Hakatere/ Ashburton River control and monitoring plan for Karoro/Southern Black-backed Gull

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This report was prepared by Toroa Consulting for Environment Canterbury.

July 2026

Citation

This report should be cited as:

Bell, M. 2026. Hakatere/ Ashburton River control and monitoring plan for Karoro/Southern Black-backed Gull. Unpublished Toroa Consulting Technical Report to Environment Canterbury.

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Introduction

In 2019 Environment Canterbury commissioned the Canterbury Southern Black-backed Gull/Karoro Management Strategy (Bell & Harborne *2019*) which recommended reducing the current Karoro population in Canterbury to 10% of its current level.

In 2024 to review control operations, against a burgeoning Canterbury Karoro population, Environment Canterbury commissioned a report to develop a control regime for the lower Waimakariri River (Bell 2024) to implement the Canterbury Southern Black-backed Gull/Karoro Management Strategy (Bell & Harborne *2019*) recommendations of reducing Karoro numbers on the lower Waimakariri River to 10% of their current levels.

The Hakatere/Ashburton River is an important breeding habitat for native and endemic braided river birds. In particular, the upper reaches of the Hakatere support the only increasing population of Banded Dotterel where sustained predator control is carried out (O'Donnell and Monks 2020). The super abundance of Karoro on the river threatens and impacts these species, and as a result there has been sporadic Karoro control by Environment Canterbury since 2005.

Following the Waimakariri Report, Environment Canterbury has commissioned the development of a control regime for the Hakatere. Using a similar format to the Waimakariri report, this report summarises the known status of Karoro on the Hakatere, reviews previous control, and develops a control regime that aims to achieve the Canterbury Southern Black-backed Gull/Karoro Management Strategy (Bell & Harborne *2019*) goals of reducing the population to 10% of its current level.

Karoro in Canterbury

Karoro population numbers and distribution

Following aerial surveys of most rivers in the region, in 2019 the Karoro population in Canterbury was estimated at 105,000 individuals (Bell and Harborne 2019). However recently this has been challenged with Whitmore (2024) suggesting a Canterbury population of 175,000 birds. The Bell and Harborne (2019) estimate were based on a breeding population of 35,000 pairs and allowing for an additional third of the population to be juvenile or sub-adult birds following Fordham (1963). Whitmore (2024) calculates subadults comprising two thirds of the population with a much higher juvenile survival rate. This significant difference in juvenile survival rates used, produces vastly different total population estimates.

Region wide aerial surveys for Tarāpuka/ Black-Billed Gull on all major rivers in 2023 and 2024 also recorded Karoro colonies. Producing an updated estimate of the breeding population to 42,000 pairs for Canterbury, an increase of 6%. Using the same method of Bell and Harborne (2019) this would give an estimated total population of 112,000 birds.

Karoro population numbers and distribution using eBird data.

eBird is among the world's largest biodiversity-related science projects, with more than 100 million bird sightings contributed annually by eBirders around the world and an average participation growth rate of approximately 20% year over year. A collaborative enterprise with hundreds of partner organisations, thousands of regional experts, and hundreds of thousands of users, eBird is managed by the Cornell Lab of Ornithology and is partnered with Birds New Zealand in Aotearoa. eBird data document bird distribution, abundance, habitat use, and trends through checklist data collected within a simple, scientific framework. Birders enter when, where, and how they went birding, and then fill out a checklist of all the birds seen and heard during the outing.

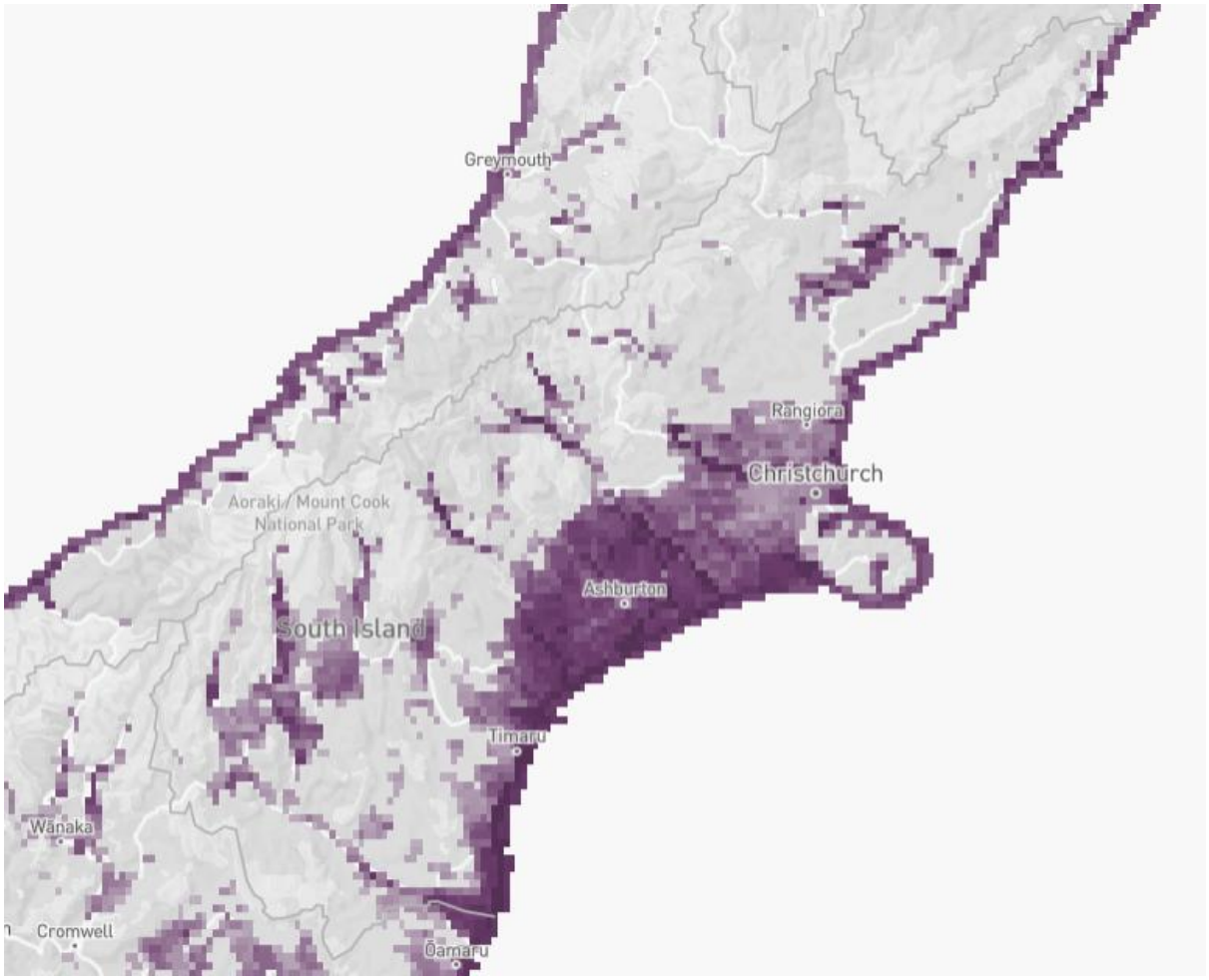
Via eBird science tabs https://science.ebird.org/en/status-and-trends users can explore the regional status and trends of a species of interest, providing the most up to date information on the species distribution and trends (Fink *et al*. 2023, Fink *et al*. 2024) using relative abundance modelling.

eBird relative abundance is the count of individuals of a given species detected by an expert eBirder on a 1 hour, 2 kilometre traveling checklist at the optimal time of day. Relative abundance predictions have been optimized for user skill and hourly weather conditions, specific for the given region, season, and species, in order to maximize detection rates. For each species, relative abundance was estimated for all 52 weeks of the year across a regular spatial grid with a density of one location per 3 km × 3 km. Estimates at each location and date were made based on the local habitat, elevation, and topography.

Using this method, eBird estimate that Canterbury has 4% of the global population of Southern Black-backed Gull/ Karoro and represents 4% of the species global range. Aotearoa has 11% of the global population and is 19% of the species range.

Karoro distribution and relative abundance across Canterbury is not even (Figure 1). With the year-round relative abundance (Figure 1) showing higher numbers along the coast, and in areas of intensive agriculture, and in particular areas with irrigation. With high populations found in the Culverden/Waiau Plains, Waimakariri Plains, and the especially the South Canterbury Plains. Further inland numbers decline, and most are distributed along braided rivers. The Hakatere is at the epicentre of Karoro density in Canterbury, with the Canterbury Plains (Selwyn River to Rangitata River) having 40% of the Canterbury Karoro population. eBird modelling shows no significant seasonal movements of Karoro in Canterbury, or Aotearoa (Fink *et al*. 2024).

Figure 1. Relative abundance map of Karoro/ Southern Black-backed gull (https://science.ebird.org/en/status-and-trends/species/kelgul/abundance-map?regionCode=NZL Sourced May 2026, Fink et al. 2024).



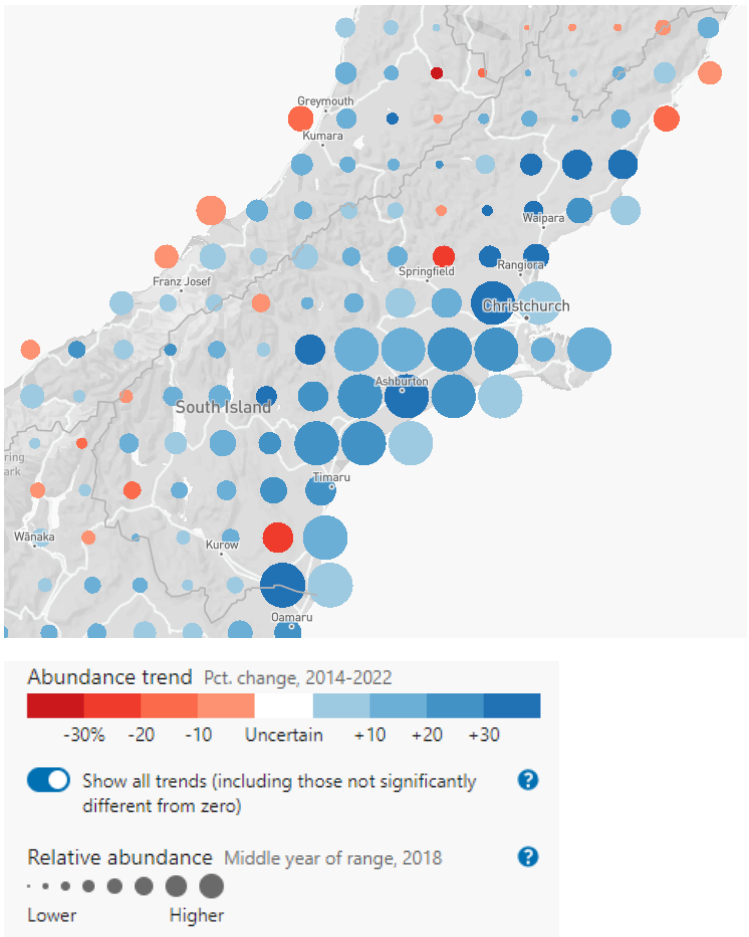
Karoro population trends

The eBird Trends maps show the cumulative percent change (or trend) in relative abundance across a grid of 27 x 27 km pixels for a study period of 7-15 years, depending on the global region, represented by blue (increasing) and red (decreasing) pixels. The darker the colour, the stronger the trend for each pixel. White circles are areas where the estimated direction of the trend is uncertain (read more uncertainty estimation here). To emphasize where overall population change was greatest on the trend maps, each 27 x 27 pixel is also sized by the estimated relative abundance at the midpoint of the regional study period.

The eBird data shows that Karoro are increasing in Canterbury (Figure 2), with the population increasing by 19% (13.5-28% at 80% confidence intervals) between 2014 and 2022. Across all of Aotearoa the population increase is 7.6% (4.7-12.5% at 80% confidence interval) (https://science.ebird.org/en/status-and-trends/species/kelgul/trends-map?week=30&showAllTrends=true&regionCode=NZL-3400 Sourced April 2024, Fink *et al.* 2023).

the only areas with population trends in decline, are areas were Karoro control operations have been carried out, The Waiau Toa/Clarence River Mouth, Waimakariri Gorge, and lower Rangitata River.

Figure 2. Population trends of Karoro in 27x27km pixels 2014-2022 in Canterbury from eBird Trends maps (https://science.ebird.org/en/status-and-trends/species/kelgul/trends-map?week=30&showAllTrends=true&regionCode=NZL-3400 Sourced April 2024, Fink et al. 2023).



Hakatere Karoro population and previous control

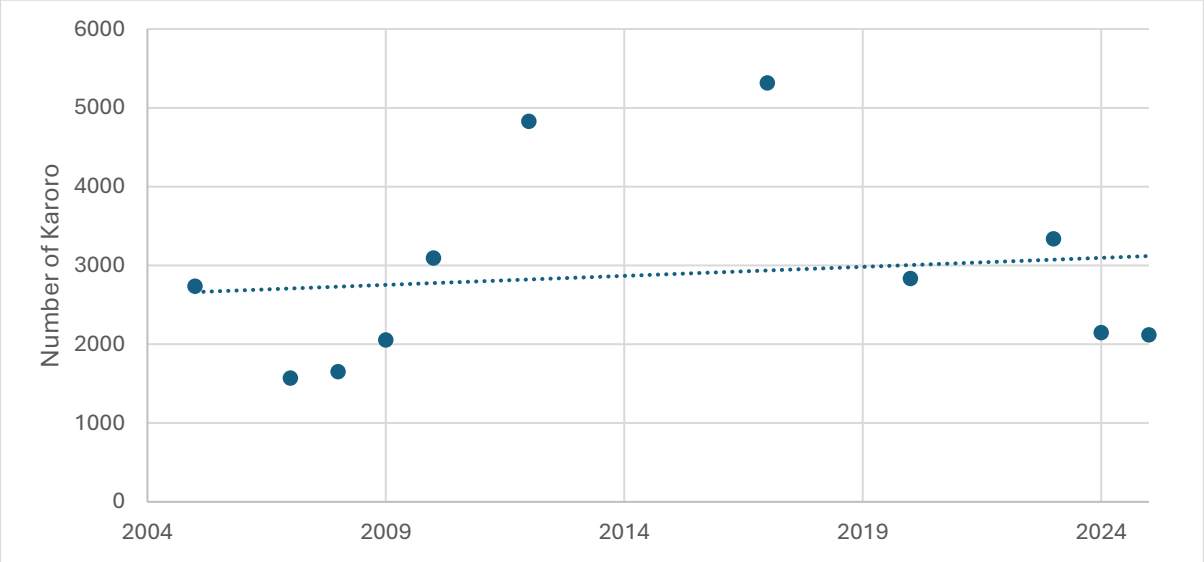
Karoro numbers and population trends

As mentioned above, the Canterbury Plains supports a super abundant Karoro population, with the Hakatere at the centre of this density (Figure 1). However, the upper reaches have much fewer birds, although there is a smaller concentration around Lake Heron/ headwaters of the Rakaia River. This area is sandwiched in between higher Karoro density in the upper reaches of both the Rakaia and Rangitata Rivers. This lack of Karoro occurs in the only river section in Aotearoa with a recorded increase in Banded Dotterel (O'Donnel and Monks 2020) and highlights the significance of this section of river.

Regular braided river bird walk-through counts have been carried out on the South Branch and lower Hakatere since 2005 (ECan unpublished data). Karoro numbers have fluctuated, reaching a peak between 2012-2017, but declined in 2020 to 2025 (Figure 3). Some of these recorded

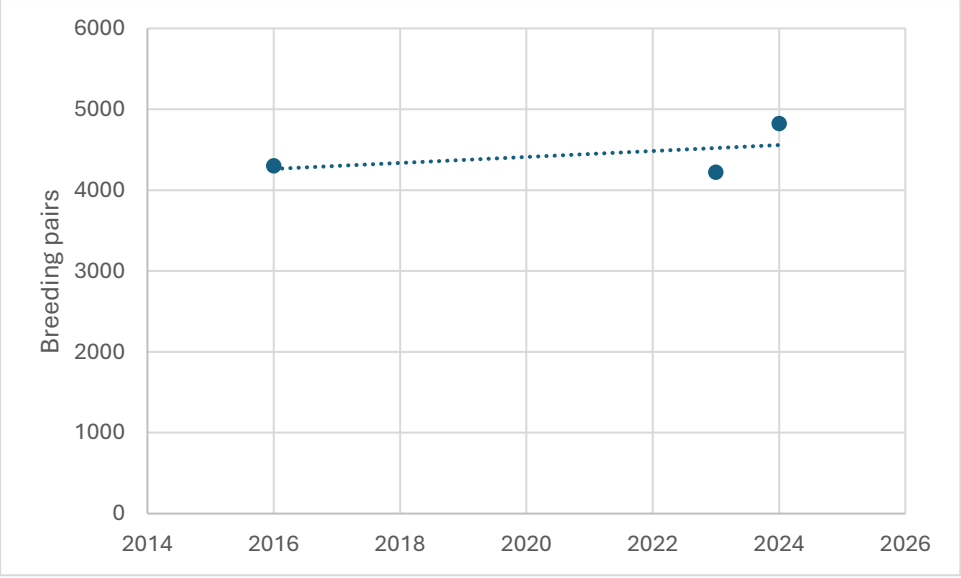
declines can be attributed to control operations occurring in 2017, 2024 and 2025. The average number throughout this period was 2,880 birds, given that these counts occur mid-way through breeding, it is likely that these numbers represent breeding pairs, as during the count one partner is likely off river foraging.

Figure 3. Number of Karoro counted on walk-through surveys of the lower Hakatere River, 2005-2024 (data sourced from Environment Canterbury).



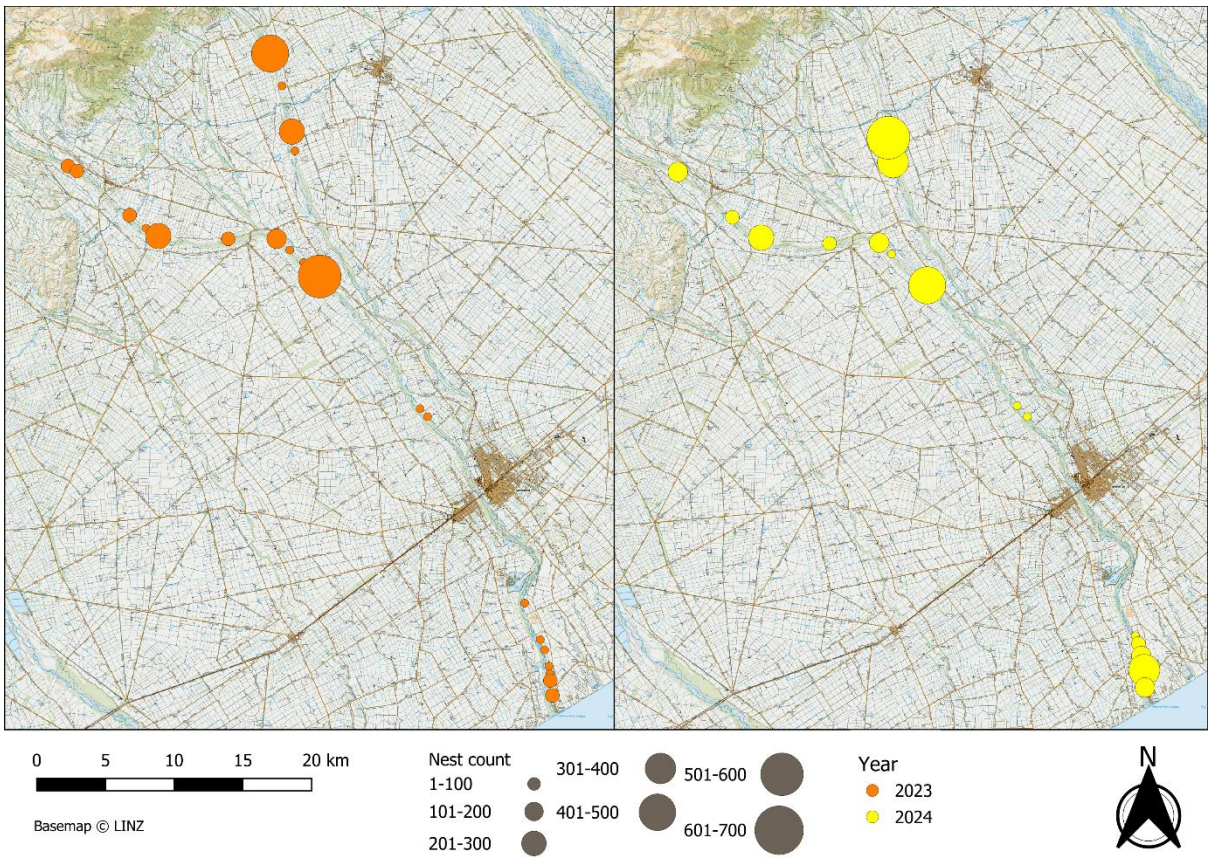
During regional wide Tarāpuka/ Black-billed Gull aerial surveys, the number of Karoro breeding on the Hakatere, including both the South and North Branch, have been counted in 2016, 2023 and 2024. These have counted an average of 4,400 breeding pairs (Figure 4). With average counts, when excluding the North Branch, so covering the same area of river as the walk-through surveys, gives an average of 3,200 pairs. A similar result to that of the walk-through surveys (2,880 pairs).

Figure 4. The number of breeding Karoro pairs recorded on the Hakatere (including the North and South Branch) during aerial surveys 2016-2024.



The spatial spread of Karoro on the Hakatere is not even, with the distribution of colonies clumped (Figure 5). Most birds occur in the mid and lower reaches, with very few birds occur in the upper reaches towards the Ashburton Lakes (Figure 5 and 6).

Figure 5. Location and size of Karoro colonies on the Hakatere during aerial surveys 2023 and 2024.

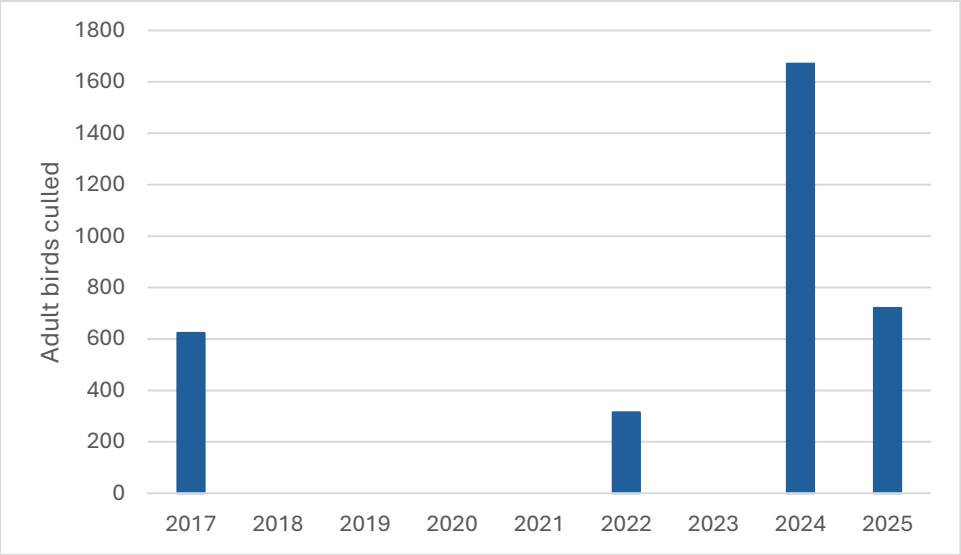


Karoro control

Karoro have been controlled in a co-ordinate fashion by Environment Canterbury on the Hakatere for the past two seasons; with very effective alpha chloralose operations carried out in 2024 and 2025. With historical control operations carried out in 2017, 2005 and 2022 (Figure 6). All these operations have been carried out in the Hāpua to Forks Section. Additional control was carried out on the Cameron River (Lake Heron) in 2024, part of the Ashburton Lakes Hakatere Conservation Park and adjacent to the headwaters of the Hakatere.

The very effective control operations in 2024 and 2025, has effectively kick started a co-ordinated control regime, and this needs to be considered in refining a management programme. As such, this plan has a start date of 2024 and incorporates the two seasons of control as the first two years of the control regime.

Figure 6. The number of adult Karoro culled on the Hakatere 2017-2025.



Population vital rate data of Karoro and other gull species as a proxy

To develop an effective control regime, population vital rates such as breeding success, recruitment and annual adult survival need to be known. Some of these are known for Karoro on the Hakatere, or for Karoro from other studies in Aotearoa or overseas. However, where data is limiting, information from other gull species with a similar ecology and increasing population (Greater, Lesser and Herring Gull), are used as a proxy.

Productivity

Productivity is the number of young successful fledged per breeding pair each season. Fortunately for Karoro breeding success has been studied on the Hakatere and the Waimakariri Rivers for four seasons 2021-2024 (W. Fox Pers. Comm.).

On the Hakatere, Karoro on average lay 2.6 eggs per nest and fledge 0.15 chicks per pair which is very low productivity. Colonies in the mid reaches of the South Branch were used to measure productivity, and these suffered heavy predation rates, which significantly impacted breeding success (W. Fox Pers Comm.).

On the Waimakariri River Karoro lay 2.57 eggs per nest and fledge 0.63 chicks per pair although there is considerable variability between colonies (range 0.21-1.28 chicks/pair) (W. Fox Pers. Comm.). Productivity is within the range of that recorded previously in Aotearoa, with 1.35 chicks/nest in Wellington in the 1960's (Fordham 1963) and 1.24 chicks/nest in Nelson in the 1990's (Bennett-Wilkinson 1992).

Given the low recorded productivity on the Hakatere during Fox's study, likely caused by predation, productivity data for the Waimakariri River is used here.

Under favourable conditions gull breeding success can be high with about half the eggs laid producing fledged young, with food availability and chick predation (including cannibalism) major impacts on breeding (Coulson 2019). In reviewing breeding success of increasing Herring

Gull populations Coulson (2019) recorded average productivity of 0.88 chicks/pair – similar to breeding success recorded in Canterbury; and in declining Lesser black-backed gull colonies of 0.35 chicks/pair. Generally, productivity of between 0.6-0.7 chicks/pair is considered necessary to prevent population declines in gull species that have high annual adult survival.

Annual adult survival

Annual adult survival is the proportion of adult birds which survive from one year to the next. Unfortunately, there is no measure of annual adult survival from either the Waimakariri or the Canterbury region. Fordham and Cormack (1970) measured Karoro survival at 0.93 in Wellington when the population there was increasing.

This is similar to other similar gull species with increasing populations with annual adult survival rates recorded between 0.84-0.94 (Table 1, source within table).

Table 1. Karoro and similar gull species annual adult survival rates.

Species	Adult survival	Location	Source
Karoro	0.93	Wellington	Fordham and Cormack 1970
Karoro	0.84	South Africa	Altwegg *et al*. 2007
Herring Gull	0.935	UK	Chabrzyk and Coulson 1976
Herring Gull	0.75	Belgium	Bosan *et al* 2016
Herring Gull	0.91	Canada	Breton *et al*. 2008
Lesser Black-backed Gull	0.9-0.94	UK	Rock and Vaughan 2013
Lesser Black-backed Gull	0.91	Netherlands	Camphuysen & Gronert 2012

Juvenile survival and recruitment rates

Juvenile survival is the survival of chicks from fledging to one-year-old; whilst recruitment is the proportion of fledglings which survive to breeding age and join the breeding population. Due to long-time frames, recruitment is difficult to measure, and there are few studies.

There is no measure of juvenile survival or retirement from the Waimakariri or Canterbury, but this has been measured in Karoro in Wellington and South Africa. Although these studies did not determine recruitment, this can be estimated from age class specific survival rates published (Table 2). Herring gull recruitment from overseas studies in increasing populations is similar to that recorded for Karoro. Further, from Karoro banded in Canterbury (including birds from the Waimakariri), Rowe (2013) found that 45% of recoveries were of birds <1 year old, and only 10% of recoveries were of birds >5 years old; suggesting that recruitment is relatively low.

Table 2. Juvenile and sub-adult survival rates, and recruitment rates of Karoro and Herring Gull from Aotearoa and overseas studies.

Species	Location	Juvenile	2nd Year	3rd Year	Recruitment	Source
Karoro	Wellington	0.53	0.79	0.89	0.373*	Fordham and Cormack 1970
Karoro	South Africa	0.44	0.84	0.84	0.311*	Altwegg *et al*. 2007
Herring Gull	UK	0.8	0.83	0.67	0.445	Chabrzyk and Coulson 1976
Herring Gull	Belgium	0.39			0.219	Bosan *et al*. 2016

* Calculated from published data on survival rates of each age class.

Immigration and emigration

Immigration and emigration are the number of birds that enter and leave the population and can have a profound effect of population trends. Again, due to the long-time frames, and the mobility of gull species, these vital life traits are exceptionally hard to measure. As such there are no estimates of immigration and emigration rates of Karoro on the Hakatere, or Canterbury, although we know it happens.

Using recovery data of dead banded birds Rowe (2013) studied Karoro movement in Canterbury, which showed that juvenile birds can disperse widely (>200km), birds older than 5 years were found back at the breeding colony; suggesting a dispersive phase, perhaps before birds returned to natal breeding sites. However, lack of search effort in all colonies, meant emigration could not be measured.

Assessing control regime options

Population control to achieve the strategy recommendations of a population 10% of present requires reducing Karoro numbers to ≤400 breeding pairs on the Hakatere.

To determine and assess control regime options, modelling population trajectories must consider population vital rates, such as productivity, recruitment, annual adult survival and immigration or emigration. These models can be manipulated to reflect different management regimes and predict the future population trajectory to determine the best approach.

Population vital rates for Karoro on the Hakatere are known for some aspects and where not, these have been estimated from other research on Karoro in Canterbury, Aotearoa or overseas, or other gull species with similar ecology; see section above for how these were determined. Population vital rates used in models are listed below (Table 3).

Given that immigration is so hard to measure, but is certainly likely to happen, I use a 2% immigration rate; that is each year 2% additional birds will be recruited to the adult population. With emigration rates also not known, but immigration being the greatest risk to assessing management outcomes, I have set emigration at 0, therefore this increases population growth by allowing for immigration, but not emigration.

Further, to assess the most effective control regime, I have worked forward from 2023. As previously mentioned, this allows for inclusion of the effective control operations of 2024 and 2025. As such, I use a population estimate for both the North and South Branch, and lower Hakatere of 4,000 breeding pairs.

Table 3. Population vital rates used for population models for assessing the effects of different control regimes.

Trait	Value	Source
Population size (pairs)	4,000 pairs	Known values from ECan survey data
Productivity	0.63 chicks/pair	Known values from the Waimakariri River W. Fox *Pers. Comm.*
Recruitment	0.342	Estimated from research on Karoro and other gull species
Annual adult survival	0.9	Estimated from research on Karoro and other gull species
Immigration	0.02	Estimated
Emigration	0	Although likely occurs, set at zero to highlight risk to control regime from immigration

No control – assessing variation in productivity.

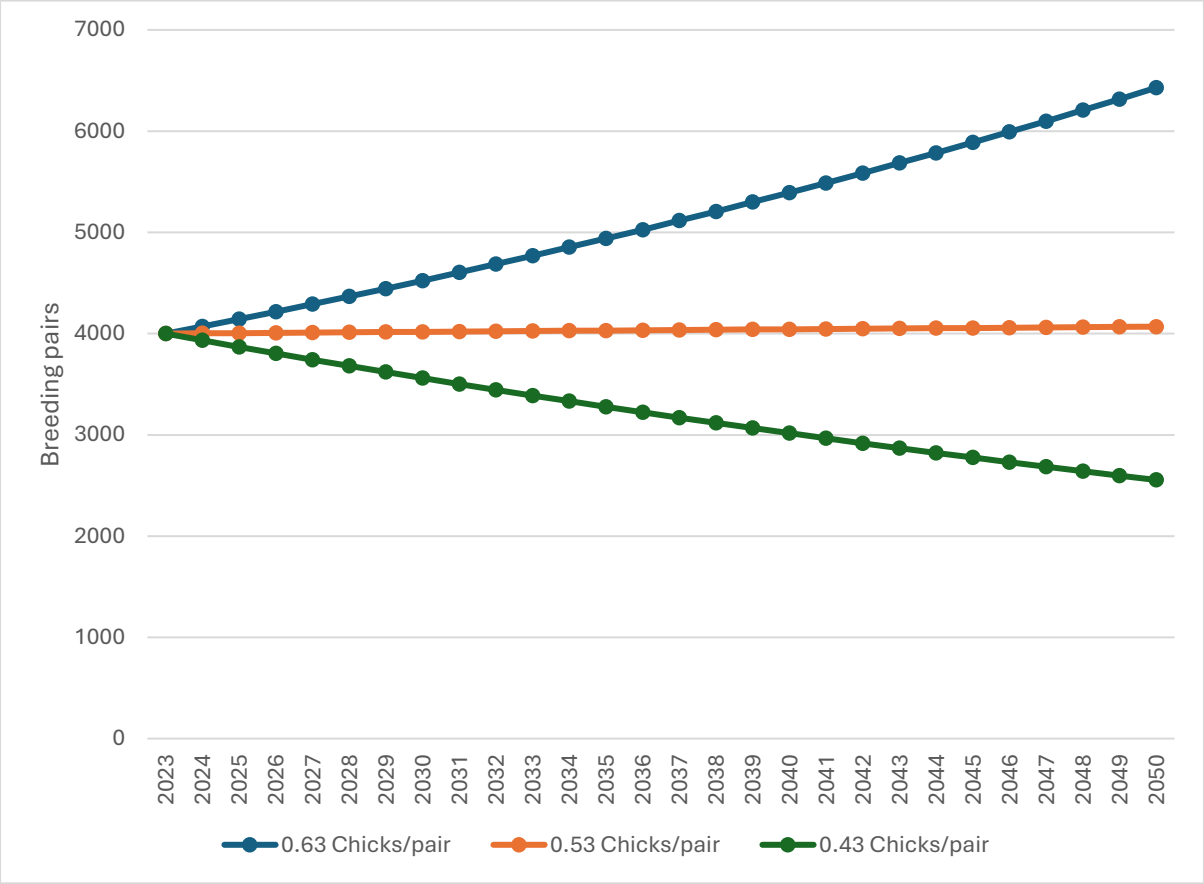
To assess the impact of differences in productivity with no population control initiated/continued, three productivity simulations were run; with productivity set at 0.63 chicks/pair (the rate recorded for the Waimakariri River), and then lower settings of 0.53 and 0.43 chicks/pair to.

With productivity of 0.63 chicks/pair the population is expected to increase at ~1.7% per annum (Figure 7). Dropping productivity to 0.53 chicks/pair has the population stable, whilst further lowering this to 0.43 chicks/pair has the population declining at 1.5% per annum.

Predicted population growth with productivity set at 0.63 chicks/pair falls within the range of the observed Karoro population increase in Canterbury. The eBird Status and Trends data shows a of 19% increase between 2014-2022 (Fink *et al.* 2023). Meanwhile counts of colonies on major rivers during the Tarāpuka/Black-billed Gull aerial survey indicates a 6% increase between 2017-2023. Both, suggesting that this level of population growth is possible and that using this productivity figure for the Hakatere is appropriate.

However, one note of caution is that this trajectory also assumes that there are no density dependent effects on population vital rates, which is probably unlikely as the population becomes super abundant.

Figure 7. Population trajectory of Karoro on the Hakatere under different productivity rates, but with no population control measures undertaken.



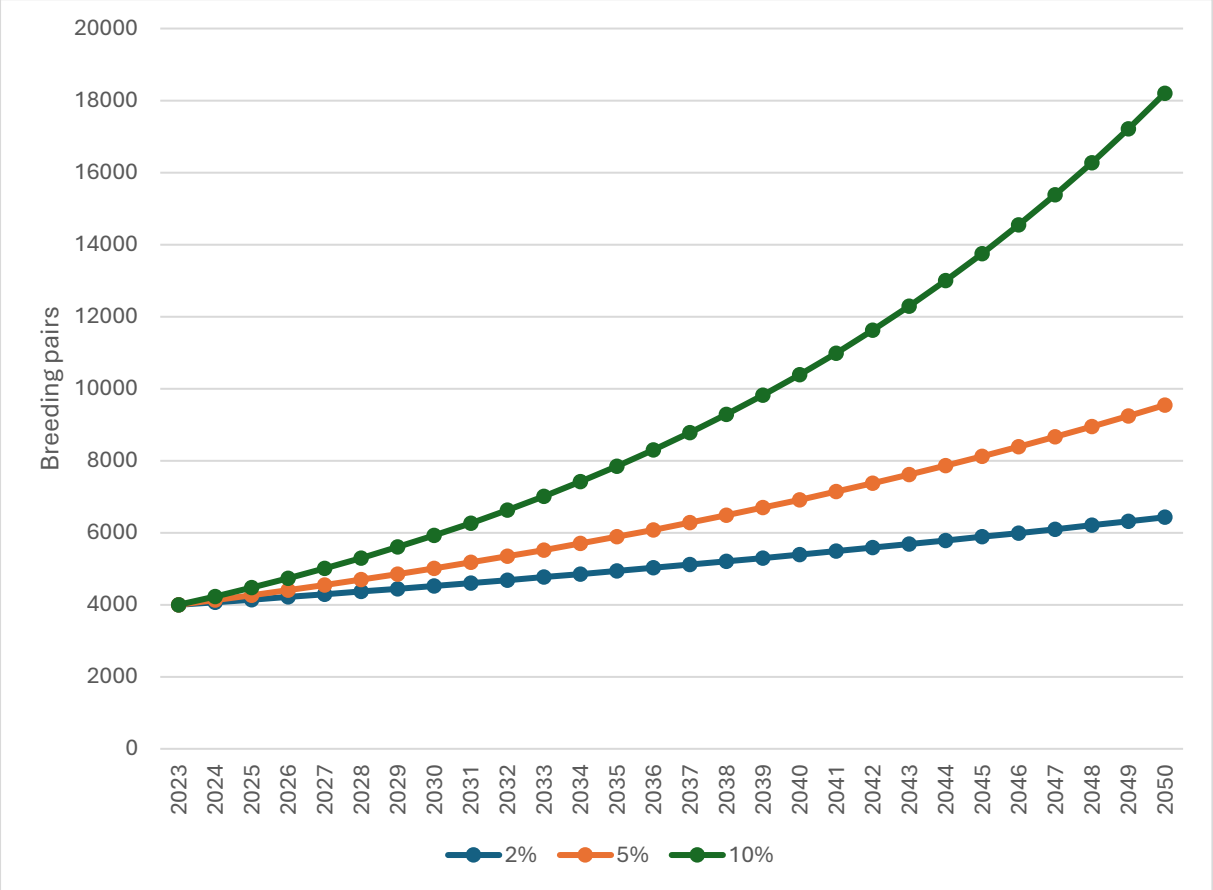
No control – assessing variation in immigration rates.

To assess the impact of differences in immigration rates with no population control initiated/continued, three immigration rate simulations were run: with immigration set at 2%, 5% and 10% of additional adults joining the breeding population per annum. Note, as discussed above, for these simulations, productivity was set at 0.63 chicks/pair.

With immigration set at 2% the population is expected to increase at ~1.7% per annum (Figure 8). Increasing immigration to 5% the population increases at 3.3% per annum, and further increasing immigration to 10% has the population expanding at 5.8% per annum.

Similar to that discussed above, predicted population growth with immigration set at 2% falls within the range of the observed in the Canterbury Karoro population Again 19% across a decade using eBird Status and Trends, and 6% over 6 years using river aerial survey data. Increasing immigration rates to 5-10% significantly push up population growth curves; likely to above realistic levels (and above recorded levels). This indicates that a 2% immigration rate setting for the Hakatere is appropriate.

Figure 8. Population trajectory of Karoro on the Hakatere under different productivity rates, but with no population control measures undertaken.



Adult cull only

Lethal control is consistently the most effective control method to reduce gull numbers (Scopel and Diamond 2017). Traditionally control methods have largely focused on culling adult birds at breeding colonies. These large-scale control operations have been successful in observing population declines in Canterbury but have not been delivered sustainably over time. Currently a co-ordinate control regime is in place on the Waimakariri River (Bell 2024).

Currently Karoro annual adult survival for the Hakatere is unknown, but it is likely to be around 0.9 (see above). Reducing annual adult survival by culling adult birds leads to population declines, and three control regimes are illustrated below, which aim to cull 10%, 20% and 30% of birds annually (Figure 9). As discussed above, in these simulations' productivity is set at 0.63 chicks/pair, and immigration at 2% additional adults joining the population per annum.

Culling 10% of adult birds annually, although reducing the population, does not achieve the strategy targets by 2050. Culling 20% will take 12 years and increasing this to 30% means it can be achieved in 8 years. This level of control requires significant culls in the first five years (Figure 10). The 2024 Hakatere control operations did remove birds at the 20% level (with operations in near the Hāpua and the Cameron River), and the 2025 operation at the 10% level. This indicates that with current resourcing control at the 20% threshold is possible to achieve.

Figure 9. Population trajectories of Karoro (breeding pairs) on the Hakatere under control regimes which cull 10% (blue line), 20% (orange line) or 30% (green line) of adult birds annually.

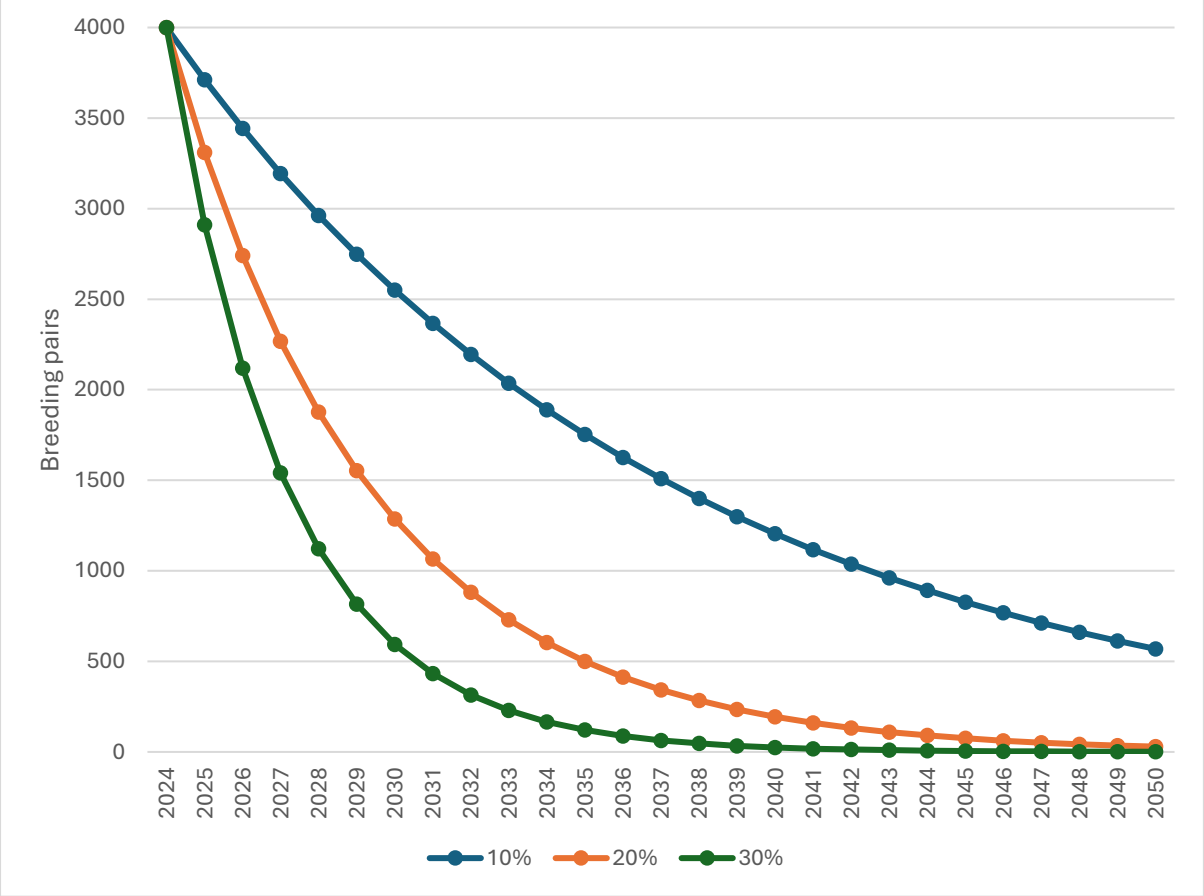
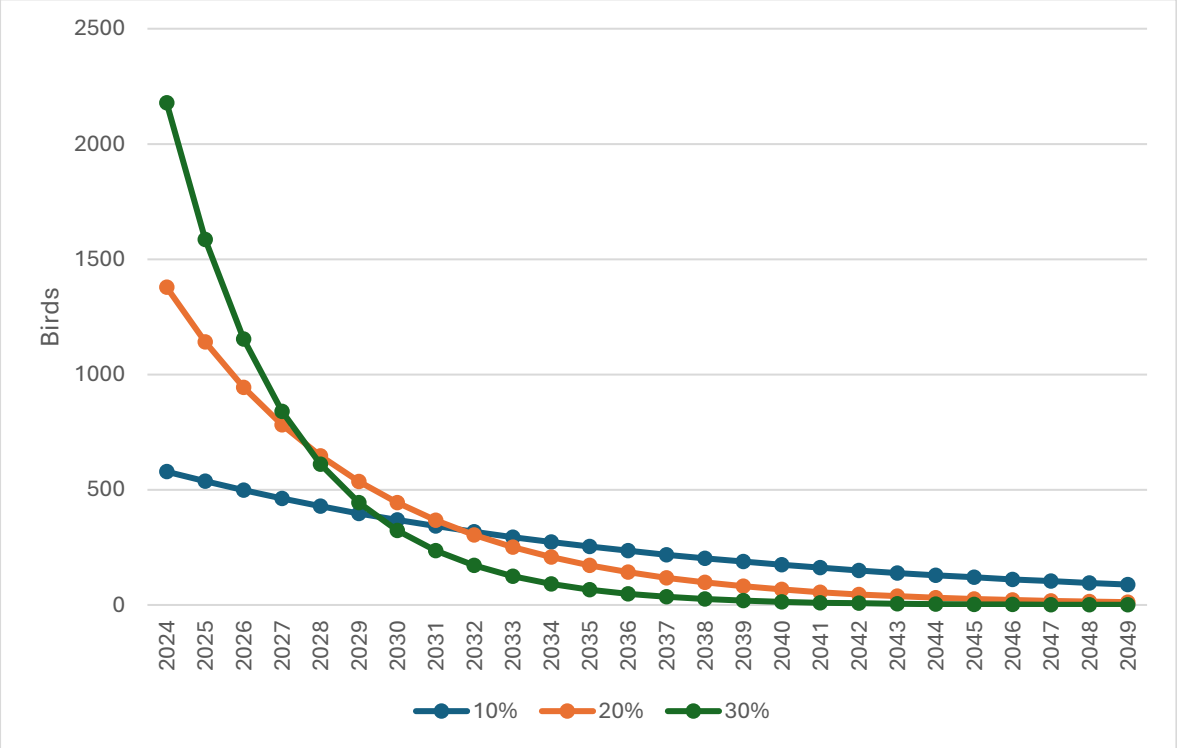


Figure 10. Estimated number of adult Karoro that would need to be culled annually on the Hakatere under control regimes which cull 10% (blue line), 20% (orange line) or 30% (green line) of adult birds annually.



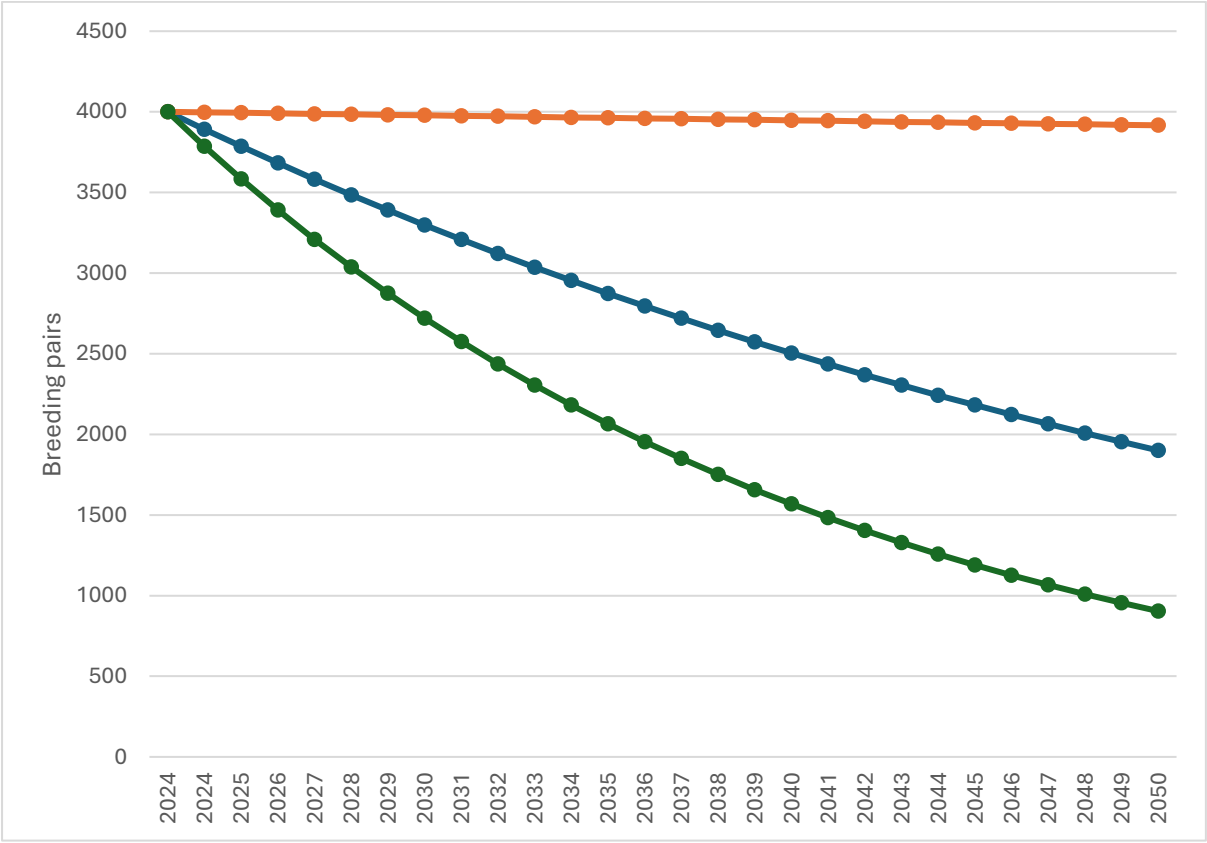
Reducing productivity

Gull populations can be reduced by reducing productivity, which overtime reduces recruitment and means there are fewer immature birds to replace adults as they die. Management can occur at colonies to reduce breeding success (i.e. nest destruction, egg pricking/oiling and/or chick culling) that reduces productivity and has been used successfully in overseas gull colonies to reduce populations (Ickes *et al*. 1998, Olijnyk *et al.* 1999) although is considered less effective than lethal control options (Scopel and Diamond 2017). Often egg sterilisation is considered a more human, or socially acceptable management option than culling birds.

Karoro breeding success and productivity has been measured in Canterbury (W. Fox Pers. Comm.), providing a target for what reduction in breeding success is needed to create a population decline. Three control regimes are illustrated below, which aim to reduce breeding success by 25%, 50% and 75% annually (Figure 11).

However, even a reduction of 75% would mean that the strategy's targets are not met by 2050, and a reduction in productivity by 25% would see the population remain stable.

Figure 11. Population trajectories of Karoro (breeding pairs) on the Hakatere under control regimes which reduce productivity by 25% (orange line), 50% (blue line) or 75% (green line) annually.



Adult cull combined with reducing productivity

A combined management regime of culling adults, whilst also reducing wider Karoro productivity was recommended to reduce the Waimakariri River Karoro population to 10% of its current size (Bell 2024). This requires co-ordinated large-scale large scale alpha operations to cull 20% of adults annually, whilst simultaneously reducing productivity across the entire river by 50% largely through egg sterilisation to reduce productivity.

To investigate if a similar approach would be appropriate on the Hakatere two simulations were run. Both require productivity to be reduced by 50%, combined with a cull of 10% and 20% of adults annually.

A management regime aiming to cull 20% of adults annually, coupled with reducing breeding success by 50%, so aiming for productivity to be < 0.4 chicks/pair, would reach the targets within 9 years (Figure 12). This requires over 1,800 adult birds to be culled in the first year, and then 2 further years of over 1,000 gulls culled annually (Figure 13); along with ensuring gull productivity across the entire river is <0.4 chicks/pair.

Culling only 10% of adults annual extends the time to achieve the strategies goals to 17 years; but significantly reduces the number of birds needing to be culled annually (<1,000 per annum). Although this appears to be a significant length of time, this management regime should half the population in 5 years, and the number of gulls needing culling each year may be more realistic.

Figure 12. Population trajectory of Karoro (breeding pairs) on the Hakatere under a control regime which culls 20% of adults and reduces productivity by 50% annually (Blue line) and culls 10% of adults and reduces productivity by 50% (orange line).

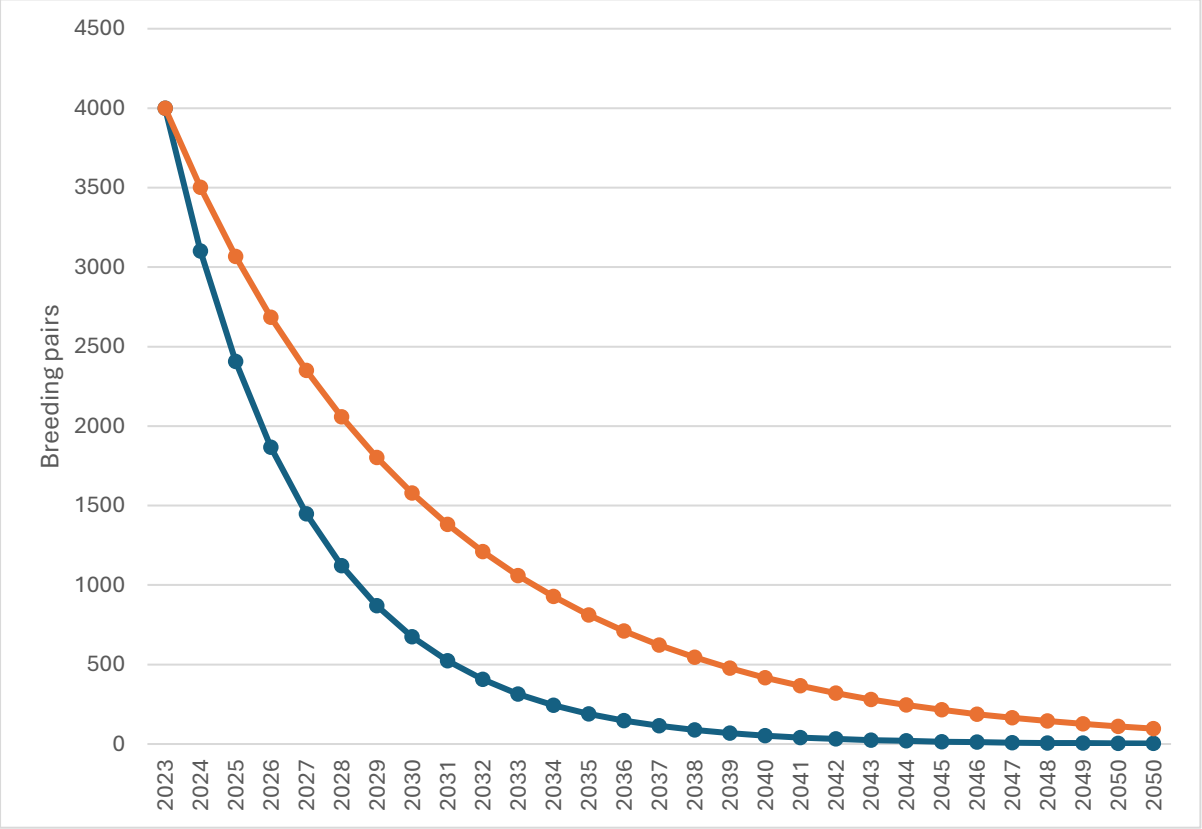
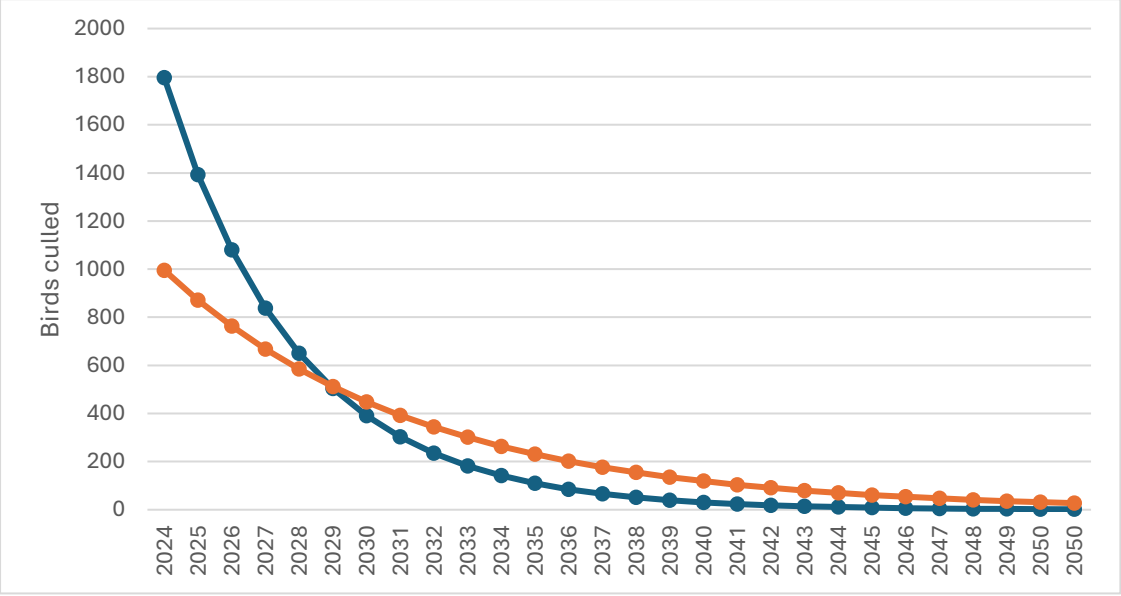


Figure 13. Estimated number of adult Karoro that would need to be culled annually on the Hakatere under a control regime which culls 20% of adults and reduces productivity by 50% annually (Blue line) and culls 10% of adults and reduces productivity by 50% (orange line).



Recommended control regime for the Hakatere

As outlined above, there are a range of different control regime options available on the Hakatere to achieve the goals of the Canterbury Southern Black-backed Gull/Karoro Management Strategy (Bell & Harborne *2019*). Key to developing a Hakatere Karoro control plan, is assessing these options considering local resourcing available (Table 4).

With this in mind, the assessment matrix below (Table 4) considers whether the Canterbury Strategy goals are achieved, the time taken to achieve this, along with a pragmatic approach to assessing the time taken to achieve a 50% population reduction and then estimating if additional resourcing is required to implement each control regime.

The recommended control regime for the Hakatere is the culling of 20% of adult birds annually. This regime may require a slight increase in current funding to achieve this cull rate in the first two years but given 10-20% cull rates were achieved in 2024 and 2025 this regime seems realistic.

Table 6. Assessment matrix of Karoro control regime options for the Hakatere.

Control regime	Canterbury Karoro Strategy achieved	Years to achieve Canterbury Karoro Strategy goals	Years to half population	Increased resourcing needed	Ranking
No control	No	Never	Never	No	Poor
Reducing productivity	No	Never	20	No	Poor
Adult Cull (10%)	No	Never	Never	No	Poor
Adult Cull (20%)	Yes	12	4	Some	Best
Combined (10% adults culled, productivity reduced by 50%)	Yes	17	5	Yes	OK
Combined (20% adults culled, productivity reduced by 50%)	Yes	9	3	Yes	Good

Where to achieve control recommendations

As described above, the Karoro population is not evenly distributed on the Hakatere, and to achieve sustained culls spatial planning in the control regime is required. Karoro on the Hakatere are largely on the plains, with limited numbers in the upper reaches above Mt Possession/Hakatere.

These upper reaches above Mt Possession/Hakatere should be treated as a containment control area. With Karoro numbers kept to a minimum and colonies either not allowed to form or allowed to build up. This areas control regime should work independently from the other four zones, responding to any Karoro build up. The containment area should extend to include the Ashburton Lakes, Lake Heron and the headwaters of the Rakaia River. This large U-shaped

valley allows easy passage of Karoro and should be treated as a “Karoro headwaters” of the Hakatere, even though geographically not all of it is true headwaters of the Hakatere.

The spread of Karoro breeding on the Hakatere effectively splits the river into five sections that could become management zones (Table 7).

Table 7. Hakatere Karoro control regime zones.

Zone	Name	Location
One	Hāpua	Hāpua to Ashburton
Two	North Branch	South/North Confluence to Arundel Rakaia Gorge Road Bridge (Alford Forest
Three	Lower South Branch	South/North Confluence to Valetta Bridge
Four	South Branch	Valette Bridge to Mt Possession
Five	Hakatere	South Branch Hakatere above Mt Possession but also including the Ashburton Lakes and Lake Heron and headwaters of the Rakaia River. This is a U-shaped valley system that effectively creates a Karoro headwater for the Hakatere, even though some of the water flows into the Rakaia.

Utilising the five river zones detailed above, control operations carried out in 2024 and 2025 have already occurred in Zone One (Hāpua to Ashburton) and Zone Five (Hakatere); pooling both years results, these operations are close to operational targets (2,390 birds culled with a target of 2,519 birds).

To keep achieving targets, whilst minimising risk of bait shyness, control should move to the middle zones to provide distance between control areas, before moving back to the lower Zones again later (Table 8).

Table 8. Recommended spatial control regime on the Hakatere to annually remove 20% of the adult Karoro population.

Year of control	Zone	Target (number of birds culled)	Results
2024	One and Five	1,378	1,670 gulls culled 2024
2025	One	1,141	720 gulls culled 2025
2026	Three	944	
2027	Four	782	
2028	Two	647	
2029	One	535	
Total		5,427	

Monitoring

Monitoring success of control programmes to both cull adults and reduce breeding success is vitally important; and collecting data to help measure the success of this management regime is highly recommended.

1. Accurate record keeping of each year's control operations should be undertaken. This should include spatial data on the location of control operations, determining the number of birds culled (accounting for unrecovered carcasses using standardised criteria each year) and the age class of each bird culled (chick, juvenile or adult).
2. Annual surveys of the river to determine Karoro population numbers should carried out. This can be either river walk-through surveys or arial surveys. This should include spatial data to enable changes in colony locations over time to be measured. This is important to track the trends in the Hakatere population, and effectiveness of control operations.
3. An accurate measure of productivity should be undertaken independently from at least 3 colonies from different reaches of the river where adult culling was not being carried out to measure annual productivity. Uncertainty in previous productivity data from the Hakatere is considered one of the key risks to this control regime.
4. Increased immigration rates present the greatest risk to the control regime, i.e. birds moving into the Hakatere from adjacent river catchments or coastal colonies to fill the void created. The Hakatere is the epicentre of the highest density Karoro population in Canterbury – the irrigated Canterbury Plains. Consideration should be given to supporting the BirdsNZ Karoro colour marking project to better understand Karoro movements.

Recommended control regime and annual work plan for recommended management regime

The proposed management regime involves culling 20% of adult gulls annually. Several control methods will need to be implemented to achieve this, often with multiple methods occurring within seasons. Please see *Karoro (Southern Black-backed Gull) Management - Environment Canterbury Operational Field Guide* (Bamber *in press*) for a decision-making matrix to help determine the best control methods for each zone.

To achieve these targets, an operational plan is outlined identifying key actions (Table 9). Please note, as discussed, this plan includes operations already carried out in 2024 and 2025, and hence gives a start date of 2024. Although, it is recommended to review this plan after Year 5 (see below).

The management regime will likely rely on large scale alpha chloralose broadcast operations in colonies; and these must be successful in achieving significant culls of adult birds (which has occurred 2024 and 2025). However, given the proximity to Ashburton township, not all control options may be available in all reaches of the river. Other control methods such as trapping, shooting and off-river control likely play a role in Karoro control on the Hakatere. Again, please refer to *Karoro (Southern Black-backed Gull) Management - Environment Canterbury Operational Field Guide* (Bamber *in press*) for guidance.

Given the low numbers of Karoro in the upper reaches of the Hakatere, a containment control regime is recommended for this area. With removal of birds to ensure the population in this area does not expand. This may include wider surveying of the Ashburton Lakes area, and control of colonies found. As was carried out on the Cameron River.

Table 9. Hakatere Karoro management regime ten-year operational plan.

Action	Time	Description
Population Survey	Oct/Nov	Determine Karoro population size using walk-through or aerial surveys. Record size and location of colonies.
Measure productivity	Nov/Dec/Jan	Determine productivity of at least three Karoro colonies from different reaches of the river (outside colonies where control is being undertaken).
Adult cull	Nov/Dec	Undertake control programme aimed at reducing adult population by 20%. Follow decision making matrix in *Karoro (Southern Black-backed Gull) Management - Environment Canterbury Operational Field Guide (*Bamber *in press)* to determine best control method for site/s.

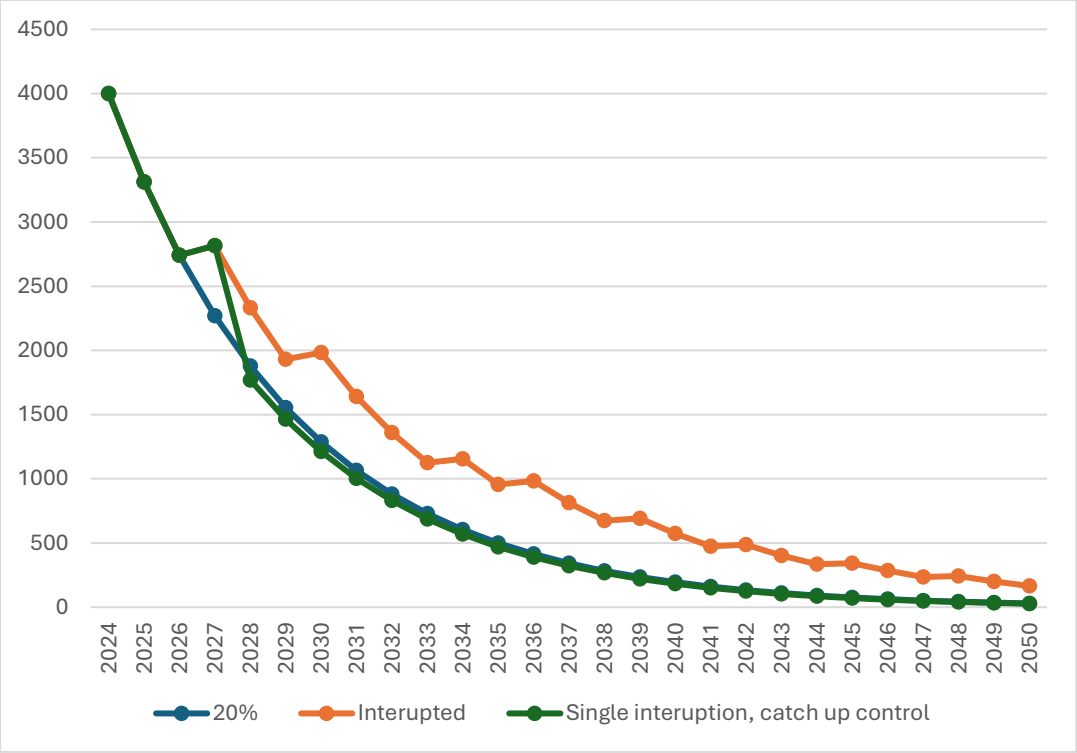
To achieve these targets, spatial spread in the management regime is required (Table 8). This includes targeting initial control operations at areas of rivers with large numbers of gulls but also allows intervals between adult control operations to prevent bait/shooting shyness as much as possible. It is recommended to review this spatial plan after Year 5 (see below).

Table 10. Karoro management regime ten-year spatial plan.

Year	Adult cull target (number of gulls)	Section				
		1	2	3	4	5
2024	1378					Containment control
2025	1141					
2026	944					
2027	782					
2028	647					
2029	535					
2030	443					
2031	367					
2032	304					
2033	251					

A multitude of operational or fiscal reasons may mean that control is interrupted in any given season, causing non-delivery of annual control targets This will have impacts of timelines for achieving overall Karoro reduction, and will extend the period to meet the Canterbury Karoro Strategy reduction targets (See example Figure 14). Increasing control effort after a missed season would be able to offset these interruptions and bring trends back onto targeted timeframes. However, this would require culling 40% of adult birds across the river – likely an unachievable investment of resources.

Figure 14. Population trajectories of Karoro (breeding pairs) on the Hakatere under control regimes which cull 20% (blue line) and when control is interrupted every 3 years (orange line), and then where control is interrupted after 3 years, but an increased control is carried out the following season to maintain population declines.



Review

It is recommended to review this management regime after five years; utilising the data collected during monitoring to assess the success of the control measures in reducing the Hakatere population. This also aligns well biologically with Karoro, as birds take 4 years to reach maturity.

As the start of this plan has been adjusted to take account of successful operations already carried out, it would mean this review would align with timing recommended for review of the Waimakariri Plan (Bell 2024). Combining learnings from both control regimes, utilising and analysing population and control data it will be possible to determine Karoro population trajectories and any refinements to the management regime can be incorporated. This will ensure an up-to-date management regime is implemented in the second half of these plans ten-year life.

If or when the Canterbury Southern Black-backed Gull/Karoro Management Strategy (Bell & Harborne *2019*) objective of reducing the Hakatere population to 10% of its current level is reached; then it is recommended to review the management regime, and shift to a maintenance regime going forward, that ensures the Karoro population on the Hakatere is not allowed to start increasing again.

Acknowledgements

This work was carried out for Environment Canterbury, and I thank Courtney Bamber for effectively managing this. I am especially grateful to Wendy Fox for allowing breeding success data from Karoro collected as part of her PhD, use of this data prior to her publishing it has vastly improved the development of control regimes.

AI use disclosure: The cover image for this report was generated using AI tool ChatGPT, but no use of AI was used in other aspect of this mahi other than the cover image. All data, text and graphics including review throughout this report did not use AI.

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