minnow traps were used to survey at this site, but only upland bullies were caught. More work is required around macrophyte control at this site to make the habitat more suitable for the galaxiids.

A new ECan funded trout barrier was constructed in the true right side of the Waterwheel Wetland spring-fed streams (Figure 11) late in the year and some trout removal work was undertaken. Once trout are completely removed, 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. A Rūnanga team supported by ECan staff completed significant trout removal from the true left spring-fed tributary of Fork Stream as part of a Te Manahuna Aoraki (TMA) funded project. They removed 711 brown trout and 196 rainbow trout from upstream of the trout barrier.

A spring-fed tributary in the Upper Otamatapaio River has a small, metre high waterfall which was inspected to confirm that it has maintained its integrity as a natural trout barrier protecting lowland longjaw and bignose galaxias. Eight bignose were caught in the pool directly above the waterfall, including two that were 90 and 92mm in length. This is the top of the size range for this species, which normally grow to a maximum of about 80mm in length. Another natural waterfall barrier further downstream was compromised by floods in 2017. Bignose galaxias were still found upstream of this waterfall despite trout invading the site following the flood. They appear to have survived by inhabiting the very upper reaches of the springs in

water too shallow for trout. A significant start was made to removing trout with two visits to electric fish them out of the system.

Figure 11. New perched culvert trout barrier to protect bignose galaxias in Waterwheel Wetlands spring fed stream. Photo: Dean Nelson

This year, PRR have incorporated the use of Environmental DNA (eDNA) into their monitoring of selected sites. eDNA is a relatively new technology that requires a water sample to be taken from the site. The sample is processed to extract DNA, and then analysed to identify which species are present in the stream. It can be used to identify species of fish, macroinvertebrates, plants, birds and mammals. This technology is particularly useful for confirming whether all trout have been removed upstream of a trout barrier. eDNA samples were collected from the Fraser Stream site as part of training by Richard Allibone. Samples were also collected from the two spring sites on Omarama Station, Corbies Creek, Ruataniwha Wetlands, and the old lowland longjaw site in the lower Ōhau River. Results seem to confirm that the Ruataniwha wetlands and lower Ōhau River site no longer contain lowland longjaws. ECan staff sampled the upper spring-fed system in Fork Stream and while a single sample from 13 collected indicated the presence of trout, this is considered to be a false positive result.

4.4.4 Lake Benmore lizards

On the shores of Lake Benmore, there are four small gullies which hold relict populations of two species of Nationally Vulnerable skinks; Lakes skink (*Oligosoma aff. Chloronoton* "West Otago") and scree skink (*Oligosoma waimatense*; Figure 12). These two skink species were discovered at the gullies in 1997, and their persistence at the sites was confirmed in 2010 by visiting herpetologist Marieke Lettink (Lettink, 2016).

Figure 12. Scree skink. Photo: Chris Woolmore

In 2019, significant weed control was undertaken at the site to remove 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. Follow up work was undertaken this season to control any regrowth.

This year, 23 Gee minnow traps were deployed across the four gullies to monitor the skink populations (Marot, 2021). The Gee minnows were baited with a small piece of tinned pear, the bottom of the trap covered with a layer of vegetation gathered from the immediate area to provide shelter for any captured animals. A small square of damp sponge was also put in the trap to provide captured animals with a source of moisture. Any lizards that were captured in the Gee-minnow were given a temporary ID using a non-toxic marker pen to allow us to determine whether we had captured them already during the trapping period. Key morphological traits, such as the length between snout and vent, and the length of any tail that has regenerated were recorded for each lizard caught, and photograph of natural markings were taken. Unfortunately, poor weather restricted the monitoring period to just three nights.

A total of fourteen skinks were captured over the 3-day survey, comprising of nine Lakes skinks, three scree skinks, one McCann's skink (*Oligosoma maccanni*) and one Southern Alps gecko (*Woodworthia* "Southern Alps"; Table 4). Lakes skinks were caught in three of the four gullies, but scree skinks were only found in one gully.

Table 4. A summary of the Lakes and Scree skinks caught in the Benmore Gullies in 2020 and 2021.

		2021	2020
Total monitoring days		3	4
Number of Gee-minnow traps		23	23
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
Total unique captures:	Lakes skinks	9	18
	Scree skinks	3	4
Number of recaptures:	Lakes skinks	0	1
	Scree skinks	0	1
Total number of lizards caught		14	29

4.4.5 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 (Figure 13). This large, flightless grasshopper occurs in shades of greys and browns that blend in well to the rocks of the braided rivers. It is a generalist herbivore that feeds on lichens, mosses, and other leafy vegetation of the braided river beds.

Figure 13. A male (top) and female (bottom) robust grasshopper *Brachaspis robustus* at Snowy River. Photo: Jennifer Schori

It has been observed and monitored at various intensities by PRR and associated researchers since the 1990s. In 2017, an annual monitoring protocol was developed, 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's survey revealed that the population density of grasshoppers in the Pūkaki River and Forks sites had declined

compared to 2017 but had increased at Patersons Terrace and Snowy River (Schori, Murray, and Nelson 2021b; Figure 14).

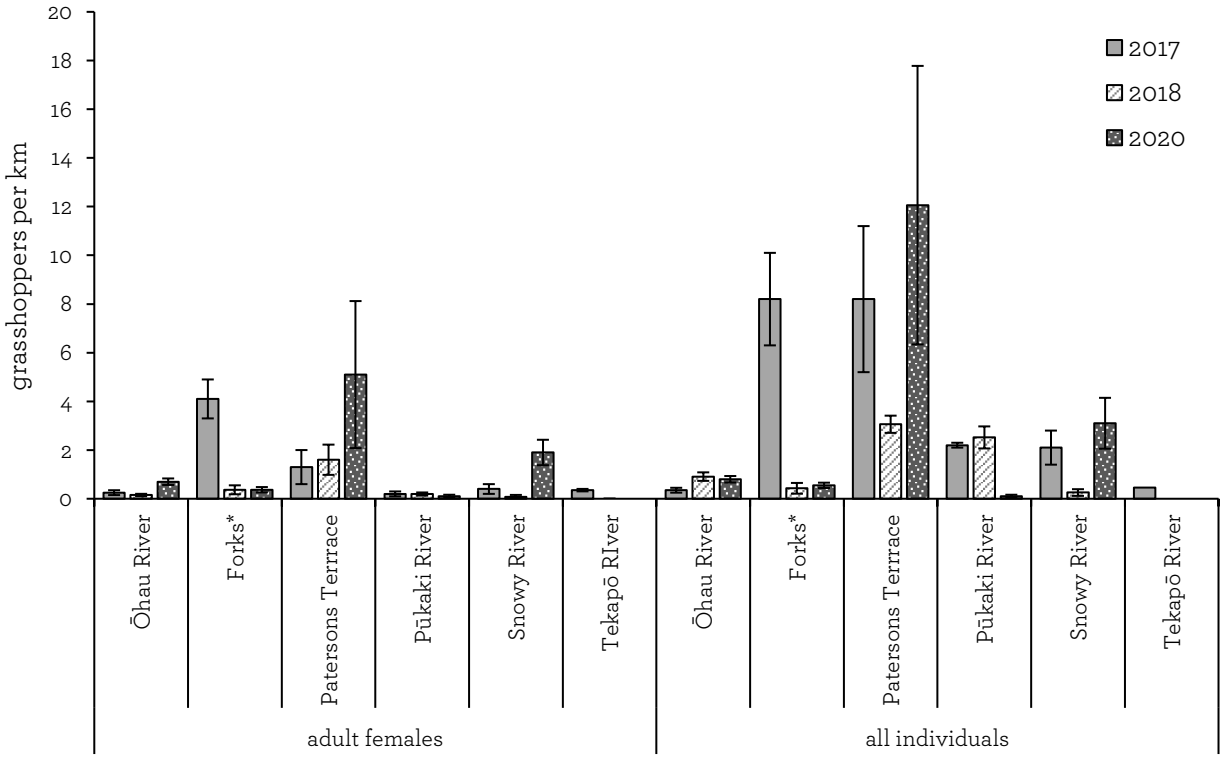

Figure 14. The mean number (±SE) of adult female (left) and total robust grasshoppers (right) per km at the Ōhau River, Forks (*including gravel pits and military land), Patersons Terrace, Pūkaki River and Snowy River in 2020 compared to 2017 and 2018.

The Tekapō River site was not monitored this year, and instead a survey of 14km of the Tekapō River was conducted to record the distribution of robust grasshoppers in the riverbed. The team of four found only seven robust grasshoppers after spending two days searching the riverbed. The survey will be used to inform a new annual monitoring site for the robust grasshopper in the Tekapō River. Project River Recovery will begin conducting regular distribution surveys of robust grasshoppers in major riverbeds.

4.4.6 Maniototo peppercress (*Lepidium solandri*)

Lepidium solandri is a Nationally Critical small plant in the Brassicaceae family, commonly known as Maniototo peppercress (de Lange 2018; Figure 15). It is endemic to the South Island and found east of the Main Divide from North Canterbury through to Central Otago. It inhabits poorly vegetated ground and can be found on bare hillsides, in short and tall tussock grasslands, grey scrub or pans of salt or open clay. In the Mackenzie Basin, it is often found on the edge of old river terraces and glacial outwash surfaces. *Lepidium solandri* is primarily threatened by land-use change and irrigation of habitat but is also excluded by introduced weedy species and browsed by animals. More recently, the spread of a brassica rust (Albugo) has added a new threat to this plant. Currently, there are fewer than 1000 plants known in the wild, and very few sites are protected. The Mackenzie Basin is now considered to be the last stronghold of the species.

Figure 15. Non-flowering *Lepidium solandri*. Photo: Sam Gale

This year, PRR and DOC actioned a multi-faceted approach for *Lepidium solandri* conservation (Sam Gale, 2021). This began with a workshop held at the local Twizel DOC office for nine DOC and council staff from across the region. The main purpose of the workshop was to provide training in the field identification of 1) the very cryptic and small *L. solandri* plants; 2) the microhabitat where *L. solandri* might be found; 3) the differences between healthy and unhealthy plants, and *Albugo* rust pustules; and 4) the differences between male, female, and potentially sterile plants. The attendees also discussed delimitation of a single population (for seed banking purposes) and were shown methods for collecting seed and taking leaf samples.

Following the workshop, monitoring plots were established at five populations across the basin to track additions and loses of plants, and to the monitor plant phenology and health (Figure 16). The plots were established in populations in Defence Force land at Tekapō, Tekapō Scientific Reserve, Maryburn Conservation Area, Pūkaki River/Ben Ōhau Conservation Area and Lake Ruataniwha Conservation Area. Between 6 and 18 plants were in each plot and a total of 52 individuals are now being monitored annually.

Figure 16. Setting up a *Lepidium solandri* monitoring plot at Tekapō Scientific Reserve (from left to right: Mike Harding, botanist; Tayla Hooker, DOC Twizel; Susan Walker, Manaaki Whenua Landcare Research). Photo: Sam Gale

Seeds were collected from each of the five populations (but not from individuals that were within the monitoring plots). Seeds collected from Maryburn Conservation Area and Pūkaki River were dispatched to the New Zealand Indigenous Flora Seed Bank (NZIFSB). In May 2021, Sam Gale travelled up to NZIFSB to clean and process the siliques (seeds) ready for long-term storage in the –20°C facilities. In total, 580 Mackenzie Basin-sourced *L. solandri* seeds were banked at NZIFSB this year. Seed and leaf material from male and female plants were also sent to Manaaki Whenua Landcare Research for laboratory and greenhouse analysis.

Seeds collected from the *L. solandri* population at Ruataniwha Wetlands were kept at DOC Twizel and these seeds were used to populate a pilot nursery established at the kakī aviary facilities. The purpose of this nursery is to provide a source of plant seeds for population restoration and expansion. The nursery enclosures protect the plants from seed predators (e.g., rats, possums) and browsers (e.g., rabbits and hares). Marianne oversaw the day-to-day plant care and nursery maintenance (Figure 17). Currently there are 57 juvenile plants now in *ex situ* management, all showing good health and growth. So far, germination and nursery husbandry processes have been shown to be effective and produce healthy plants. The next milestone will be to determine whether plants can produce viable seed through either natural or assisted pollination.

Figure 17. Marianne Marot ensuring the glass surface of the *L. solandri* pilot nursery in Twizel is kept clean to maximise photosynthesis (left). A healthy juvenile *L. solandri* in the pilot nursery (right). Photos: Sam Gale

4.4.7 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 18). 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.

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. The surveys include counts of all Orthoptera seen by the observers. Vegetation monitoring at the three sites occurs every three years, usually in autumn.

Since 2018, minute grasshopper populations have declined at all three monitored sites. Populations of *S. minutus* appear to undergo major, regular fluctuations at the Upper Ōhau site, but be in constant decline at the Tekapō Scientific Reserve and the Lower Ōhau River (Schori et al., 2021c). Underlying causes for the fluctuations should be investigated before these trends can be interpreted. Possible causes for variations in counts include the time of days that monitoring took place, the experience of the observers, and the weather conditions when monitoring was conducted.

Figure 18. Three of the colour variations of the minute grasshopper, *Sigaus minutus*. Photos: Jennifer Schori

4.5 Objective 5: Protect and manage upper Waitaki wetlands

The constructed Ruataniwha and Waterwheel wetlands have continued to provide habitat for a range of native fauna and flora. PRR manages these wetlands by manipulating water levels and controlling weeds, providing suitable habitat for rare ephemeral plants, and improving feeding sites for wading birds. Water level management allows ponds to be drier for a longer period during late summer to allow significant ephemeral species to thrive. The managed wetlands provide habitat for at least eight At Risk or Threatened vascular plant species and three At Risk or Threatened non-vascular plant species including *Centipeda minima* (Nationally Endangered, Waterwheel Wetland), *Isolepis basilaris* (Declining; Ruataniwha Wetlands), *Dysphania pusilla* (Nationally Critical; Ruataniwha Wetlands), and the native liverwort, *Riccia cavernosa* (considered to be Nationally Critical; Figure 19).

Figure 19. The ephemeral habitat at Ruataniwha wetlands (left). *Riccia cavernosa* and *Limonsella lineata* found at the Ruataniwha wetlands (right). Photos: Tayla Hooker.

From mid-April to early May, Ruataniwha Wetlands were surveyed to identify the distribution of threatened plants in the wetland, particularly those in the ephemeral habitats (Gale & Hooker, 2021; Hooker, 2021). Two sites were selected on the wetland margins, and three transects were established at each site, at low, middle and high water levels. The vegetation in each of the transects was surveyed using quadrats. In each quadrat, the surface cover (%), plant species cover (%) and total count of threatened plant species (vascular and non-vascular) were recorded along with the water depth and/or moisture index and soil pH (where possible).

The transects at the low-water line had the highest percent-cover and diversity of native ephemeral plants, and the highest number of threatened plant species. No threatened species were found on the high-water line transects (Table 5). Several weedy species were also identified in the ephemeral zones, some of which have potential to overcrowd native species. On-going monitoring will be important for determining whether these weedy species increase in density, and how they affect the native and threatened plant species. We intend to continue this monitoring for the next 5 years, and next year plan to add a third monitoring site located where a population of *Centipeda minima* (Nationally Endangered) occurs.

Table 5. The percentage cover of the native plant species found on transects established at the low, mid and high water lines at sites 1 and 2 during a survey of the emphemeral zones at Runataniwha Wetlands.

Species/threat ranking*	% cover					
	Low-water line		Mid- water line		High-water line	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Argentina anserinoides, NT	-	4.7	-	-	-	4.0
Carex secta, NT	-	-	-	-	-	13.3
Centipeda aotearoana, NU	3.0	0.7	-	-	-	-
Dysphania pusilla, NE	-	-	9.7	-	-	-
Glossostigma elatinoides, NT	0.8	-	-	-	-	-
Hydrocotyle sulcata, NT	6.8	0.3	-	-	-	-
Isolepis basilaris, D	2.7	-	-	-	-	-
Lemna disperma, NT	-	0.3	-	-	-	-
Limosella lineata, NT	5.3	-	-	-	-	-
Myriophyllum propinquum, NT	2.7	-	-	-	-	-
Pseudognaphalium luteoalbum, NT	4.7	2.0	-	4.7	-	-
Total % cover of native species	26.0	8.0	9.7	4.7	0.0	17.3
Total number of native species	7	5	1	1	0	2
Total number of threatened species	2	1	1	1	0	0

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

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, several projects were contributed to. Invertebrates collected and sorted as part of the Tasman River Invertebrate Study were given to Lincoln University to hold as part of their reference collection. This year $4000 in funding was provided for a student to sort further reference specimens that were collected as part of the study.

Nearly $30,000 was contributed to a University of Otago study initiated by DOC, looking at addressing the key gaps in our knowledge and tools around hedgehogs as a predator. This study over three years will consider how to deploy current trapping tools more effectively, which lures work best and what toxins kill hedgehogs.

A Lincoln University masters student is using GPS tags to assess the breeding season movements and winter dispersal of black-fronted tern/tarapirohe. The information will be used to identify habitat use, feeding areas and migration routes and the multiple year study will include birds from the Tern Island colony in the upper Ōhau River. This year, $10,000 was contributed to the costs of the GPS tags and satellite communication hubs.

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 (see Figure 20). 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.

Figure 20. Map showing the planned operational area for the Te Manahuna Aoraki Projet. The Green line indicates the project's boundary and the red lines indicate the proposed locations for predator proof fencing. Source: Te Manahuna Aoraki Website.

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 (see 4.2.1). 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. The new facility was key to this season's kakī breeding success. A total of 181 chicks were hatched this season from eggs gathered from wild breeding pairs (Mischler et al., 2021) or laid in captivity, with a record 51 chicks hatching in a single week (Brown et al., 2021).

7 Project River Recovery's financial statements 1st July 2020 – 30th June 2021

Project River Recovery spent $481,000 in the 2020-2021 financial year. PRR's revenue and expenditure for the 2020-2021 financial year is itemised in Table 6.

Table 6. Project River Recovery statement of financial performance for year ending 30th June 2021.

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

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