

BRAIDED RIVER BIRD MANAGEMENT PLAN FOR THE WAIMAKARIRI RIVER REGIONAL PARK



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BRAIDED RIVER BIRD MANAGEMENT PLAN FOR THE WAIMAKARIRI RIVER REGIONAL PARK

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1. INTRODUCTION

Waimakariri River Regional Park (the Regional Park, Figure 1) covers 15,000 hectares of the Waimakariri River and riparian land that is managed by Environment Canterbury for flood protection and recreation. The Regional Park extends from Sheffield to the river mouth, near Kaiapoi. The lower Waimakariri River, from the Gorge to the mouth, is an important breeding and nesting habitat for various Threatened and At Risk indigenous braided river birds, i.e. species that rely on this habitat type for key elements of their life cycles.

To date, management of braided river birds in the Regional Park has been undertaken by the Environment Canterbury Parks Team. They require a management plan to help ensure the coordination, continuity, sustainability, and success of future management actions aimed at the protection and enhancement of the braided river bird populations.

Environment Canterbury's work has focussed on the colony-nesting species - such as black-billed gull (*Larus bulleri*) and black-fronted tern (*Chlidonias albobristatus*) – which are therefore the main focus of this review and management plan. These species have been the focus because there has not been sufficient resources to monitor and manage more widely dispersed species. Discussion is provided throughout the plan, however, on the need to include other endemic bird species in future monitoring and management.

2. ECOLOGICAL AND STATUTORY CONTEXTS

Canterbury has the most braided rivers of any region in New Zealand. Braided rivers and associated gravel riverbeds have been identified as a historically rare ecosystem type and are naturally uncommon, on a national basis, (Williams *et al.* 2007) and are classified as Threatened-Endangered (Holdaway *et al.* 2012).

Indigenous braided river birds are protected under the Wildlife Act 1953, which states that no-one may kill or have them in their possession unless they have a permit. The effects of human activities on biodiversity, which includes braided river birds, are managed within the framework of the Resource Management Act (RMA) 1991. The RMA identifies two matters of national importance that are relevant to the protection of braided river birds: the preservation of the natural character of rivers and their margins, and the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna. A Draft National Policy Statement for Indigenous Biodiversity was published in November 2019 and when it becomes operative will establish the objectives and policies to identify, protect, manage, and restore indigenous biodiversity under the RMA.

At a regional scale, the Canterbury Regional Policy Statement (RPS) 2013 provides an overview of the significant management issues facing the Region and sets out policies and methods for the integrated management of natural and physical resources. Braided river birds and their habitat are protected under policies that aim to protect significant natural areas. The RPS provides criteria for the assessment of the ecological significance of areas of indigenous vegetation and habitats of indigenous fauna. The criteria set includes representativeness, rarity and distinctive features,

diversity and pattern, and ecological context. Significant habitats of indigenous fauna can include both indigenous or exotic vegetation and aquatic habitats, such as braided rivers - and associated networks of gravel bars and channels if they are important habitat for indigenous fauna.

Habitats in the Regional Park meet many of the significance criteria in the Canterbury RPS and is considered to comprise significant habitat for indigenous fauna, particularly for braided river birds.

A River Regional Plan applies to the Waimakariri catchment, regulating activities that can disturb the beds of rivers and lakes or activities that can disturb, remove, damage or destroy associated habitats. Granting of resource consents for specific activities identified in the regional plan needs to address effects on biodiversity, including braided river birds if they could be affected. The Regional Plan is discussed further in Section 3 below, in relation to water and gravel management.

3. SIGNIFICANCE OF AVIFAUNA HABITAT IN THE REGIONAL PARK

3.1 Indigenous species

Indigenous bird species known to nest in the Regional Park include black-billed gull (*Larus bulleri*, Threatened-Nationally Critical), black-fronted tern (*Chlidonias albostratus*, Threatened-Nationally Endangered), white-fronted tern (*Sterna striata*, At Risk-Declining), banded dotterel (*Charadrius bicinctus*, Threatened-Nationally Vulnerable), South Island pied oystercatcher (*Haematopus finschi*, At Risk-Declining), wrybill (*Anarhynchus frontalis*, Threatened-Nationally Vulnerable), southern black backed gulls (*Larus dominicanus*, Not Threatened), and pied stilt (*Himantopus himantopus*, Not Threatened).

Table 1: Indigenous bird species known to nest in the braided river system within Waimakariri River Regional Park.

Species	Status	Conservation Status
Banded dotterel (<i>Charadrius bicinctus</i>)	Endemic	Threatened- Nationally Vulnerable
Black-billed gull (<i>Larus bulleri</i>)	Endemic	Threatened- Nationally Critical
Black-fronted tern (<i>Chlidonias albostratus</i>)	Endemic	Threatened- Nationally Endangered
Pied stilt (<i>Himantopus himantopus</i>)	Indigenous	Not Threatened
Southern black backed gull (<i>Larus dominicanus</i>)	Indigenous	Not Threatened
South Island pied oystercatcher (<i>Haematopus finschi</i>)	Endemic	At Risk-Declining
White-fronted tern (<i>Sterna striata</i>)	Native	At Risk-Declining
Wrybill (<i>Anarhynchus frontalis</i>)	Native	Threatened-Nationally Vulnerable

¹ Source: Robertson *et al.* 2017.

² Source: <http://nzbirdsonline.org.nz/>



Legend

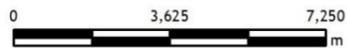
- Waimakariri River Regional Park (WRRP)
- Braided river bird management sites (2012-2019)**
- Monitored black-fronted tern colonies
- Monitored black-billed gull colonies
- Southern black-backed gull control sites

This is not the full distribution of these species in the Regional Park

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Figure 1. Braided river bird management undertaken within the Waimakariri River Regional Park (2012-2019)



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 Date: 30/04/2020
 Cartographer: KM
 Format: A3R

Banded dotterel, wrybill, black-billed gull, black-fronted tern, and South Island pied oystercatcher are endemic species that have evolved to live in braided river habitats. White-fronted tern are also coastal breeders, and also breed on islands surrounding Tasmania. Pied stilt have breeding populations throughout the tropics and warmer temperate regions of the world.

Southern black-backed gulls breed in a wide variety of habitats throughout New Zealand and are considered to be unnaturally 'superabundant' due to increased food supply from human sources (Miskelly 2013). They are serious predators of other braided river birds and take up extensive areas of favourable breeding habitat, and are therefore considered to be a threat (see Section 5).

Black-fronted dotterel (*Elseyaornis melanops*, Native, At Risk-Naturally Uncommon) have been recorded on two occasions in the lower Waimakariri River (Environment Canterbury, unpubl. data). Black-fronted dotterel have recently colonised from Australia, and maybe slowly spreading, with records dating back to the 1950s and breeding was first detected in the South Island in the 1970s (Armitage 2013). White-winged black terns (*Chlidonias leucopterus* Migrant) have also been recorded in the Regional Park over the last few seasons, and Australasian bittern (*Botaurus poiciloptilus* Threatened-Nationally Critical), a wetland specialist, have been observed in the Te Rauakaaka Nature Reserve and Poynters Wetlands.

3.2 River Values Assessment System (RiVAS)

The River Values Assessment System (RiVAS) has been applied to braided rivers of Canterbury to evaluate the habitat value of rivers for avifauna (Hughey and Baker 2010). Primary attributes and indicators were used to assess the Waimakariri River. The assessment considered relative distinctiveness, habitat size, numbers of indigenous birds surveyed on the river (excluding black-backed gull), diversity of foraging guilds present, number of Threatened or At Risk species, and significant breeding site (proportion of 'Threatened or At Risk' species present with a significant (>1% or >5%) proportion of their total populations).

The Waimakariri River scored 'High' for all indicators except the diversity of foraging guilds where the score was 'Medium'. More precisely, the Waimakariri River meets the following indicators:

- Habitat type or species assemblage not represented in other regions in New Zealand.
- 14,342 hectares of habitat for braided river birds.
- 3,396 individuals of indigenous species recorded.
- Six foraging guilds present: open water divers, deep water waders, shallow water waders, dabbling waterfowl, aerial hunting gulls and terns, and riparian wetland birds.
- Eight Threatened or At Risk species present: wrybill, banded dotterel, black-fronted tern, black-billed gull, Caspian tern, white-fronted tern, New Zealand pied oystercatcher, and pied stilt.

- Significant breeding site for black-fronted tern (more than 5% of the total population), wrybill (10% of the total population), and banded dotterel (no estimate of proportion provided).

The river was classified as being nationally significant for avifauna because it met the significant breeding site criterion and because it scored more than 15 points on the overall assessment.

3.3 Important Bird Area (IBA)

Important Bird Areas (IBAs) are sites that are significant for the long-term viability of key bird species and are recognised as internationally important for bird conservation. The Waimakariri River was identified as an Important Bird Area (Forest and Bird 2016) for seabirds because it meets the following global IBA criteria:

- More than threshold numbers of one or more globally threatened species (A1).
- More than threshold numbers of one or more congregatory species, including more than 1% global population of seabirds (A4ii).

The assessment was done in 2013 and was based on the populations of three trigger species, which are considered to be globally threatened: black-billed gull, black-fronted tern, and wrybill. During the breeding season between 1981 and 2014, it was estimated that the Waimakariri River provided nesting habitat for 376 to 2,292 breeding pairs of black-billed gull (Forest and Bird 2016). Breeding pairs of black-fronted terns were estimated to be between 309 and 540 for the period 1980 to 2009 (Forest and Bird 2016). Population estimates for black-billed gulls and black-fronted terns on the Waimakariri River represents more than 1% of the global population of each species. The population estimates for wrybill 2007 to 2009 were 36 to 84 breeding pairs (Forest and Bird 2016).

3.4 Ramsar Wetlands of International Importance

Signatories to the Ramsar Convention on Wetlands of International Importance need to designate sites of international importance based on nine criteria. The Waimakariri River is not identified as a Ramsar site and has not been assessed against the Ramsar criteria, but information on birds using and breeding in the riverbed habitat could mean that the river, or some segments of it, meet some of the Ramsar criteria (Table 2).

Table 2: Ramsar criteria for wetlands of international importance likely to be met by the Waimakariri River.

Ramsar Criteria	Likely Level of Compliance	Explanation Based on New Zealand Guidelines (Denyer and Robertson 2016)
Criterion 2: Supports vulnerable, endangered, or critically endangered species or threatened ecological communities	Strong	Habitat for a population of one or more species that are classified as Threatened-Nationally Critical or Nationally Endangered. Black-billed gull and black-fronted tern nest in the Waimakariri River.

Ramsar Criteria	Likely Level of Compliance	Explanation Based on New Zealand Guidelines (Denyer and Robertson 2016)
Criterion 3: Supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region	Moderate	A national stronghold for 1-4 distinctive species. Four endemic braided river birds are known to nest in the Waimakariri River.
Criterion 4: Wetlands that are demonstrated to be key habitats and national strongholds for threatened indigenous wetland-dependent species during breeding, migration, moulting or weather extremes.	Strong	Wetlands that are demonstrated to be key habitats and national strongholds for threatened indigenous wetland-dependent species during breeding, migration, moulting or weather extremes. The Waimakariri River is a significant breeding site for black-fronted tern (more than 5% of the total population), wrybill (10% of the total population) and bitterns. Australasian bittern also inhabit wetlands connected to the lower river.
Criterion 6: Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Moderate	Regularly supports 2-24% of a biogeographical population of one or more waterbird species or subspecies. The Waimakariri River is a significant breeding site for black-fronted tern (more than 5% of the total population) and wrybill (10% of the total population).

4. CURRENT STATE OF AVIFAUNA POPULATIONS

Bird surveys have been undertaken on the Waimakariri River since 1980. This survey occurs on a single day with multiple observers counting birds on different sections of the river. The most complete data set available covers the segment from Waimakariri Gorge to Harewood crossbank (situated east of McLeans Island) where surveys were undertaken in 1980, 2006, 2007, 2008, 2009, 2017, and 2018.

Observations were compiled and analysed for the following key species to evaluate population trends over the period 1980 to 2018: black-billed gull, black-fronted tern, banded dotterel, white-fronted tern, wrybill, South Island pied oystercatcher, and southern black-backed gull (Figure 2). Black-backed gulls were not counted during the ground-based surveys in 1980 and 2017.

Many of the key species show similar trends where the number of birds counted in the most recent surveys are higher than in previous surveys, which could mean that populations are increasing or were particularly abundant during the survey period, e.g. black-billed gulls.

Black-billed gull counts were low from 1980 to 2009, with less than 50 birds counted in 1980, 2007, 2008, and 2009 (Figure 2). The number of black-billed gulls counted increased substantially in 2017 and 2018. However, given that this based on a single day of survey effort there is no measure of within year variation for these populations.

Estimations of black-billed gull breeding success have been calculated since the 2013-2014 breeding season (Table 3). Success rate estimates were calculated as the average number of chicks fledged per breeding pair of adults present (c.f. Popenhagen 2019).

Success rates vary year to year due to flood events that wash out colonies and nests, and disturbance associated with human recreational activities.

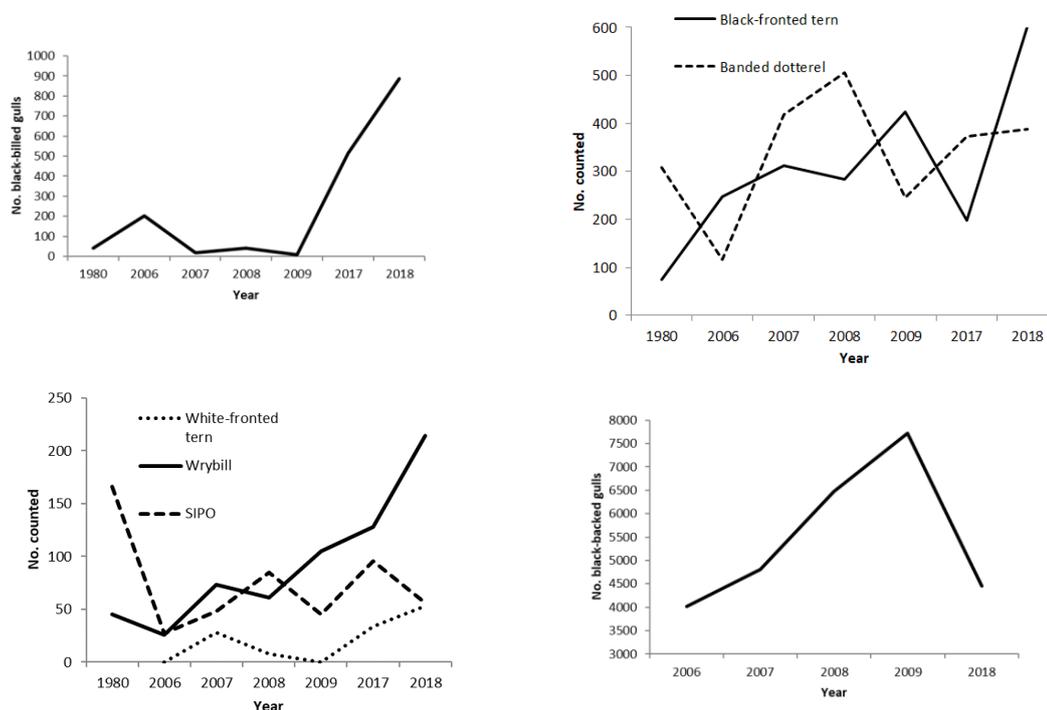


Figure 2: Numbers of birds counted during the bird surveys undertaken on the Waimakariri River - Waimakariri Gorge to Harewood Crossbank - 1980 to 2018.

Table 3: Black-billed gull chicks fledged and estimated breeding success rates from 2013-2014 to 2018-2019.

Season	Recorded Adult Breeding Pairs	Number of Known Chicks Fledged	Estimated Success Rate
2013-2014	243	121	0.5
2014-2015	1,143	1,550	1.1
2015-2016	804	339	0.42
2016-2017	1,120	738	0.66
2017-2018	1,029	520	0.51
2018-2019	792	291	0.37

These estimates of breeding success are extremely useful for understanding reproductive success and how it is affected by management actions. However, because not all colonies are monitored each year, the number of adult breeding pairs may not be an accurate measure of the total number of black-billed gulls present in the Regional Park.

Wrybill and white-fronted tern show a similar trend (Figure 2). Black-fronted tern counts also show a general increase from 1980 to 2018, but an important dip in the numbers counted occurred in 2017 (Figure 2). Banded dotterel numbers vary year to year, with no clear trend evident (Figure 2), and the number of birds counted peaked in 2008. More than 150 South Island pied oystercatchers were counted in 1980

(Figure 2) but numbers have varied in subsequent years, remaining below 100 individuals.

Southern black-backed gull numbers increased from 2006 to 2009 but a reduction in number of birds counted was observed in 2018 (Figure 2). Black-backed gull control started during the 2012-2013 nesting season and could potentially explain the decrease in numbers counted in 2018 but the 2018 data is only a single count after nine years, and should be treated cautiously.

However, these counts, although repeated over a number of years, all of these counts are from a single day of survey effort per annum, and should be treated cautiously. Helicopter surveys of southern black-backed gulls have been undertaken since 2016 (Bell 2017 and 2020, Willis and Bell 2018):

- 2016: 5,015 pairs.
- 2017: 3,031 pairs.
- 2018: 4,017 pairs.
- 2019: 3,810 pairs.

These aerial surveys provide more robust data and suggest a possible decline, although numbers have fluctuated.

5. THREATS TO BRAIDED RIVER BIRDS IN THE REGIONAL PARK

5.1 Predation

Predation is a major threat to braided river birds. Braided river birds and their nests and fledglings are preyed upon by a suite of introduced mammalian predators, and by indigenous predators, such as southern black-backed gulls and Australasian harriers (*Circus approximans*). The roles of these predators are discussed further below.

Introduced Mammals

Stoats (*Mustela erminea*), ferrets (*Mustela furo*), weasels (*Mustela nivalis*), feral cats (*Felis catus*), hedgehogs (*Erinaceus europaeus occidentalis*), and rats (*Rattus* spp.) are all known to prey upon nests, fledgling, and adult birds (Keedwell and Brown 2001, Keedwell *et al.* 2002).

Braided rivers in full flow can be difficult to cross, and birds often nest on islands. Reduced river flows are considered to have increased access by mammalian predators to nesting sites (Dowding and Murphy 2001).

Southern Black-Backed Gulls

Black-backed gulls are a large predatory bird, c.60 centimetres in length and about one kilogram. Although black-backed gulls are an indigenous species, they are considered to now be unnaturally 'supper-abundant' due to increased food supply from human-related land uses (Miskelly 2013). They reach very large numbers on Canterbury's braided rivers. In 2019, 3,180 breeding pairs were observed on the lower

Waimakariri River (Bell 2020). In the Regional Park, there have been many observations of black-backed gulls harassing and preying on nesting colonies of black-billed gulls and black-fronted terns (e.g. Popenhagen 2014, 2015, 2017, 2018, 2019).

Black-backed gulls are also likely to be preying upon the nests of smaller waders, such as banded dotterel and wrybill.

Black-backed gulls also nest on braided rivers, competing with other braided river bird species for nesting habitat. Their nesting season – October to January - overlaps with other braided river bird species. They have a tendency to occupy the higher less flood-prone sites, forcing species such as black-billed gulls and black-fronted terns to nest in areas that are more likely to be flooded during freshes.

Australasian Harrier

Incidents of Australasian harriers preying directly on black-billed gulls have been observed in the Regional Park (Popenhagen 2019). Harriers in the nearby Ashley River were observed to kill 117 black-billed gulls and this was thought to be at a higher level than rat predation at this location (Davey 2020). Australasian harriers should be considered to comprise a potential threat to braided river birds within the Regional Park and their numbers and impacts should be monitored more closely.

5.2 Natural disturbance by flooding

Braided rivers such as the Waimakariri are dynamic ecosystems where water flows across a gravel floodplain in multiple mobile channels (Gray and Harding 2007). Small and large floods are common and are responsible for creating a highly diverse mosaic of habitats at different successional stages. Habitats are generally unstable and have high turnover, but the proportion of each habitat type remains constant over time over the section of river under consideration (Latterel *et al.* 2006).

Braided river birds are specialists and have specific habitat requirements for particular parts of their life cycles. Flooding events provide the clean substrate that many braided river birds need for nesting. Braided river birds have also developed breeding adaptations that ensure hatching success over a natural range of flooding conditions and frequencies (Hughey 1985). When clutches fail due to large floods that destroy nests, they have the ability to nest again, which improves their breeding success.

Braided rivers close to large urban centres are managed to prevent flooding outside of the main river channel. For example, the lower section of the Waimakariri River has been straightened, narrowed and stop-banked to prevent flooding, particularly between Christchurch and Kaiapoi (Gray and Harding 2007, Young *et al.* 2004). Within the main river channel, the recurrence of floods and freshes increases and habitats experience more regular disturbances (O'Donnell *et al.* 2016, Gray and Harding 2007). Furthermore, willow plantings associated with river protection works can encroach into the main river channel and modify river morphology, although this area is sprayed routinely to limit encroachment by willow, gorse and broom. This could mean that birds that nest in habitats along the main channel of a braided river with flood protection structures may need to nest closer to active river channels as

higher elevation habitats are invaded by vegetation, and sites closer to the main channel are likely to experience more frequent disturbances from flooding. No scientific studies were found on the long-term impact of flood control structures on flood recurrence within the main channel of braided rivers and how it affects bird habitat. However, it is assumed that more frequent flooding and disturbances during the braided river bird breeding season may lead to a decrease in nesting and fledging success (O'Donnell *et al.* 2016, Maloney *et al.* 1997).

5.3 Extractive commercial activities

Water abstraction and gravel extraction are undertaken in sections of the Regional Park, and the effects of those activities are discussed below.

Water Abstraction

The volume of water abstracted from a braided river and the timing of the abstraction can have an impact on river bed habitat. Water uptake can lower the flow of braided rivers and lead to weed encroachment, which can reduce the breeding habitat available for braided river birds and provide cover for pest mammals (O'Donnell *et al.* 2016). Lower flows are also associated with a reduction in the number of channels, which can negatively affect the quantity and quality of breeding habitats. Rivers with reduced flows often have more stable channels which would also lead to an increase in weed encroachment. Water abstraction is also likely to reduce the magnitude and the frequency of smaller floods that can flush sediments and periphyton (Jenkins 2015).

The Waimakariri River is subject to water abstraction for the Waimakariri Irrigation Scheme, three community stock water schemes, and the domestic supply for Darfield. In 2002, it was estimated that 20 cubic metres per second (cumecs) were abstracted for irrigation and stock water (Environment Canterbury 2011). Flow measurements between 1967 and 1994 show that the Waimakariri River has a mean flow of 124 (cumecs) and a mean annual daily low flow of 41.5 cumecs (Environment Canterbury 2011). The mean annual seven-day low flow (MALF) is estimated to be 40.2 cumecs (Jenkins 2015).

Restrictions on the volume of water that can be removed from the Waimakariri River at different flows are identified in the Waimakariri River Regional Plan (Environment Canterbury 2011). The Plan sets allocation limits and minimum flow requirements within the catchment. It also identifies when it is necessary to cease or reduce water abstraction to prevent periphyton mats from having significant adverse effects. The minimum flow in the allocation regime is 46 cumecs. This is superior to the proposed National Environmental Standard value for minimum flow in rivers where mean flows are greater than five cumecs, which is calculated as 80% of MALF or 32.2 cumecs for the Waimakariri River (Jenkins 2015). The National Environmental Standard has also proposed an allocation limit of 50% of MALF, which equates to 20.1 cumecs for the Waimakariri River (Jenkins 2015). The allocation limit in the plan is slightly higher, at 22 cumecs.

The Plan does not specify flow requirements for the braided river bird breeding season. Jenkins (2015) mentions that flows in the Waimakariri River should be in the range of 55 to 96 cumecs between September and December for the nesting season.

Gravel Extraction

Braided rivers are an important source of gravel for residential and commercial construction and roads. Extraction activities can directly affect braided river birds when they are undertaken during the breeding season. Nesting birds can be disturbed, nests can be crushed, and breeding habitats can be disturbed by flow diversion or by the movement of heavy machinery (O'Donnell *et al.* 2016). Over-extraction of gravel can also change braided river morphology through the lowering of the riverbed, modification of sediment volume and composition and alteration of channel profiles (Kelly *et al.* 2005, Environment Canterbury 2012, Environment Canterbury 2017). These can have consequences on habitat structure within the main channel of the river and on bird breeding habitat.

On the other hand, braided river birds can benefit from well-managed gravel extraction operations (O'Donnell *et al.* 2016, Environment Canterbury 2017). In areas where gravel extraction has occurred, the riverbed is often free of weeds, which creates breeding habitat suitable for numerous braided river birds. New Zealand braided river birds are known to colonise and use sites that have been cleared of weeds for breeding (Maloney *et al.* 1999, O'Donnell *et al.* 2016, Schlesselmann *et al.* 2018). Consequently, gravel extraction can potentially be used to clear vegetation in the riverbed and increase the proportion of suitable nesting habitat.

A framework for the sustainable management of gravel extraction is provided in the Canterbury Regional River Gravel Management Strategy (Environment Canterbury 2012).

The Waimakariri River Regional Plan provides details on permitted activities in the bed of the river and the Canterbury Regional Council River Gravel Extraction Code of Practice presents best practices for gravel extraction. The Regional Plan stipulates that for small scale gravel extraction (less than 10 cubic metres per week and less than 50 cubic metres per year), riverbed disturbances cannot occur within 100 metres of nesting bird colonies between 1 September and 31 January and cannot physically disturb an indigenous bird's nest that is in use.

A consent is required for any larger disturbances of the riverbed, and these generally include a condition for the protection of birds during breeding seasons, with requirements for surveys before starting gravel extraction works and minimum separation distances from nests and birds where they are present.

Gravel extraction rates in the Waimakariri River have generally exceeded the bedload transport rate (Jenkins 2015). This resulted in a one metre reduction in bed level between 1985 and 2008 in the lower section of the river (Jenkins 2018). From 2008 to 2011, the quantity of gravel extracted is estimated to have been close to 500,000 cubic metres per year (Environment Canterbury 2012) while the sustainable supply of gravel has been calculated to be around 250,000 cubic metres per year (Environment Canterbury 2006, Jenkins 2018).

5.4 Habitat loss

Key habitat requirements of indigenous braided river birds are well described (Hughey 1985, Hughey 1998) and can be summarised as follows:

- Large areas of bare shingle for nesting, preferably on islands. Nesting is often most dense where the highest degree of braiding occurs.
- Ponds, backwaters, shallow riffles, runs and seepage zones, so that short-legged waders such as the dotterel species can feed on aquatic insects.
- Larger/main channels for foraging by South Island pied oystercatcher, pied stilt, and other larger bird species.
- Wet sandy areas where short- and long-legged waders often forage.

Loss of these habitats can easily occur if braided rivers are not properly managed. Weeds, water flow levels, invasive aquatics species, and water quality can all potentially have adverse effects, as discussed below.

Weeds

Woody weeds such as gorse (*Ulex europaeus*), Scotch broom (*Cytisus scoparius*), and tree lupin (*Lupinus arboreus*) commonly occur on gravel in riverbeds, particularly areas that are not very flood-prone. If unmanaged they encroach into and reduce valuable nesting habitat, often on more suitable higher ground.

Reduced River Flows

If river flows are reduced substantially because of excessive water abstraction or damming, this can reduce the amount of feeding habitat such as ponds, riffles, and backwaters, available for braided river birds. Reduced river flows, and lack of flooding, can also further exacerbate weed infestations, resulting in them becoming more extensive along main river channels, or on islands in the river.

Invasive Aquatic Species

Invasive aquatic species, both plant and animal, have the potential to disrupt the food webs that are so critical to maintaining braided river bird populations. River biosecurity is therefore very important.

Water Quality

Elevated nutrient levels from inputs from surrounding land uses can, under certain conditions, cause excessive algal growth, and produce toxins. This can be particularly pronounced if water flows are not managed properly, and fall below critical levels.

5.5 Recreational disturbance and damage

River users can have adverse impacts on nesting birds in two ways:

- Destruction by vehicles driving over nests, or people walking on nests. Smaller waders such as banded dotterel and wrybill nest in scrapes amongst stones and their eggs are very difficult for the untrained eye to detect.
- Disturbance by human activity near nests can cause birds to leave the nest either to defend it (e.g. dive bombing by black-fronted terns) or to try and distract the person from the nest site. If birds are continuously off nests due to disturbance this can result in nest failure because eggs are not appropriately thermo-regulated. Continuous disturbance can also cause birds to abandon nests.

Smith and Hughey (1997) investigated human disturbance of nesting braided river birds on the deltas of the Ohau and Tekapo Rivers. They found that, as long as vehicles stayed on well-formed tracks (not causing direct destruction) they disturbed nesting birds for a small amount of time. They also noted that the birds settled down when a vehicle was stationary. Humans slowly walking through the area were found to cause far greater disturbance, with one angler slowly fishing in pools observed to disturb a black-fronted tern colony for 40 minutes.

Popenhagen (2014, 2015, 2017, 2018, 2019) has recorded a considerable amount of disturbance to black-billed gull and black-fronted tern colonies in the Regional Park by both vehicle users and people on foot.

Uncontrolled dogs - such as dogs from neighbouring properties or dogs roaming off-leash - can also disturb and destroy nests.

5.6 Wilful destruction

Wilful acts of harm by members of the public towards braided river birds have occurred (Popenhagen 2014, 2015, 2017, 2018, 2019) in the Regional Park. Some of these are particularly destructive and concerning incidents, and are summarised as follows:

- 2014-2015 breeding season: dead black-billed gulls were found that appeared to have been shot, with used shotgun cartridges nearby.
- 2016-2017 breeding season: a 4WD was observed driving through a black-billed gull colony, despite signage to alert people to the presence of the colony.
- 2017-2018 breeding season: vehicles doing 'donuts' on Kaiapoi Island forced black-fronted terns to abandon nests.
- 2018-2019 breeding season: an *c.*800 pair black-billed gull nesting colony was largely abandoned with only *c.*200 pairs remaining. Evidence indicated that birds had been shot with a .223 rifle.
- 2019-2020 breeding season: five black-billed gull fledglings were found stoned to death.

5.7 Relative severity of these threats

It is very difficult to assess the relative importance of these different threats for nesting braided river birds on the Waimakariri River without quantitative evidence on the role each of these threats is playing in the decline of these species. Until such information is available, a precautionary approach should be adopted and it should be assumed that all of these threats are relevant.

It is nevertheless clear that the species are under a lot of pressure from all of the above threats, as illustrated by the following:

- Flood control has meant that there are more frequent freshes disrupting nesting in the lower river from McLeans Island downstream. It is possible that climate change may also increase the number and severity of freshes throughout the river system in the future.
- A suite of introduced mammals that prey on the birds and their nests.
- Large numbers of black-backed gulls occupy important nesting space and are predators of the birds and their nests.
- Weed infestations occur on elevated islands and riparian areas which might otherwise be nesting habitat that is less disturbed by flood events.
- The lower Waimakariri River is immediately adjacent to New Zealand's second largest city, resulting in a lot of recreational activity that has the potential to disturb nesting birds.
- There are annually-documented illegal attacks on colonies of nesting birds, and it is a real concern that the observed attacks may be the tip of the iceberg.

The Regional Park still nevertheless contains high quality habitat for braided river birds and the above threats need to be managed appropriately. Maintaining the integrity of this habitat is very important, because any reduction in the quality of this habitat through altered/reduced flow regimes, water pollution, or biosecurity breaches, is likely to have a significant detrimental effect on populations of nesting braided river birds.

6. CURRENT MANAGEMENT

6.1 Overview

Environment Canterbury has implemented a programme to monitor and manage braided river birds in the Regional Park since 2013 (Popenhagen 2014, 2015, 2017, 2018, 2019). During the 2018-2019 breeding season *c.*\$34,000 (not including in-kind costs, e.g. ranger time) was spent on this management, including a contribution towards black-backed gull control from Christchurch International Airport Limited. The Airport has assisted with black-backed gull control every year since commencement of the programme.

The management programme has been focused on the monitoring and protection of black-billed gull colonies, but has also incorporated black-fronted tern colonies over the past two seasons. Management has been focused on these colony breeders because the limited funding has meant that it is not possible to monitor and manage widely dispersed solitary nesters such as banded dotterel and wrybill.

The monitoring component of the programme involves an ornithologist being contracted to undertake surveys (currently Niall Mugan, Keystone Ecology) of sections of the river, to identify and monitor breeding colonies, and to implement predator control, and to advise Environment Canterbury staff on management measures, especially where restrictions on public access may be required. Environment Canterbury staff have also undertaken various public education activities .

6.2 Introduced mammals

Permanent trap lines targeting mustelids, hedgehogs, and rats have been set up in riparian areas of the lower Waimakariri by Environment Canterbury and Christchurch City Council (Figure 3). In addition to this trapping, the contract ornithologist undertakes low-intensity ‘ring-trapping’ at black-billed gull colonies or black-fronted tern colonies, using additional traps

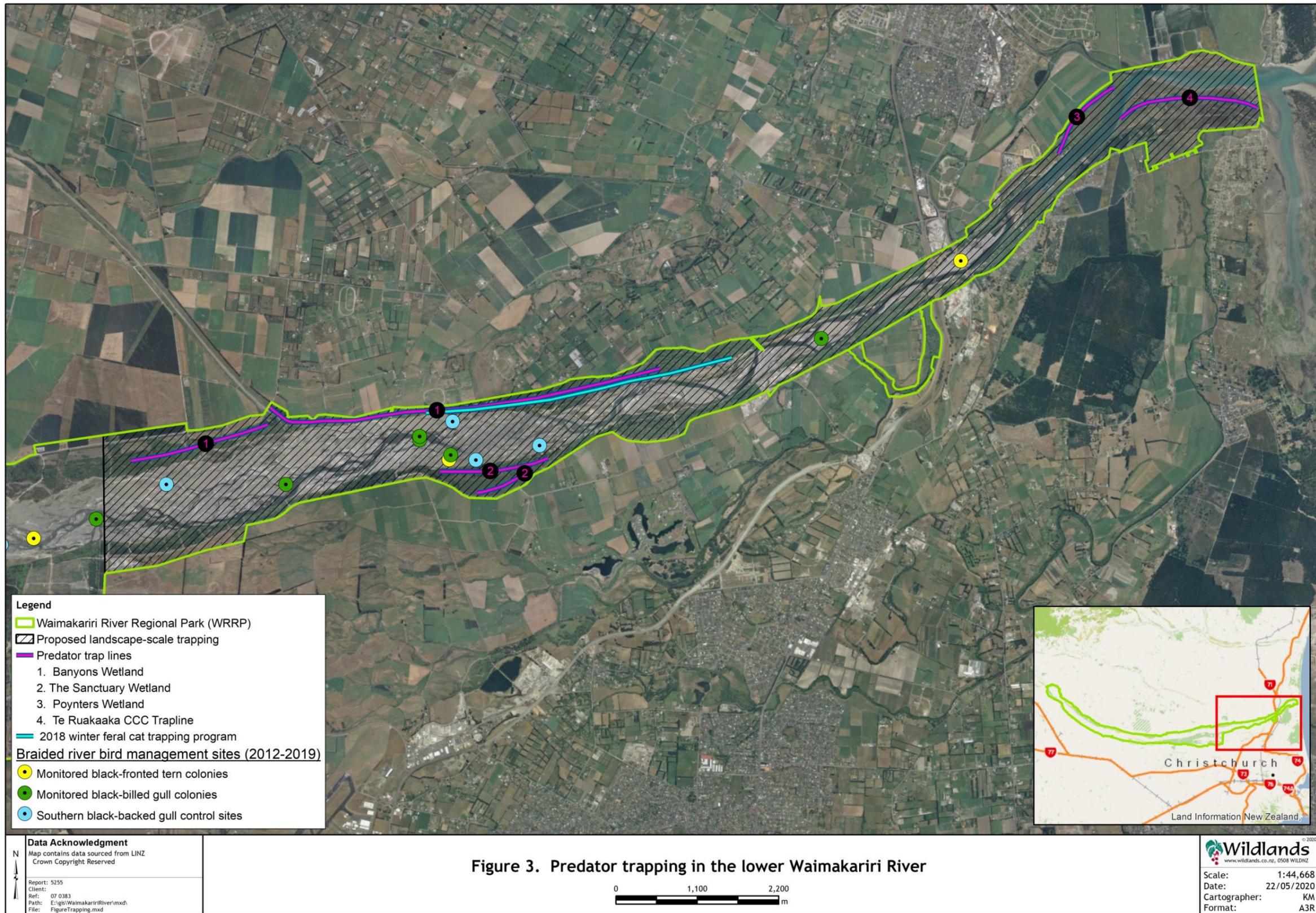
During the 2014-2015 breeding season 10 feral cat traps were deployed. In 2017-2018 a feral cat was recorded attacking a black-billed gull colony near Sanctuary Wetland. During the winter of 2018 a feral cat trapping programme was implemented over a four kilometre section of the river between Taylors Road and Halls Road, with eight feral cats removed.

6.3 Southern black-backed gulls

Control activities are described in Environment Canterbury’s braided river bird management annual reports and are summarised below. Control of black-backed gulls is undertaken mainly using a combination of alphachloralose and shotgun shooting. During the 2012-2013 breeding season, black-backed gull eradication was implemented within a 1.5-kilometre buffer of the main black-billed gull colony, by regularly destroying the nests and eggs (Mugan 2013). Egg and nest destruction has been implemented regularly since then to discourage black-backed gull colonies setting up in areas where black-billed gull or black-fronted tern colonies are present (Courtney Popenhagen, Environment Canterbury, pers.comm).

During the following breeding season (2013-2014), black-backed gull control was undertaken in conjunction with Christchurch International Airport where gulls pose a bird strike risk to aircraft (Thompson 2014). Three colonies were targeted because of their close proximity to establishing black-billed gull colonies. A simple control methodology was developed and black-backed gulls were poisoned using alphachloralose. It is estimated that 780 black-backed gulls were killed.

Black-backed gull control was implemented in 2014-2015 by Environment Canterbury and Christchurch International Airport (Thompson 2015), and control of black-backed gulls increased during this season, with a greater number of birds killed in the lower Waimakariri River than in previous years. Exact numbers of gulls killed



were not recorded, but observations suggest a marked decrease in the local population. Black-billed gull breeding success was high and this could be due, at least in part, to more effective control of black-backed gulls.

Control operations and results for the 2014-2015 season highlighted the need to develop standards and best practices for black-backed gull control in the Regional Park, and these were developed prior to the 2016-2017 nesting season. They provide guidelines for the timing of operation, bait preparation and applications, and training.

An issue arose with black-backed gull control in the lower section of the River during the 2016-2017 season (Popenhagen 2017) when initial poisoning failed due to possible bait shyness behaviour. Consequently, the control could not proceed according to the technical standards and one control operation was undertaken at a large colony just below the Waimakariri Gorge, where it is estimated that 2,000 black-backed gulls were poisoned.

The technical standard is reviewed and updated prior to the beginning of each nesting season, involving consultation with a Technical Advisory Group and the Department of Conservation. Southern black-backed gull control also follows Department of Conservation best practice standards.

The first aerial survey of black-backed gull colonies was undertaken in the the lower Waimakariri River in November 2016. In November 2017 a further aerial survey was undertaken where each gull colony was recorded using a GPS unit, and the number of breeding pairs was estimated (Bell 2017). A total of 3,031 breeding pairs of black-backed gulls were recorded at 23 breeding colonies located from approximately eight kilometres upstream of the river mouth, to just below the Gorge. Two alphachloralose control operations were undertaken at the large colony just below the Waimakariri Gorge bridge (Popenhagen 2018), where more than 1,200 adults were killed. An incident with dogs led to updates of the Best Practice Technical Standard for landowner and public notifications prior to control operations.

A shotgun shooting trial was also undertaken close to a black-billed gull colony in the lower section of the river, where about 80 black-backed gulls were shot. It was noted that the bait and decoys also attracted one black-billed gull and one white-fronted tern and that shooters need to be able to distinguish species at a distance. Shooting could help to reduce black-backed gull presence in the lower reached of the river where they are more spread out and show a reluctance to eat pre-feed baits.

A second aerial survey of black-backed gulls was undertaken in November 2018 (Willis and Bell 2018) and a total of 4,017 breeding pairs were recorded at 36 breeding colonies on the lower Waimakariri River, from approximately 10 kilometres upstream of the river mouth, to just below the gorge. The 2018-2019 season was the third consecutive season where Environment Canterbury and Christchurch International Airport have pooled funding, with an Environment Canterbury representative coordinating and overseeing black-backed gull control throughout the lower Waimakariri River on behalf of both parties. Alphachloralose poisoning was used with a combination of shotgun shooting and egg smashing throughout the season. A successful trial shooting outside of the breeding season was undertaken in September and 30 non-nesting gulls were killed. Three additional

shooting operations were undertaken and a further 337 gulls were killed. One alphachloralose control operation was undertaken upstream of Downs Road and 800 adults were killed. Shotgun shooting is proving to be a useful supplementary tool to poisoning, particularly where poisoning is not possible.

The fourth black-backed gull survey was undertaken in October 2019 (Bell 2020), with a total of 3,810 breeding pairs recorded in 29 breeding colonies on the lower Waimakariri River, from approximately 10 kilometres upstream of the river mouth, to just below the Gorge. Since 2016, the number of black-backed gulls recorded on the river has decreased by about 1,000 pairs, suggesting that control measures are reducing the population.

6.4 Public disturbance

Regional Park infrastructure already limits a lot of vehicle activity in the lower reaches of the river. Efforts to prevent public disturbance at breeding colonies has involved:

- Placement of concrete blocks around colonies to prevent vehicles access.
- Thick wire cables run through concrete blocks and attached to trees.
- Warratah/electric tape fencing.
- The use of signage to advise the public of the presence of the birds.
- Some targeted ranger patrols.



Plate 1: Signage used by Environment Canterbury to alert the public to black-billed gull and black-fronted tern nesting colonies.

Although, these management efforts will have reduced vehicle disturbance, some of the breeding colonies have failed because of other reasons, such as flooding. One black-billed gull colony protected from vehicles by concrete blocks failed when due to

disturbance by an angler, and another failed due to vehicle disturbance despite warratah/electric tape fencing.

6.5 Wilful destruction

Wilful destruction of breeding bird colonies has been observed and recorded, as noted in Section 5.6 above. However, despite incidents being reported to the Department of Conservation, to date there has never been an arrest or a prosecution.

6.6 Public education

Efforts to educate members of the public using the area have involved:

- Brochures, signage and school talks.
- An educational video produced for the public.
- Stickers for children.
- Ranger interactions with members of the public.

There has been some indication that public awareness of braided river birds has increased amongst amongst the general public (Popenhagen 2014, 2015, 2017, 2018, 2019).

Public education has not focussed on southern black-backed control, and there has been some negative publicity regarding the control of black-backed gulls. This includes a post on a veterinary Facebook page that was out of context, following a courtesy notification by Environment Canterbury on the use of alphachloralose in the area.

6.7 Artificial island construction

Attempts have been made to build artificial islands that are high enough to survive freshes, with construction of these islands undertaken as in-kind contributions by gravel extraction companies. During the 2016-2017 breeding season, Fulton Hogan constructed two islands to the height of the main river bank. Decoy black-billed gulls were deployed on one island but not the other, so that it could act as a control site. Lime was used to mimic black-billed gull guano. The islands survived a series of 2.8 metre freshes, but the target species did not nest on either of them. Eventually the islands were washed out by a one in 15 year flood event in early 2017.

In 2017-2018, Rooney Earthmoving Ltd constructed a large artificial island. No decoys were deployed on this island, and no target species nested on it.

There have also been earlier attempts to construct artificial islands, but there are not well documented (Courtney Popenhagen, Environment Canterbury, pers.comm).

7. FUTURE MANAGEMENT

7.1 Overview

Following sections address current and potential management options to improve the protection of braided river birds, and relative priorities, under the following topics:

- Control of introduced mammals.
- Southern black-backed gulls and Australasian harriers.
- Weed control.
- Human disturbance.
- Wilful destruction.
- Commercial activities.
- Artificial islands.
- Prioritisation of management options.
- Estimated costs of increased management effort.

7.2 Control of introduced mammals

Landscape-scale control of predators in the Regional Park is aligned with the goals of Predator Free New Zealand 2050.

Predator trapping currently being implemented in riparian areas along the lower Waimakariri River is a reasonable start, but it needs to be expanded in order to achieve meaningful reductions of introduced mammalian predators.

Feral cat trapping is likely to be insufficient as they are known to occur at reasonably high densities on braided rivers (Sanders and Maloney 2002, Steffens *et al.* 2012). The removal of eight feral cats in the winter prior to the spring/summer breeding season in 2018 is likely to have had very little impact on the presence of feral cats during the braided river bird breeding season. Feral cats can have large territories and can disperse over long distances, and will easily reinvade braided river habitats. Live trapping has confirmed the presence of feral cats in the areas where nesting colonies are known to form.

O'Donnell *et al.* (2016) provide best practice guidelines for predator control to protect braided river birds:

- Target the entire predator guild, including indigenous avian predators.
- Use very high densities of capture devices if small high value sites (e.g. breeding colonies) are to be protected.
- Use all available predator control methods e.g. different traps for different small mammals, toxins in bait stations for rats.
- Monitor predator capture rates and biodiversity outcomes (this is discussed further in Section 8 below).

- Consider indirect ways of controlling predators, for example:
 - Remove primary prey such as rabbits.
 - Maintain safe islands with high water flows around them.

Environment Canterbury and its partners (e.g. the Department of Conservation and Christchurch City Council) need to work incrementally towards landscape-scale predator control in the Regional Park to achieve widespread suppression of introduced mammalian predators along the riverbed and its riparian margins. This landscape-scale predator control should be phased in, starting in the lower Waimakariri River where predator control is already happening (Figure 3), and should eventually be expanded further up the river towards the gorge. The goal of this should be to provide year-round pressure on predators in the river bed, so that they are at low abundance each year when braided river birds commence nesting.

It is envisaged that landscape-scale predator control in the lower Waimakariri River would involve the following (where practicable):

- Link riparian trapping on both sides of the river, so that it is continuous.
- Where feasible, having two approximately parallel trap lines in riparian edges on both sides of the river. Where this is not feasible, one line will suffice.
- Trapping in older, undisturbed, parts of the riverbed and on dry islands that are not thought to be flood-prone (so that traps are not lost).

Individual traps on a line should be 200 metres apart. Traps should be spaced more closely (e.g. 50-100 metres apart) in high value areas such as wetlands. The bulk of the trapping should be undertaken with DOC-series traps, which will catch mustelids, hedgehogs, rats, and sometimes feral cats. In areas where monitoring shows that rats are problematic bait stations should be deployed.

Kill-traps for feral cats should also be added to these lines, spaced at 500 metre intervals, to have one feral cat trap every 30 hectares. This will not be possible in areas where residential cats are at risk from the traps. In these locations, pulsed live-trapping will need to be used with obvious residential cats returned to their owners. Live-trapping should also be run in conjunction with the braided river bird breeding season.

Landscape-scale predator control will also provide substantial benefits for wrybill, banded dotterel, New Zealand pied oystercatcher, and black-fronted dotterel. Current ring-trapping around black-billed gull and black-fronted tern colonies will not be providing sufficient protection of these species.

Control of introduced mammals should be synchronised spatially with the control of black-backed gulls as it would be counter-productive to have braided river birds protected from mammalian predators but then preyed on by black-backed gulls, or vice versa. Incremental expansion of the trapping programme should be coupled with similar incremental expansion of southern black-backed gull control.

Colony-Specific Trapping

Colony-specific trapping should be more intensive than the current low intensity ring-trapping. Although a small number of traps may sometimes catch predators that would otherwise move into a colony, some feral cats and stoats will have already become alerted to a colony from further away, via audio and olfactory cues, and will ignore the traps as they approach the colony.

Very intensive trapping to protect an individual black-fronted tern colony is described in O'Donnell *et al.* (2016, Box 3). It seems impractical to deploy this level of intensive control effort at all the breeding colonies in the Regional Park each season. A lot of trapping equipment would also be put at risk of being lost during floods. Rather, it is suggested that small intensive 100 × 100 metre trapping grids are set up around important colonies. The actual number of traps will depend on the colony size, but an initial suggested prescription would be to establish a 200 metre buffer around each colony, but this should be expanded if predation is not being adequately prevented. This type of approach is being used around rock wren (*Xenicus gilviventris*) nests in Mt Aspiring National Park (Hufton 2018).

7.3 Southern black backed gulls and Australasian harriers

Management Strategy

Black-backed gulls are present on all braided rivers in the Canterbury Region and are an immediate and long-term threat to braided river birds during the breeding season. A Canterbury-wide black-backed gull management strategy was prepared in September 2019 (Bell and Harbone 2019). This strategy provides a description of black-backed gull biology and of its impact on braided river birds, and reviews the management and control methods currently used in New Zealand. It includes the results of consultation with stakeholders from a wide range of sectors which identified the need to develop a black-backed gull regional management plan. The following measures are suggested:

- A containment control approach for higher altitude inland river reaches where black-backed gulls are currently present in low densities, which could be further reduced and maintained at zero density within the next five years.
- Inclusion of black-backed gull control on all sections of river that are already subject to a pest mammal control programme.
- A reduction in the black-backed gull population of 5% per year over the next 20 years, to improve the breeding success of braided river birds.
- Undertake further research into gull movement, habitat use, land-use management, and control options.
- Establishment of a position for a black-backed gull management coordinator for the Canterbury Region.

Predation of nesting colonies and competition for nesting habitat are discussed further below.

Black-Backed Gull Predation of Nesting Colonies

Data presented in Popenhagen (2019, Table 4) suggests that only 15-21% of the black-backed gull population is killed each year, largely due to lack of resourcing. This means that there are still very large numbers of these predatory birds present, and this was evident during the site visit.

Unfortunately, despite numerous observations of black-backed gulls attacking endemic braided river birds, there has been no formal research into the relationship between black-backed gull abundance and predation rates. It is therefore currently not possible to set empirically-based threshold targets for the control of black-backed gulls. Obtaining robust data to develop these thresholds is a major priority (see Section 9). In the interim, the goal of black-backed gull control should be to reduce predation and disturbance of black-billed gull and black-fronted tern colonies to a level where it no longer prevents successful breeding. A recent strategy discussion document has recommended trialling a 5% reduction per year (Bell et al. 2019). A five percent reduction per year is a good target subject to it being coupled with monitoring of endemic braided river birds, so that the level of suppression required is properly identified. Once the appropriate level of suppression of black-backed gulls is identified it should be maintained as a target density.

The aim should be to achieve this overall 5% reduction in black-backed gulls, but control should be prioritised to areas where black-billed gulls and black-fronted terns are expected to form colonies and nest. The approach being undertaken to date has largely been achieving this. However, disturbance of colonies of black-billed gulls and black-fronted terns by black-backed gulls is still occurring, indicating that the level of black-backed gull control needs to be increased.

The current budget for operational control of black-backed gulls should be increased, to achieve a 5% reduction in black-backed gull numbers per annum, and guidelines on this are provided in Section 9.1 below. This will provide an iterative approach for determination of the appropriate level(s) of expenditure needed to protect braided river birds from black-backed gulls. As expenditure is increased, monitoring should be used to determine the threshold where:

- No black-billed gull or black-fronted tern colony failure can be attributed to black-backed gulls.
- There is no substantial predation of nests of black-billed gulls, black-fronted terns, banded dotterel, or wrybill by black-backed gulls.

Identification of this threshold will enable identification of the level of expenditure required for cost-effective black-backed gull control in the Regional Park. When this threshold is understood it may be possible to scale back expenditure to maintain numbers of black-backed gulls at or below the threshold.

An important aspect of black-backed gull control is social licence, as discussed further in Section 7.5 below.

Competition from Black-Backed Gulls for Nesting Habitat

Black-backed gulls need to be managed to prevent predation of endemic braided river birds and also to prevent competition for nesting habitat. A novel approach, already undertaken by Environment Canterbury rangers, is targeted nest destruction close to endemic braided river bird colonies. The objective of this should be to try and force southern black-backed gull colonies to abandon these nesting areas, freeing up habitat for other braided river bird species. Large-scale nest destruction may not have such a poor public image as culling of adults, but its impacts on the overall population size is unknown but likely to be slow, therefore culling of adult southern black-backed gulls would still be necessary.

Australasian harriers

Australasian harriers should be managed on a case-by-case basis. If particular birds are observed to be a problem for black-billed gull or black-fronted terns they should be targeted for control. If lured in with a rabbit bait it may be possible to control individual harriers by shooting with shotguns, and this could potentially be dovetailed with control of black-backed gulls.

7.4 Weed control

A weed management plan should be developed for the braided river section of the Regional Park, and the following matters need to be addressed:

- All weed infestations within the braided river bed should be mapped, from the gorge to the mouth.



Plate 2: Woody weeds encroaching into braided river bird nesting habitat in the lower Waimakariri River.

- Weed control should be prioritised along the following lines:
 - Weed control that will increase the amount of elevated nesting habitat in areas currently utilised by black-billed gulls, or black-fronted terns, banded dotterel, and wrybill.
 - Weed control that will open up significant new nesting habitat in areas currently unoccupied by nesting braided river birds.

Weed control in parts of the river bed that are unlikely to be used by braided river birds is a low priority.

7.5 Human disturbance

Efforts to prevent vehicle access to colonies should be continued, along with signage to inform people on foot. It is very difficult to completely eliminate human disturbance, but it is clear that despite current efforts there is still poor awareness of braided river birds, their threat status, and biodiversity values. It is therefore critical that public awareness is increased. A major promotional programme should be undertaken to improve public awareness in the greater Christchurch area (including the Waimakariri and Selwyn Districts) area:

- Place a one page advertisement in the Christchurch Press at the start of each breeding season.
- School visits and an educational programme for school groups.
- Flyers for letterboxes of residents in the greater Christchurch area including the Waimakariri and Selwyn Districts.
- Detailed signage at major Regional Park access points (rather than just the small signs around the colonies).
- Increased ranger presence on the river.
- Television advertising.
- Incorporation with the Braided River Revival initiative.

This public awareness programme should also address control of black-backed gulls, so that there is greater awareness of why this is necessary.

Effective public engagement will provide a huge opportunity to involve people across the greater Christchurch area (including the Waimakariri District) in the conservation and protection of braided river birds in the Regional Park.

7.6 Wilful destruction

Wilful destruction of braided river bird nesting colonies in the Regional Park, by members of the public, needs to be stopped. These are criminal acts and are very damaging. It is the responsibility of the Department of Conservation to prevent these, along with Environment Canterbury as the landowner. In some cases it may also be the responsibility of the New Zealand Police, particularly if firearms and vehicles are involved.

A joint task force should be set up and camera surveillance monitoring undertaken of colonies in areas thought to be prone to acts of wilful destruction. Advice should be sought from a security firm on how best to place CCTV cameras in and around colonies to achieve these goals. Game cameras with active sim cards could also be used to send images in real time. The goal should be to collect sufficient evidence for a prosecution under the Wildlife Act 1953. When a prosecution is achieved, a press release should be prepared, to encourage media attention, to act as a deterrent.

7.7 Commercial activities

Water Abstraction

It is critically important that water abstraction from the Waimakariri River is managed so that minimum flow levels required for braided river bird habitat are maintained (as described in Section 5.3 above). Analysis of September to January flow rates should be included in annual braided river bird management reports, to enable correlation with the relative success of each breeding season.

Gravel Extraction

As described in Section 5.3 above, well-managed gravel extraction can reduce weeds and create breeding habitat for braided river birds. There is clearly an increasing awareness and understanding of braided river birds within the gravel extraction industry, and tremendous goodwill, as shown by the in-kind construction of experimental islands. There is a great opportunity for Environment Canterbury to work with gravel extractors to achieve conservation outcomes for braided river birds.

However, as regulators, Environment Canterbury also need to ensure that gravel extraction is not over-allocated. If gravel extraction is creating a reduction in the bed level, as estimated by Jenkins (2018), then this will be making braided river birds more vulnerable to nest losses during freshes.

7.8 Constructed islands

Construction of elevated islands as breeding habitat is a novel idea, and it is not clear why the multiple trials undertaken to date have not been successful. However, it is known that when the river is not in flood that the constructed islands represent a tiny area compared to the amount of nesting habitat that is available across the total system.

If the gravel extraction industry can commit to it, it would be good to see a trial with an increased number of islands over a larger area. Perhaps 5-10 islands of varying sizes could be constructed throughout the area, with 50% of them to be decoyed. If this was repeated over 3-5 years then a pattern of proportional uptake could potentially occur, and it would be possible to determine whether decoys are necessary. It would be useful to undertake analysis, prior to construction of islands, of the size and shape of areas where breeding colonies establish naturally, to ensure that the islands replicate the characteristics of actual breeding sites, e.g. are the correct size and shape. Consideration should also be given to construction of these islands prior

to the breeding season, so that they are available when birds return to the river to breed.

If elevated islands could be constructed during lower flows (e.g. in the winter) in locations that might receive flow in the spring, then these islands may have the additional benefit of providing refuges from mammalian predators.

8. MONITORING

8.1 Key requirements

It is essential, as a minimum, that the current level of monitoring of black-billed gull and black fronted tern breeding success is maintained and that annual helicopter surveys of southern-blacked gulls continue.

Annual ground-based river-wide surveys should also be continued, as it is useful for making long-term comparisons with data collected as far back as 1980. However, because these surveys are undertaken over a single day, they are not as useful as other monitoring methods for informing site-specific management actions.

8.2 Monitoring of smaller waders such as wrybill and banded dotterel

Due to limited funding, current monitoring is focussed on the colony-nesting species: black-billed gulls and black-fronted terns. These species are well-monitored, with annual reports providing clear insights into the success of failure of these colonies and the factors affecting them.

There is considerably less information on how nesting wrybill and banded dotterel are coping with the various threats. The Waimakariri River is clearly an important habitat for wrybill as it is estimated to have 10% of the national wrybill population. Nest monitoring of these small waders is more difficult, because nests are not grouped in colonies, and can be spread over large parts of the riverbed. However, it would be very useful to establish monitoring of a sample of wrybill and banded dotterel nests as robust information on nest fates would greatly inform the management of these species. To ensure efficiency, the sample of nests should on a section of the river where the contract ornithologist is monitoring black-billed gull and black-fronted tern colonies, and preferably between colonies that are being monitored.

8.3 Nesting success

Current monitoring of black-billed gulls and black-fronted terns is used to estimate apparent nesting success for the Regional Park each year (number of observed chicks fledged/number of adult breeding pairs counted). This is a useful metric and is providing important insights into seasonal variability in nesting success. However, research has shown that estimates of apparent nesting success are sometimes biased because the probability of finding a successful nest is much higher than the probability of finding an unsuccessful nest (Mayfield 1961, 1975). Models have been developed in Program MARK (Cooch 2019) that allow for nesting success to be estimated without bias. Current monitoring of black-billed gull and black-fronted tern

nests would be sufficient to provide data for these models. Data collection would require careful recording of:

- Fate of individual nests.
- The first day an individual nests was found.
- The last day an individual nest was found.
- The final day an individual nest was searched for.

In addition to providing more precise estimates of nesting success, approaches like this can be used to develop multi-season models that can the influence covariates such as predator density and seasonal flooding on nesting success. Such analyses would allow for more rigorous empirical investigation into which variables are most important for conservation of braided river birds within the Park.

The causes of nest failure could also be assessed using camera trap monitoring, but this would be intensive work, and should only be considered if management actions do not seem to be improving nesting success i.e. to identify other causes of nest failure.

8.4 Mammalian predator monitoring

As mammalian predator control is developed further in the Regional Park, best practice monitoring using tracking tunnels, WaxTags, and chew cards needs to be implemented. This will help to determine the relative abundance of the different introduced mammals, and identify which parts of the Regional Park they are most numerous in.

In addition to this monitoring, monthly trapping tallies should be collated and reported on annually.

9. PRIORITISATION OF MONITORING AND MANAGEMENT

9.1 Key requirements

The bottom line is that current levels of monitoring and management should be maintained or increased.

Priorities for monitoring and management are addressed below and should be separated and addressed in separate budgets, to remove potential conflicts between the resourcing of these key activities.

9.2 Monitoring priorities

The highest priorities for monitoring are as follows:

1. Continuation of the annual aerial black-backed gull counts.
2. Continued monitoring of the nesting success at colonies of black-billed gulls and black-fronted terns.

3. The addition of banded dotterel and wrybill nest monitoring.
4. Monitoring of mammalian pest control, which should be done in conjunction with the establishment of landscape-scale riparian trapping.

Note: Collection of data to enable better estimation of nesting success (as described in Section 8.2 above) will not require additional time for monitoring, rather a more robust set of rules is required for data collection during monitoring. Breeding colonies are currently visited 1-2 days per week throughout the entire breeding season, and this should be more than sufficient to collect the appropriate data.

9.3 Management priorities

Management actions should be focused on reducing the rates of nest and colony failures, and increasing the amount of nesting habitat and the highest priorities for management are:

1. Reduce predation (mammalian and avian):
 - Reduce the population of southern-black backed gulls by 5% per annum until braided river birds experience a suitable level of protection.
 - Landscape scale riparian trapping should be implemented when funding is available.
2. Weed control to increase breeding habitat.
3. Reduction of disturbance by people, including wilful acts of destruction.

Mammalian and avian predation should be implemented using the methods described in Sections 7.2 and 7.3 above.

Weed infestations should be mapped and a weed control plan should be developed and implemented. The goal of weed control is to increase the extent of habitat available for nesting, particularly elevated habitat.

Disturbance should be reduced by continued education and actions within the Regional Park, using techniques such as notification of the public through signage and prevention of access to colonies. An inter-agency approach should be developed for the surveillance and prosecution of deliberate offences under the Wildlife Act (1953).

A fourth priority is to ensure that commercial activities do not adversely affect the integrity of the braided river habitat. This can be achieved by ensuring that river flows are able to occur at natural levels, particular minimum flow rates. It is also important that over-allocation of gravel extraction does not excessively reduce riverbed levels.

Given the lack of success to date with bird use of constructed islands, further investment in this approach is a low priority. Nest abandonment due to flooding is difficult to manage and varies annually, making it difficult to predict its impact on individual breeding seasons. A proper trial of the effectiveness of constructed islands would need to be undertaken on quite a large scale and would therefore be relatively costly, unless this type of innovation was suited to a particular funding stream. In the

meantime, weed control and reduction in competition for habitat by black-backed gulls will provide substantially more breeding habitat.

9.4 Overview of timeframes for actions and deliverables

Action	Implementation Date	Priority Level
Increased SBBG control	2020-2021 breeding season	High
Wrybill and banded dotterel monitoring*	2020-2021 breeding season	High
Procurement of riparian trapping funding	Winter/Spring 2020	High
Setup of riparian trapping	February-March 2021	High
Commission a weed control plan	August 2020	High
Implementation of weed control plan	March 2021 (onwards)	High
Development/implementation of public education	Winter 2020	Medium
Establishment of Wildlife Act compliance taskforce	Winter 2020	Medium

*Additional to other existing monitoring.

9.5 Costs of future monitoring and management

It is difficult to cost a monitoring and management programme to implement all of the measures suggested in this plan, particularly given the staff contributions that will be made by Environment Canterbury and other agencies. Increased surveillance and public education efforts will need to be costed using scoping and feasibility studies. Weed control should be costed as part of a weed management plan.

Ballpark costings are provided below for increased levels of control for mammalian predators and black-backed gulls.

Control of Pest Mammals

Landscape-level intensification of predator trapping in the lower Waimakariri River would involve *c.*1,700 hectares (Figure 3) and is costed below based on landscape-scale predator control set-up and operational costs estimated for the Otago Lakes catchments (Wildland Consultants 2020).

Potential costs are based on a trap density of one per 12 hectares, which is suitable for the control of mustelids, possums, and feral cats. Set-up costs include trap purchase, labour for set-up, transport, bait, fixings, tags, and signage. Annual operational costs are based on monthly servicing visits to the traplines and include bait replacement, labour, transport, maintenance, and servicing of traps. It is assumed that all the labour would be provided using contractors. Estimated pest control intensification costs for the lower Waimakariri are presented in Table 4. The 142 traps required for the 1700 hectares are additional to those already in place in other parts of the lower Waimakariri River and would be deployed in the riparian berm areas of the lower Waimakariri River, as it is not possible to deploy them in the active riverbed (see Section 7.2 above)

Riparian trapping will be less intense than the localised trapping already taking place, and is aimed at providing lower intensity, but more widespread trapping of the berms in the lower Waimakariri River, to reduce the numbers of predators travelling along the river's edge.

Table 4: Estimated costs of landscape-scale pest control along riparian berms of the lower Waimakariri River. The 1,700 hectare area is identified in Figure 3.

Location	Area (ha)	No. Traps	Set-Up Costs	Annual Costs
Lower Waimakariri River	1,700	142	\$23,462.67	\$14,858.42

Once this has been expanded phase has been established and is operational, funding should be sought to extend this trapping further upriver.

Control of Black-Backed Gulls

Estimates are provided in Table 5 for the annual costs of removing 50% and 75% of black-backed gulls from the Regional Park, based on the control costs in 2018 and 2019. Costs do not include Environment Canterbury staff and volunteer time. A range of costs are provided that allow for variability in the number of breeding pairs per annum (based on the 2016, 2017, and 2018 surveys (Table 5).

Table 5: Potential costs for control of southern black-backed gulls in Waimakariri River Regional Park.

Estimated breeding pairs	Estimated population	Control costs/ bird	Costs to effectively remove 50% of population	Costs to effectively remove 75% of population
5,000	10,000	\$17	\$85,500.00	\$127,500.00
4,000	8,000	\$17	\$68,000.00	\$102,000.00
3,000	6,000	\$17	\$51,000.00	\$76,500.00

In 2018-2019 Environment Canterbury spent \$12,045 on control of southern black-backed gulls. Based on Table 5, and an assumption that there are currently 5,000 pairs of black billed gulls in the Regional Park, a further \$73,455/annum would be required to achieve a 50% reduction in black-backed gull numbers across the Regional Park, or roughly \$7,345 per year over 10 years. This is a coarse indication and does not account for inflation or a cumulative reduction in black-backed gull numbers. It is suggested that expenditure should be increased by \$8,000 per year, with costs to be evaluated and reviewed annually to determine how results are tracking towards the 50% and 75% reductions in black-backed gulls, and towards the WMIL (2019) target of a 5% reduction per annum.

9.6 Future budgets

Current Braided River Bird Management

During the 2018-2019 breeding season, Environment Canterbury had a budget of \$40,000 per annum to manage braided river birds in the Regional Park. This includes an annual contribution by CIAL towards southern black-backed gull control of \$7,000-\$10,000. This budget does not include Environment Canterbury ranger salaries, or the costs of permanent traplines (which are funded out of other budgets).

To achieve the objectives outlined in this plan expenditure will need to be increased, as set out below:

- The current budget of c. \$15,000 per annum for monitoring should be increased to \$20,000 per annum to allow for monitoring of nesting by wrybill and banded dotterel.
- The budget for control of southern black-backed gulls should be increased by \$8,000 per annum, as discussed in Section 9.1
- Consumable spending - which has been between \$800-\$2,000 over the last two seasons – should be extended to an annual budget of \$4,000 to ensure that rangers have sufficient signage and resources to block access to colonies.

These measures would increase the annual operational budget for the 2020-2021 season to **\$55,000**.

It is assumed some of this budget could be sourced internally within Environment Canterbury, but it would be worthwhile to discuss potential partnership funding with the Department of Conservation. CIAL could also be approached for additional funding support.

Costs should be reviewed annually, by the Technical Advisory Group.

Increased Riparian Predator Trapping

The increased riparian trapping addressed in Section 7.2 above would have one-off set-up costs of \$23,500 and annual operational costs of \$15,000 (Section 9.1 above). It is not expected that this would necessarily be part of the existing braided river bird management programme within the Regional Park, but could form part of wider braided river trapping or Predator Free 2050 initiatives run by Environment Canterbury, Department of Conservation, and Christchurch City Council.

If a community trust is set up, it could potentially get funding for this predator control from other sources and provide governance and management for a more extensive trapping network in the Regional Park. Funding sources potentially available would be the NEXT Foundation, the Community Conservation Partnership Fund, and Predator Free 2050.

Weed Control

Development of a weed management plan for the Regional Park is estimated to cost between \$12,000-\$20,000, and would be at the higher end of this estimate if detailed mapping of weed infestations is included. This plan is required to accurately cost and prioritise weed control in the Regional Park.

Development of this plan is will meet other catchment management objectives, and other objectives under the Regional Pest Management Plan, and could potentially be partly funded by several Environment Canterbury programmes.

Community Engagement and Prevention of Wilful Destruction

Environment Canterbury and the Department of Conservation should assess their joint capacity to develop a community engagement strategy, and establish an in-tr-agency task force to investigate and address wilful acts of destruction. This would require input from a broad cross-section of staff including those with expertise in ecology, compliance, media, and public relations.

10. RESEARCH REQUIREMENTS

10.1 Overview

The following are high priority research needs:

- Black-backed gull impacts on nesting braided river birds.
- Demographic analysis of braided river birds.
- Importance of other rivers for braided river birds.

10.2 Southern black-backed gull impacts on nesting braided river birds

Better quantification is required of the level of impact that black-backed gulls are having on braided river bird populations within the Park. This is necessary to provide guidance on the level of mortality of black-backed gulls that is required. This is more important than understanding these dynamics for introduced mammals, because black-backed gulls are an indigenous species, and occur naturally in braided river systems. Complete eradication is therefore undesirable, while retention of a small base population would be acceptable.

It is possible that the current programme of black-backed gull counts, recording the numbers culled, and nesting success of black-billed gulls and black-fronted terns will provide a clearer picture of this over time. However, it is confounded by nest loss caused by other factors such as mammalian predation and flooding. More direct research into black-backed gull impacts would make a good PhD thesis topic, as black-backed gulls would provide large sample sizes for analysis.

10.3 Demographic analysis of braided river birds

Demographic analysis to better understand predicted population trajectories of the different braided river birds in the Regional Park would be useful information for management. In the absence of such analyses, managers are always trying to guess whether their actions are providing long-term protection for these species.

Population viability analysis (Beissinger and McCullough 2002) is a modelling platform which can be used to determine whether species population trajectories are stable, increasing, or decreasing. If a population trajectory is declining then population viability analysis can be used to estimate time to extinction. Given reliable data, the method can also be used to determine the likelihood of success of different management options.

Population viability analysis is commonly used by conservation managers in other parts of the world to develop action plans by ranking different management scenarios, and assessing the potential impacts of habitat loss.

10.4 The importance of other rivers for braided river birds in the Regional Park

Braided river birds are highly mobile and when freshes occur they move to alternative habitat in neighbouring rivers with different catchments. When large freshes on the Waimakariri River have caused large black-billed gull colonies to abandon sites, similar numbers of birds have often been noted arriving at the Ashley/Rakahuri River within a few days. It is important to understand the role(s) of neighbouring rivers for maintaining braided river bird populations on the Waimakariri River. If they are important for the survival of braided river birds in the Waimakariri, then a wider management plan needs to address the conservation management of these rivers in conjunction with the conservation of populations on the Waimakariri River.

The most practical way of understanding this better would be by banding braided river birds within the Regional Park so that sightings of banded birds can be recorded during surveys of other Canterbury rivers.

11. CONCLUSIONS

Waimakariri River Regional Park is outstanding habitat for Threatened and At Risk braided river birds. Notably, it has 5% of New Zealand's black-fronted tern and 10% of New Zealand's wrybill population. Black-billed gull (Threatened-Nationally Critical) also nest within the Regional Park. All of these species face a wide range of threats, including:

- Natural flooding.
- Risks from climate change,
- Predation by introduced mammals.
- Predation and competition with southern black-backed gulls.
- Disturbance by people.
- Wilful acts of destruction by people.
- Weed encroachment into potential nesting habitat.

Commercial activities need to be managed appropriately to prevent additional disturbance and further habitat loss.

Environment Canterbury currently manages some of these threats by trapping mammalian predators, controlling black-backed gulls, putting up barriers to prevent vehicle access to nesting colonies, and implementing initiatives to educate people. However, despite these efforts, there is still a considerable level of nesting colony abandonment by black-billed gulls and black-fronted terns. Management efforts and protection of these populations therefore need to be increased. In particular, Environment Canterbury should work towards preventing all nesting colony abandonment due to pests and human-related effects. They should also optimise the

amount of nesting habitat that is available in the Regional Park, by undertaking targeted control of woody species in the riverbed.

Monitoring effort should be increased, to include:

- More detailed monitoring of smaller waders such as wrybill and banded dotterel.
- More precise estimation of nesting success rates.
- Monitoring of the relative abundance of introduced mammalian predators.

Research priorities include:

- Improved understanding of the relationship between black-backed gull population size and predation pressure on braided river birds.
- Demographic analysis of braided river bird populations, and better understanding the role that adjacent rivers play in maintaining the braided river bird populations which utilise the Waimakariri River.

The latter will help to inform Environment Canterbury on the need for complementary management of other rivers for the conservation of braided river bird species.

Priorities have been developed for monitoring and active management and these should be applied in an adaptive manner, with annual reviews of results and costs.

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