

Analysis of braided river bird count data from the Waiau Uwha and Waimakariri Rivers

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Summary

Project and client

- Environment Canterbury (ECan) contracted the Bioeconomy Science Institute Maiangi Taiao (BSI)¹ to provide advice on the analysis of braided river bird count data from the Waiau Uwha and Waimakariri Rivers.
- This report briefly describes the analysis approach and results for inclusion in a forthcoming report authored by ECan.

Objectives

This report focuses on three braided river reaches in Canterbury: the Waiau Uwha River, mid Waimakariri River, and upper Waimakariri River. Our three objectives are:

- 1 Review available braided river bird count data.
- 2 Provide summary statistics for river bird count data sets.
- 3 Undertake statistical analyses to reveal trends in bird populations over time.

Methods

- Since 2006, ECan conducts bird surveys on the Waiau Uwha and Waimakariri Rivers annually over 3–4-year periods, interspersed with gaps of 4–7 years without surveys. Due to weather conditions and access limitations, not all river sections were surveyed every year. Since 2018, data has been recorded in 1 km sections in addition to the established survey sections.
- We provide summary statistics to provide an overview of current state of braided river avifauna. We calculated these summary statistics as the mean number of birds per km² by averaging counts for each survey section across a survey period. For each reach, summary statistics were provided at three grouping levels: for species, feeding guilds, and threat classification categories.
- Using mixed effects models, we estimated the percent change in density for the same three grouping levels (species with sufficient detections, feeding guilds, and threat classification category) over a 10-year period to enable comparisons between rivers for the Waiau Uwha and mid Waimakariri. We did not undertake a trend analysis for the upper Waimakariri River as count data from only one survey period was available. We provide a measure of the strength of evidence for a given trend detected.

Results

- At the three focal rivers, specialist native braided river bird species were present, including Threatened and At Risk species (as reported under the New Zealand Threat Classification System for birds in NZ 2021), within each section across surveys. Density of birds varied between rivers, within sections of surveyed rivers and over time.

¹ On 01 July 2025 Landcare Research New Zealand Ltd became the New Zealand Institute for Bioeconomy Science Ltd; Manaaki Whenua – Landcare Research operates as an internal group within this Institute, which is less formally known as the Bioeconomy Science Institute Maiangi Taiao, or Bioeconomy Science Institute (BSI).

- In the Waiau Uwha River,
 - 5 of 15 species declined, 6 showed little change, and four increased in abundance, although evidence for 7 of those species was moderate or weaker.
 - At the guild level, 2 guilds declined, 2 guilds showed little change, and 2 guilds increased.
 - At the threat category level, Threatened and At Risk species declined while Introduced & Naturalised species increased.
 - There was strong evidence for trends at the guild and threat classification level.
- In the mid Waimakariri River,
 - 2 of 14 species rapidly declined, 1 species showed little change, and 11 species increased in density; however, support for these trends was moderate or lower for 5 species.
 - At the guild level, 2 guilds declined and three guilds increased with strong evidence, with moderate evidence for an increase in one guild.
 - At the threat classification level, there was little change for Introduced & Naturalised species and an increase in Not Threatened, Threatened and At Risk species.

Conclusions

- The braided river bird count data provide an important update on the state of braided river avifauna in the three focal rivers and have enabled an assessment of population trends across the bird community of the Waiau Uwha and mid Waimakariri Rivers.
- We have strong evidence for differing trend trajectories for the Waiau Uwha and mid Waimakariri rivers.
- It is important to consider species' initial abundances and ecology when interpreting percentage change estimates. Species or groups with relatively low counts will exhibit greater percentage changes than those that are more abundant. Change in abundance at a reach level may be due to movement, particularly for colony nesting species.
- The analysis approach used here accounts for changes in survey coverage between years, variation in survey area of each section, and year-to-year fluctuations in counts driven by factors such as weather or river flow. The adoption in 2018 of 1 km survey sections, which are compatible with existing longer survey sections, will reduce data loss from partially surveyed sections in future monitoring and will provide a more fine-scaled overview of distribution of braided river bird species.

Recommendations

- ECan should continue monitoring of braided river birds using the km-section method and annual surveys during a 3–4-year survey period for a river. This would enable ongoing assessment of trends of braided river bird species and guide management.
 - Specifically, an additional survey round in the upper Waimakariri River would enable trend analyses.
- Always instruct observers to record *all* species to avoid having to omit data from analyses.
- For reporting, continue to assess trend directions together with evidence strength in future assessments. Such an approach could also be developed more widely to enable reporting at regional and reach levels.

1 Introduction

Braided rivers are an internationally rare ecosystem (Holdaway et al. 2012). New Zealand, and in particular the Canterbury region, contains a disproportionately large number of them (Gray & Harding 2007). These highly dynamic river systems provide habitat for specialist guilds of endemic bird species² that rely on them for at least part of their annual cycle (Table A1.1; O'Donnell 2000). Environment Canterbury (ECan) undertakes regular bird surveys across Canterbury's braided rivers as part of its biodiversity monitoring programme. Through this work, ECan aims to assess current levels of bird population abundance, detect changes over time, and identify areas of particular significance for key bird assemblages.

This report describes the analysis methods and summarises key results from work undertaken by the Bioeconomy Science Institute Maiangi Taiao (BSI),³ as commissioned by ECan, for incorporation into a forthcoming report by ECan. Interpretation and discussion of these results are outside of the scope of this report here and will be addressed in the upcoming ECan report.

2 Objectives

This report focuses on three braided river reaches in Canterbury: the Waiau Uwha River, mid Waimakariri River (from the Waimakariri Gorge Bridge to SH1 bridge), and upper Waimakariri River (from the Bealey Bridge to the Esk River confluence). Our three objectives are shown below.

- 1 Review available braided river bird count data.
- 2 Provide summary statistics for river bird count data sets.
- 3 Undertake statistical analyses to reveal trends in bird populations over time.

3 Methods

3.1 Description of the data

Bird count data from the three target river reaches are available from 1975 onwards (Figure 1). Since 2006, ECan has conducted bird counts in these areas during discrete survey periods of several years interspersed with gaps of 4–7 years. Since 2018, survey data have also been recorded in specified 1 km intervals in addition to the existing survey sections which are of different lengths. In this report we have analysed data collected from 2006 onwards based on the survey sections to enable meaningful comparisons of surveys over time.

Data were collected annually or every second year during survey periods in a river (Figure 1). There are data available from:

² Nomenclature used throughout is based on the threat classification (Robertson et al. 2021); te reo Māori names following Ngāi Tahu Claims Settlement Act 1998 where listed or Robertson et al. (2021)

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- three survey periods spanning from 2008 to 2024 from the Waiau Uwha River
- two survey periods spanning from 2006 to 2020 from the mid Waimakariri River
- one survey period spanning from 2012 to 2016 from the upper Waimakariri River.

During each survey the full width of the riverbed, encompassing all potential habitat, was surveyed by a group of observers forming a line with approximately 50 m spacing between observers. The observers walked downstream, counting all birds seen as they passed them. Double counting of flying birds was avoided by communication among observers. This standard protocol for surveys was used each year apart from 2017 in the mid Waimakariri, where observers were instructed to not count southern black-backed gulls / karoro (*Larus dominicanus dominicanus*) as a separate aerial survey specifically for southern black-backed gulls was undertaken.

It was not possible to survey all sections during each survey (e.g. Section 9 on the Waiau Uwha River in 2010; Figure 1a) due to weather and access constraints, but within a survey period all sections were surveyed at least twice.

Because grey ducks / pārerā (*Anas superciliosa*) and mallard / rakiraki ducks (*Anas platyrhynchos*) readily hybridise and are difficult to distinguish in the field (Williams 2019), records listed as duck species, grey duck, mallard duck or hybrid were combined into a single category: grey duck - mallard hybrid (*Anas superciliosa* × *platyrhynchos*). Records of shag species that were not identified to species were excluded from the analyses.

Because southern black-backed gulls / karoro were not counted in 2017 in the mid Waimakariri, we calculated summaries for that species, its guild (i.e. aerial gulls and terns) and threat classification (i.e. Not Threatened) excluding 2017 (i.e. 2018–2020) for the species, the entire guild, and the threat classification, respectively.

3.2 Summary statistics

As an overview of the past and current state of bird populations, we present summary statistics for each survey period and for each survey section and the river as a whole. These summary statistics provide a foundation for identifying and mapping high-value bird sites within the braided riverbeds, an approach previously applied by Greater Wellington Regional Council (McArthur et al. 2015).

We calculated the mean density (number of birds per km² calculated using the section area or sum of section areas) and associated standard error for each survey period for the three levels (Table A1.1.).

1 Species

2 Freshwater feeding guilds (O'Donnell 2000) which categorises species into the following categories based on their feeding habits.

- *Shallow water waders*
- *Deep water waders*
- *Aerial gulls and terns*
- *Open water divers*
- *Dabbling waterfowl*
- *Riparian wetland species*
- *Swamp specialists*

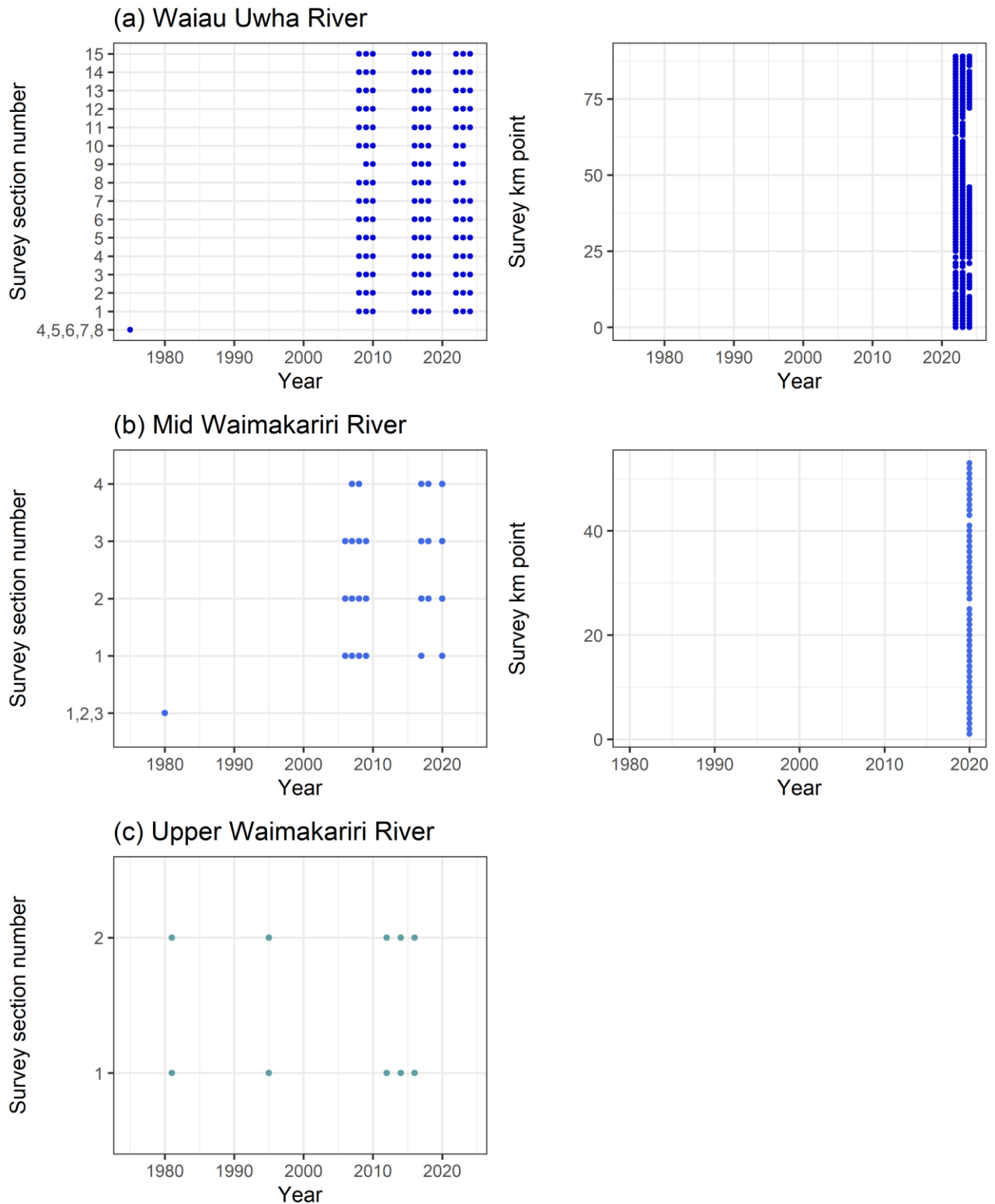


Figure 1. Overview of braided river count data available for a) Waiau Uwha River; b) mid Waimakariri River; c) upper Waimakariri River. The left column shows data available recorded in standard survey sections of differing lengths, and the right column shows data available recorded in 1 km survey sections. [Note: Only data for fully surveyed sections are displayed. No data recorded in 1 km sections was available from the upper Waimakariri River.]

3 New Zealand Threat Classification categories (Robertson et al. 2021) which classifies species into the following threat categories:

- *Threatened* consisting of four conservation statuses (Nationally Critical, Nationally Endangered, Nationally Vulnerable, Nationally Increasing)
- *At Risk* consisting of five conservation statuses (Declining, Recovering, Relict, Naturally Uncommon)
- *Not Threatened*
- *Non-resident Native* with the following status (Migrant)
- *Introduced and Naturalised*.

In the main report we present figures showing mean density for each section and across the river, with detailed estimates and standard errors provided in Appendix 3 (Tables A3.1–A3.6)

3.3 Trend analysis

3.3.1 Rationale for analysis approach

We considered the ecological characteristics of braided river bird species and the available data to develop our analysis approach to assess trends of bird populations. Many braided river bird species are highly mobile and change breeding locations within a river from year to year depending on conditions (Schlesselmann et al. 2025). Such mobility may mask actual trends of species. For example, individuals of a species may have shifted into another river section rather than the population experiencing an actual decline. We therefore considered comparing trends of species or groupings at the river level as more appropriate than comparing trends of species or groupings at a section level.

Because not all survey sections were covered during each survey, it is not possible to analyse total bird counts per year across the full data set. We therefore considered three approaches.

- Restricting the analysis to years with complete survey coverage across all sections. This would exclude 3 years of data for the Waiau Uwha River (Figure 1, Table A2.1) and 4 years of data for the mid Waimakariri River (Figure 1, Table A2.2). Since this would result in substantial loss of data, we did not pursue this option.
- Limiting the analysis to river sections with the fewest missing survey years. For the Waiau Uwha River, this approach would require omitting sections 8, 9, 10 (Figure 1, Table A2.1). For the mid Waimakariri River, this would allow analysis of total counts of sections 1, 2, and 3 across all years except 2018, or alternatively, sections 2 and 3 for all years (Figure 1, Table A2.2). Due to the significant data loss, we did not pursue this option.
- Analysing all available data of fully surveyed sections, statistically accounting for missing data and the size of each survey section. Because adjacent sections within a river may be more similar than those further apart, the data will not be spatially independent. Therefore, this approach may require incorporating a spatial autocorrelation term to account for spatial dependence. We considered this the most practical solution to maximise the use of the available data.

We also evaluated whether comparing bird counts from the defined monitoring periods (e.g. first period versus second period) or fitting a trend to individual annual count data would be more appropriate given the species' ecology and available data. The approach of comparing differences between survey periods was preferred for three reasons, as listed below.

- 1 **Limited sample sizes:** The number of annual surveys is too small to have sufficient power to reliably detect trends (Waiau Uwha $n = 9$; mid Waimakariri, $n = 7$; Figure 1, Table A2.1 and Table A2.2).
- 2 **Annual variability and confounding factors:** Year-to-year differences in survey conditions (e.g. recent flooding resulting in birds abandoning nests, variation in observer skill, weather impacts on visibility) and natural variation in bird movements may obscure underlying trends. Comparing broader periods incorporates such annual variability and simplifies the model.
- 3 **Differences in survey coverage between years:** While it was not possible to survey every section during each survey, each section was surveyed during each survey period. Therefore, comparing these broader periods would enable detection of meaningful change given the available data.

A generalised linear mixed model was required to appropriately account for the distribution of data and the overall data structure. Because the data were counts of individuals, the data were discrete, non-negative and typically exhibited greater variance with an increased mean. These properties violate assumptions of a normal distribution. Therefore, using an appropriate error distribution such as Poisson distribution is required, which allows the mean-variance relationship inherent in count data to be modelled correctly. Random effects accounted for the repeat-sampling structure in the data, i.e. multiple sections within the same river were surveyed within the same year (which would have experienced the same environmental conditions) and the same sections were sampled repeatedly across years.

We considered explicitly including explanatory variables (e.g. weather, river flow) in the statistical analysis. However, we decided it was not necessary because annual variation between counts was already accounted for within the modelling framework through the random effects.

In summary, we compared changes between survey periods for the Waiau Uwha and mid Waimakariri Rivers using all data from fully surveyed sections and using a statistical framework to account for the structure of the data and missing data. Trend analyses were not possible for the upper-Waimakariri River as counts from only one survey period (2012–2016) are available (Table A2.3).

3.3.2 Description of analysis and reporting methods

We analysed trends for the Waiau Uwha River and mid Waimakariri River at three different response levels. These are listed below.

- 1 **Individual species:** Analyses were limited to species recorded on at least 10 year-by-section occasions (i.e. a species would need to have been recorded 10 times across *all* sections and years) for the mid Waimakariri River and at least 50 occasions for the Waiau Uwha River so that there would be enough samples to have confidence in the statistical inference. This allowed assessment of trends for 15 species for the Waiau Uwha River and 14 species for the mid Waimakariri River. Although swamp harriers / kāhu (*Circus approximans*) on the mid Waimakariri River were initially included in analyses due to being present frequently enough, the model was found to be unreliable and the species was therefore excluded.
- 2 **Feeding guild:** Swamp specialists (i.e. Swamp hen / pūkeko [*Porphyrio melanotus melanotus*]) were excluded from the Waiau Uwha River analysis because they were detected too infrequently to support an assessment of trends.
- 3 **Threat category:** ‘Non-resident Native - Migrant’ species (i.e. Sharp-tailed sandpiper / kohutapu [*Calidris acuminata*] and white-winged black-tern *Chlidonias leucopterus*) were

excluded from analyses for both rivers because they were detected too rarely to allow meaningful evaluation of trends between monitoring periods.

We included survey period and an offset term for the surveyed river section as predictors to account for the differences in the area (measured in km²) of each river survey section. Including this offset meant that the response variable represents bird density (number of birds/km²), because changes of counts are standardised by the area of the survey section (Kéry & Kellner 2024).

We first compared three models using Akaike Information Criterion (AIC) corrected for small sample size (AICc), each with a different random effects structure, to determine which structure of random effects best explained the data (Burnham & Anderson 2002). The model with the lowest AICc value was considered the best supported, and differences greater than 10 AICc units were taken as strong evidence favouring one model over another model (Burnham & Anderson 2002).

- 1 **Section and year:** Random intercepts were included for river section to account for inherent differences between sections, and for survey year to account for annual variation in environmental conditions such as river flow or flooding affecting all surveyed sections.
- 2 **Section and year as well as observation-level random effect:** In addition to the random effects described above, an observation-level random effect (OLRE) was included to account for overdispersion (i.e. where the variance is greater than the variance expected under the Poisson distribution; Harrison 2014).
- 3 **Spatial autocorrelation term for section and year:** This structure incorporated a spatial autocorrelation term to account for spatial dependence of river sections, recognising that adjacent survey sections were more likely to be similar to each other than sections further apart. Year was included as a random intercept.

The random-effects structure of the second model (i.e. section, year and OLRE) was consistently selected as the best model across response levels and rivers, and was therefore used for subsequent trend analyses.

We followed the reporting protocols used in other New Zealand bird monitoring programmes (MacLeod et al. 2022, 2024, 2025) and applied this model structure to classify both the direction of trends and the strength of evidence associated with each trend. In contrast to traditional binary *P* - values, this approach provides a more intuitive and transparent way to communicate to a general audience the direction of trends and strength of evidence for a given trend.

We used parametric bootstrap sampling ($n = 1,000$ replicates) to estimate the uncertainties in resultant trend estimates by simulating new data from the fitted base model, refitting the generalised mixed effects models, and recalculating section estimates for each response level (i.e. species, guild, or threat category; MacLeod et al. 2022). We calculated a river total estimate through weighting section estimates by their survey area. Specifically, the weights for each section were calculated as the proportion of total river area surveyed within each section. We then summed section estimates using a weighted average to produce a river total estimate (MacLeod et al. 2022).

We used data from the full time frame spanning the survey periods (i.e. 17 years for the Waiau Uwha River and 11 years for the mid Waimakariri River) to estimate the rate of change over time, expressed as the slope between the mid-points of the survey periods (see two examples for the Waiau Uwha River in Figure 2). We use the slope estimate from the model to predict the percentage change in bird density over the most recent 10-year period to allow comparison of population change across river systems over a consistent time frame. These 10-year intervals

were set from the most recent midpoint of a survey period. As the most recent monitoring period for the Waiau Uwha River was from 2022 to 2024 (Figure 1), the midpoint was set to 2023 and estimates of change over a 10-year interval refer to an initial estimate from 2013 to 2023. For the mid Waimakariri River, the most recent monitoring period was from 2017 to 2020 (Figure 1) with a midpoint over this 4-year period being the midpoint between 2018 and 2019 and is therefore set to 2018.5. Thus, estimates of change over a 10-year-interval refer in the mid Waimakariri to an initial estimate from 2008.5 to 2018.5. The percentage change in bird density was calculated for each bootstrap run.

The median estimate of percentage change across all bootstrap replicates was used to assign the trend category, while evidence strength was determined by the percentage of bootstrap replicates that fell within the same threshold category as the trend (MacLeod et al. 2022). The definition for both metrics, along with the way they are presented in the results, are provided in Table 1. If the distribution of bootstrap estimates included zero, indicating that bird density could have either increased or decreased, a lower evidence category was assigned (MacLeod et al. 2022).

Overall, species or groupings with lower between-year variance to show stronger evidence of trends. The percentage change will be influenced by initial density estimates. For example, species present at low initial densities would require only small absolute changes to produce larger percentage changes, whereas species that were initially more abundant would require larger absolute changes to generate the same proportional shift.

All data analysis was carried out in R, version 4.5.1 (R Core Team 2025).

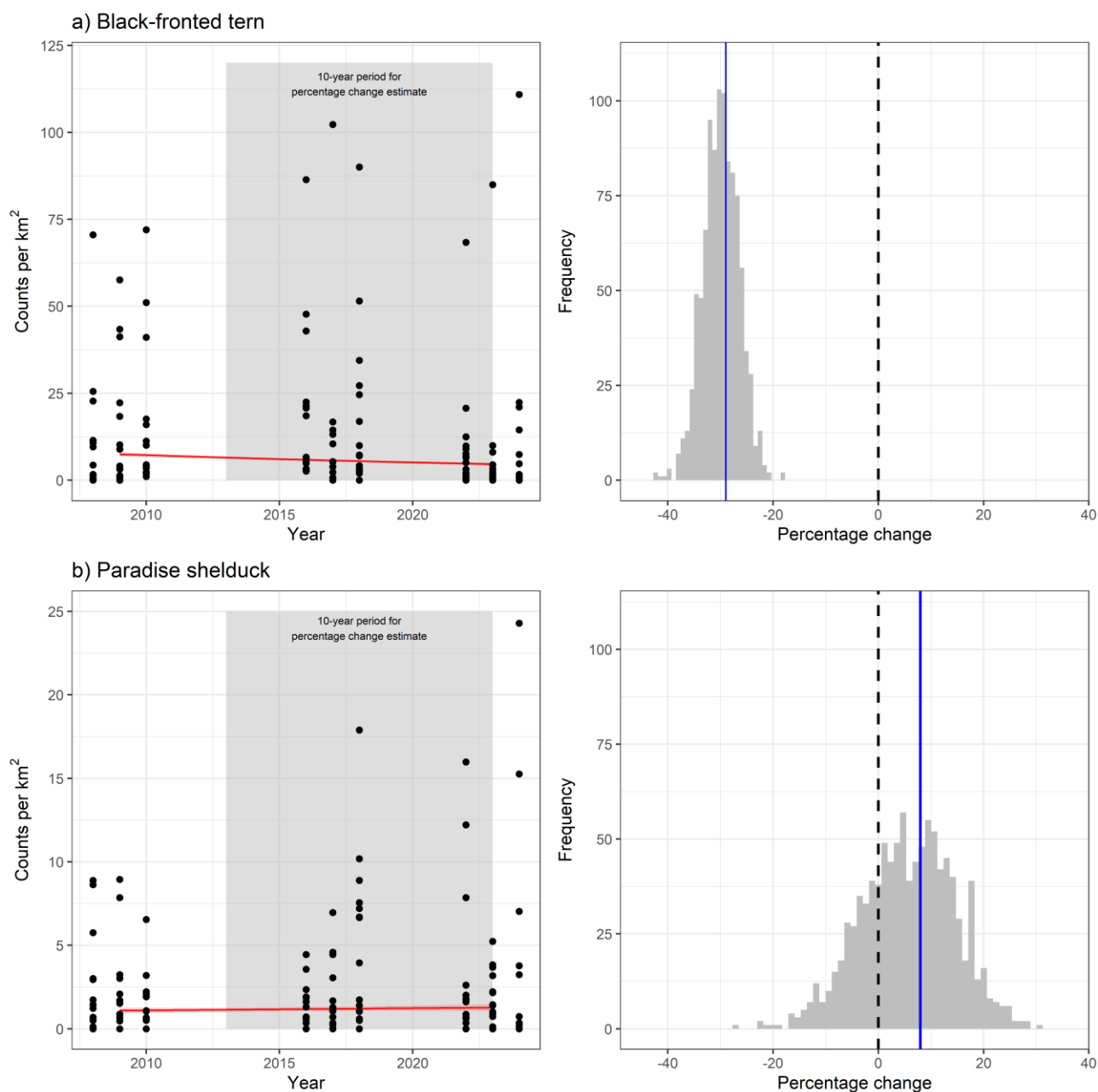


Figure 2. Example of calculation of trend and percentage change over 10-year time interval for two species on the Waiau Uwha River with different strength of evidence for a trend: a) black-fronted tern / tarapirohe with very strong evidence for a decrease; b) paradise shelducks / pūtakitaki with very weak evidence for an increase. [Notes: Graphs to the left show observed density per river section (points) and the fitted trend line from midpoints between observation periods (red line). The grey shaded area shows the 10-year window from the last midpoint of the last monitoring period over which an estimate of change was calculated. The graphs to the right show bootstrap estimates (grey bars), with the weighted median trend estimate based on the bootstrap estimates (blue line). Negative percentage change values, i.e. below zero (dotted line) indicate decline and positive values indicate increase.]

Table 1. Trend and evidence-strength categories used to assess changes in bird density. The trend category reflects the median percentage change over a 10-year period, while evidence strength indicates the level of certainty associated with that trend category. All values are derived from 1,000 bootstrap samples.

Metric	Category	Definition	Displayed as
Trend		<i>Median percentage change over a 10-year period</i>	
	Rapid decline	-∞ to -50%	
	Moderate decline	-49% to -25%	
	Shallow decline	-24% to -10%	
	No or little change	-9% to +9%	
	Shallow increase	10% to 24%	
	Moderate increase	25% to 49%	
Evidence strength		<i>Percentage of bootstrap replicates within same category as median</i>	
	Very strong	> 90%	●●●●●
	Strong	80% to 89%	●●●●○
	Moderate	70% to 79%	●●●○○
	Weak	60% to 69%	●●○○○
	Very weak	50% to 59%	●○○○○
	Insufficient	0% to 49%	○○○○○

Note that trend analyses for southern black-backed gulls, aerial terns and gulls as a group, and all species categorised as 'Not Threatened' excluded data from 2017 as southern black-backed gulls were not counted in 2017. However for easier comparison, we used the same 10-year period for calculating percentage change for all analyses concerning the mid Waimakariri River bird counts.

4 Results

4.1 Waiau Uwha River

4.1.1 Summary statistics

A total of 38 species from 7 feeding guilds were detected at least once during the surveys of the Waiau Uwha River sections (Figure 3). Noteworthy records include two international migrant species (red knot / huahou [*Calidris canutus rogersi*] and sharp-tailed sandpiper / kohutapu [*Calidris acuminata*]) and black stilt / kakī (*Himantopus novaezelandiae*).

All river sections supported a representative assemblage of native braided river bird species, although mean abundance varied between sections and monitoring periods (Figure 3, Table A3.1). Threatened and At Risk species were recorded throughout the surveys and across all sections, while Non-resident Native – Migrant species were detected only occasionally (Figure 4, Table A3.2).

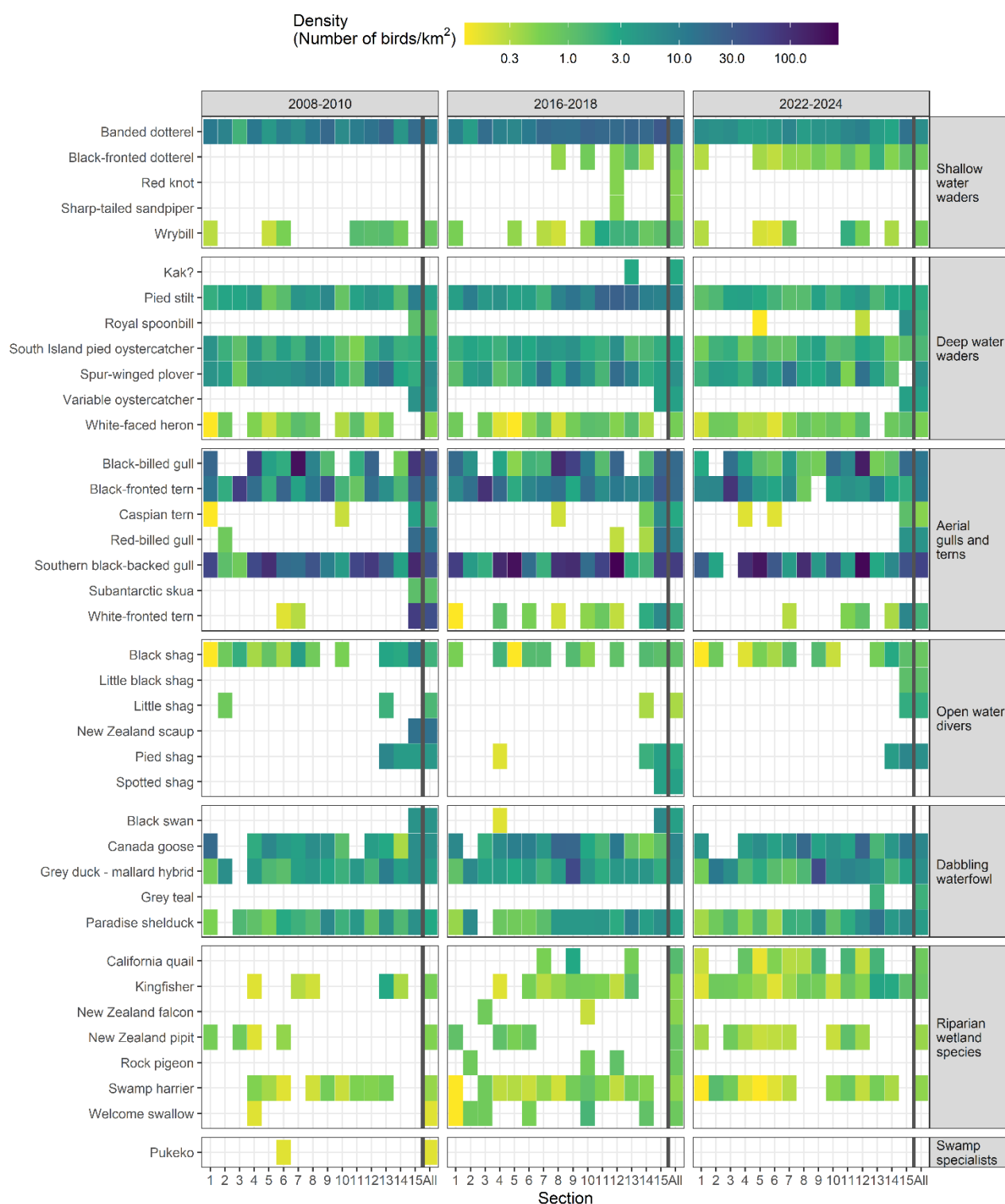


Figure 3. Mean density of freshwater bird species recorded during river survey periods 2008–2010, 2016–2018 and 2022–2024 on the Waiau Uwha River, by species and feeding guild (see Table A1.1). [Note: Coloured squares show the mean density (number of birds per km²) on a log₁₀ scale during spring surveys. Panel rows represent species grouped by feeding guild (as in O'Donnell 2000), columns correspond to the 15 river sections, and the dark vertical line separates these averages from an overall density measure across all river sections. White squares indicate that no individuals of a species were detected in a given river survey section during that survey period. For simplicity, only the English common name for each species is given.]

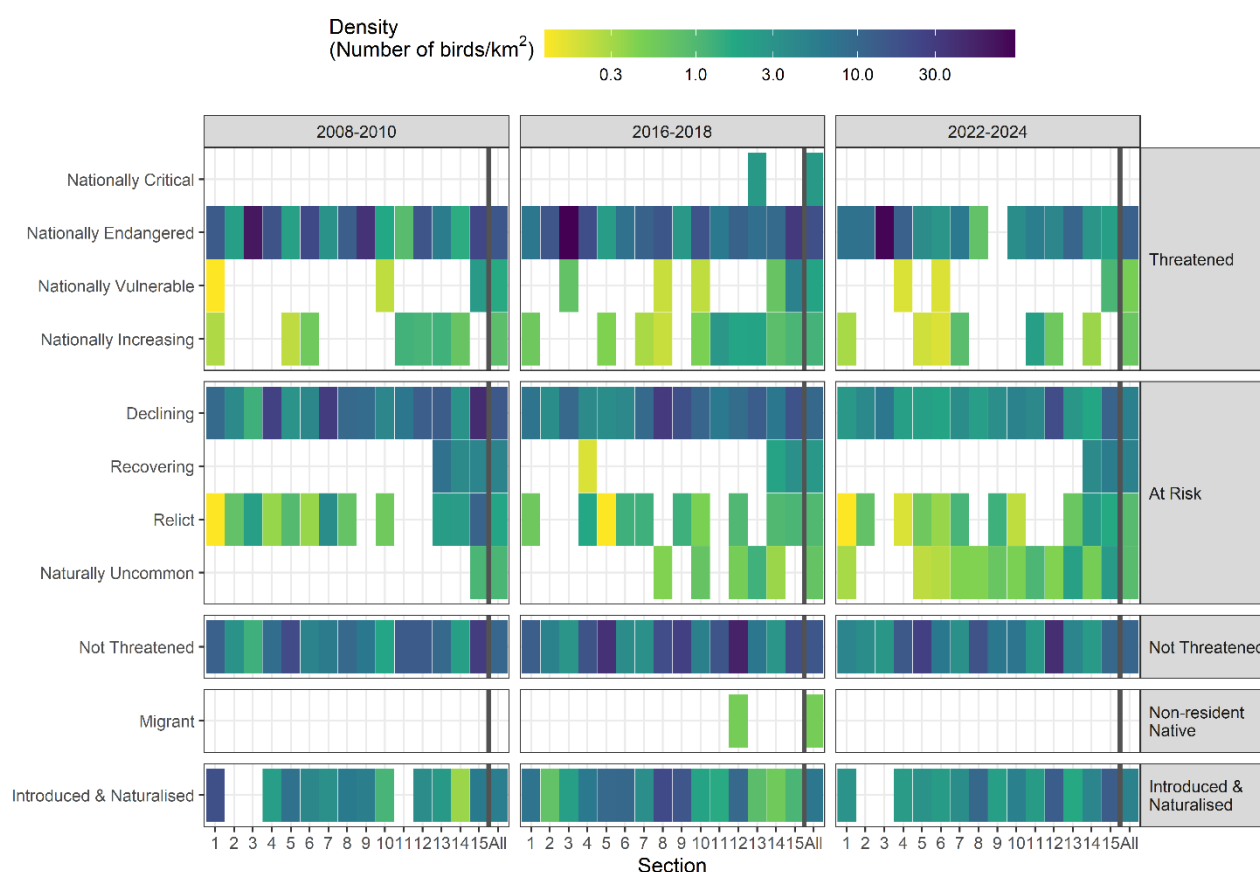


Figure 4. Mean density of freshwater bird species grouped by threat status (see Table A1.1) recorded during river surveys in 2008–2010, 2016–2018 and 2022–2024 on the Waiau Uwha River. Coloured squares show the mean density (number of birds per km²) on a log₁₀ scale during spring surveys. [Note: Panel rows represent threat status grouped by threat category (after Robertson et al. 2021) and columns indicate the river count section, with the vertical grey line separating the total across all ($n = 15$) sections. White squares indicate that no species within that threat-status category were detected in a given river survey section during the survey period.]

4.1.2 Trend analysis

We assessed trends for the 10-year interval preceding the midpoint of the final survey period (i.e. 2013–2023) to enable comparison of percentage change across river systems using a consistent time frame. At the species level, our results indicate strong or very strong evidence for:

- a moderate decline in black shags / māpunga (*Phalacrocorax carbo novaehollandiae*), South Island pied oystercatchers / tōrea (*Haematopus finschi*) and black-fronted terns / tarapirohe (*Chlidonias albobstriatus*)
- a shallow decline in banded dotterels / tūturiwhatu (*Charadrius bicinctus bicinctus*)
- no change or little change in southern black-backed gulls / karoro
- a moderate increase in white-faced herons / matuku (*Egretta novaehollandiae*) and Canada geese (*Branta canadensis*)
- a rapid increase in New Zealand kingfishers / kōtare (*Todiramphus sanctus vagans*).

Detection frequency allowed trend analysis for 15 of the 38 species recorded on the Waiau Uwha River. In total, 5 species declined, 6 showed little change, and 4 increased in abundance, although evidence for 7 species was moderate or weaker (Table 2). No species-level analysis was undertaken for species detected too infrequently to support trend estimation.

Table 2. Trend summary for braided river birds in the Waiau Uwha River, based on changes in density estimates. Change estimates represent the change over a 10-year period from survey midpoints, i.e. 2013 to 2023. The initial estimate corresponds to the midpoint of the first survey period, i.e. 2013. Evidence strength is categorised as: ●●●●● = very strong, ●●●●○ = strong, ●●●○○ = moderate, ●●○○○ = weak, ●○○○○ = very weak, ○○○○○ = insufficient. Median estimates are presented alongside their 90% confidence intervals in brackets. Species are listed alphabetically within feeding guilds (Figure 3).

Species	Initial estimate (Number of birds/km ²)	Trend							Evidence strength	Change estimate
		Rapid decline	Moderate decline	Shallow decline	No or little change	Shallow increase	Moderate increase	Rapid increase		
Banded dotterel / Tūturiwhatu	9.10 [8.88; 9.31]								●●●●●	-24% [-26; -21]
Wrybill / Ngutu parore	0.25 [0.21; 0.28]								○○○○○	-1% [-21; 14]
Pied stilt / Poaka	1.72 [1.60; 1.83]								●○○○○	-9% [-17; -1]
South Island pied oystercatcher / Tōrea	2.00 [1.89; 2.12]								●●●●●	-35% [-40; -30]
Spur-winged plover	2.53 [2.38; 2.69]								●●●○○	-6% [-13; 0]
White-faced heron / Matuku	0.18 [0.14; 0.22]								●●●●○	86% [38; 117]
Black-billed gull / Tarāpuka	0.0008 [0.0005; 0.0012]								●●○○○	-18% [-42; 4]
Black-fronted tern / Tarapirohe	6.52 [6.27; 6.76]								●●●●●	-29% [-33; -25]
Southern black- backed gull / Karoro	136.25 [131.78; 140.04]								●●●●●	-1% [-8; 6]
Black shag / Māpunga	0.13 [0.10; 0.18]								●●●●●	-49% [-62; -39]
Canada goose	5.03 [4.81; 5.25]								●●●●○	59% [46; 70]
Grey duck-mallard hybrid	1.77 [1.64; 1.88]								○○○○○	10% [-2; 16]
Paradise shelduck / Pūtakitaki	1.14 [1.06; 1.22]								●○○○○	8% [-2; 20]
New Zealand kingfisher / Kōtare*	0.05 [0.03; 0.07]								●●●●●	566% [242; 760]
Swamp harrier / Kāhu	0.12 [0.09; 0.15]								●●○○○	64% [14; 99]

At a guild-level, incorporating data from all species, there was strong or very strong evidence (Table 3) for:

- a moderate decline in open water divers
- a shallow decline in shallow water waders
- no change or little change in aerial gulls and terns, as well as deep water waders
- a shallow increase in dabbling waterfowl
- a rapid increase in riparian specialists.

Table 3. Trend summary for feeding guilds (see O'Donnell 2000) of braided river birds on the Waiau Uwha River based on the change in density estimates. Change estimates represent the percentage change over a 10-year period from survey midpoints, i.e. 2013 to 2023. The initial estimate corresponds to the midpoint of the first survey period, i.e. 2013. Evidence strength is categorised as: ●●●●● = very strong, ●●●●○ = strong, ●●●○○ = moderate, ●●○○○ = weak, ●○○○○ = very weak, ○○○○○ = insufficient. Median estimates are presented alongside their 90% confidence intervals in brackets.

Guild	Initial estimate (Number of birds/km ²)	Trend						Evidence strength	Change estimate
		Rapid decline	Moderate decline	Shallow decline	No or little change	Shallow increase	Moderate increase		
Shallow water waders	9.44 [9.23; 9.64]							●●●●●	-19% [-22; -16]
Deep water waders	8.76 [8.53; 9.00]							●●●●○	-6% [-10; -2]
Aerial gulls and terns	66.05 [65.08; 67.02]							●●●●●	1% [-1; 4]
Open water divers	1.04 [0.94; 1.12]							●●●●●	-47% [-56; -38]
Dabbling waterfowl	8.01 [7.80; 8.22]							●●●●●	31% [25; 36]
Riparian wetland specialists	0.39 [0.34; 0.44]							●●●●●	204% [160; 242]

At a threat classification level, incorporating data from all species, there was strong or very strong evidence (Table 4) for:

- a moderate decline in Threatened or At Risk species
- a shallow increase in Not Threatened
- a moderate increase in Introduced & Naturalised species.

Table 4. Trend summary of braided river birds based on their threat classification (see Robertson et al. 2021) in the Waiau Uwha River based on the change in density estimates. Change estimates represent the percentage change over a 10-year period from survey midpoints, i.e. 2013 to 2023. The initial estimate corresponds to the midpoint of the first survey period, i.e. 2013. Evidence strength is categorised as: ●●●●● = very strong, ●●●●○ = strong, ●●●○○ = moderate, ●●○○○ = weak, ●○○○○ = very weak, ○○○○○ = insufficient. Median estimates are presented alongside their 90% confidence intervals in brackets.

Threat classification	Initial estimate (Number of birds/km ²)	Trend						Evidence strength	Change estimate
		Rapid decline	Moderate decline	Shallow decline	No or little change	Shallow increase	Moderate increase		
Threatened	7.11 [6.89; 7.35]							●●●●○	-28% [-32; -24]
At Risk	18.44 [18.12; 18.74]							●●●●●	-29% [-32; -27]
Not Threatened	50.81 [50.17; 51.49]							●●●●●	29% [26; 32]
Introduced & Naturalised	4.48 [4.28; 4.68]							●●●●●	74% [60; 87]

4.2 Mid Waimakariri River

4.2.1 Summary statistics

A total of 25 species from 6 feeding guilds were detected at least once during the surveys of the mid Waimakariri River sections (Figure 5). Species presence and mean counts varied among sections, but all sections supported key native braided river bird species (Figure 5, Table A3.3). Threatened and At Risk species were detected across surveys, while Non-resident Native – Migrant species were detected only occasionally (Figure 6, Table A3.4).



Figure 5. Mean density of freshwater bird species from river surveys during 2006–2009 and 2017–2020 on the mid Waimakariri River by species and feeding guild. Coloured squares show the mean density (number of birds per km²) on a log₁₀ scale during spring surveys. [Note: Panel rows represent bird species grouped by feeding guild (see O'Donnell 2000) and columns correspond to river sections, with the vertical grey line separating the total across all ($n = 4$) sections. White squares indicate that no individuals of a species were detected in a river section during the survey period. For simplicity, only the English common name for each species is given.]

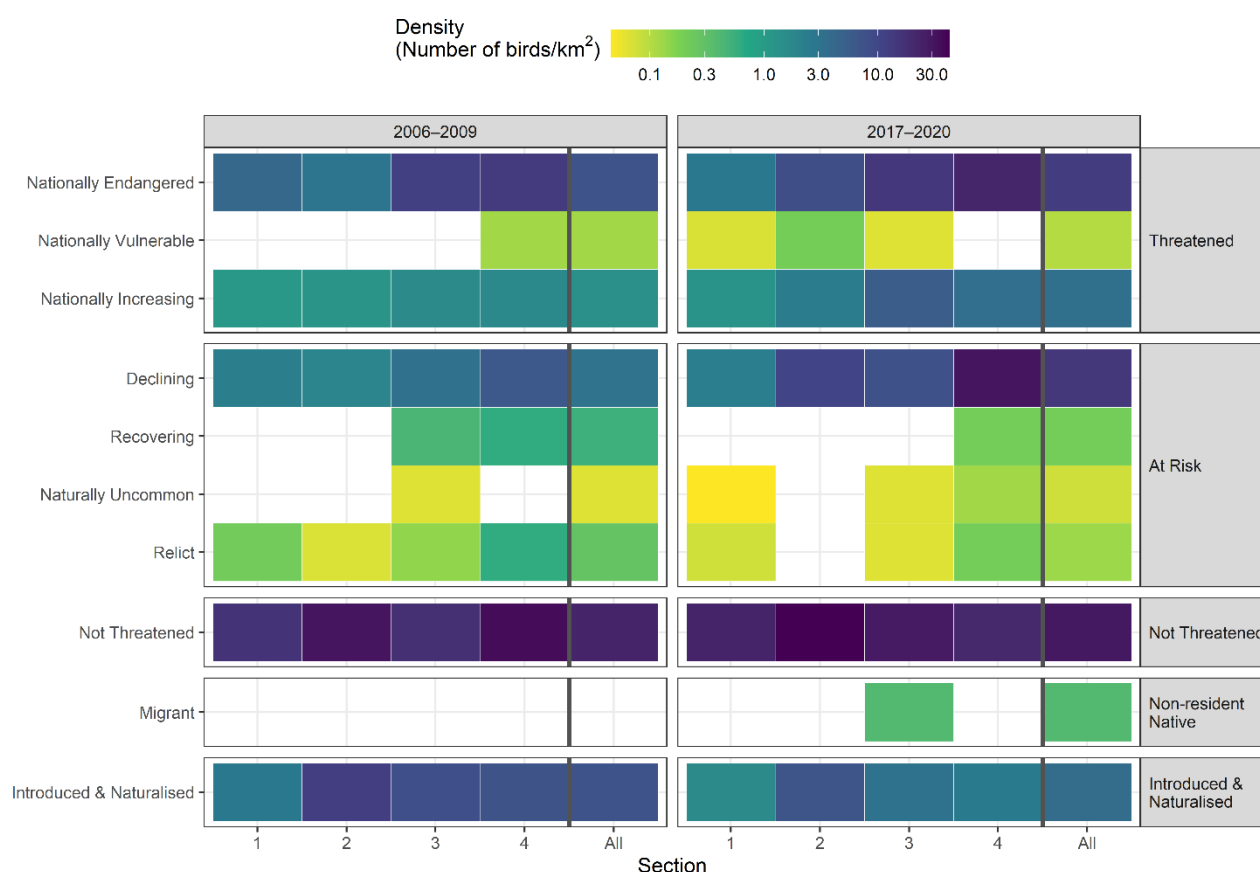


Figure 6. Mean density of freshwater bird species by threat status category (see Table A1.1) from river surveys during 2006–2009 and 2017–2020 on the mid Waimakariri River. Coloured squares show the mean density (number of birds per km²) on a log₁₀ scale during spring surveys. [Note: Panel rows represent threat status grouped by threat category (after Robertson et al. 2021) and columns correspond to the river section, with the vertical grey line separating the total across all ($n = 4$) sections. White squares indicate that no species of a given threat classification status were detected in a given river section during the survey period.]

4.2.2 Trend analysis

We assessed trends for a 10-year interval before the midpoint of the final 4-year survey period (i.e. 2008.5–2018.5) of 14 species which were detected frequently enough in surveys (Table 5). Our results show that we have strong or very strong evidence for:

- a rapid decline of grey duck–mallard hybrids
- a shallow increase in banded dotterels / tūturiwhatu, black-fronted terns / tarapirohe and paradise shelducks / pūtakitaki (*Tadorna variegata*) and southern black-backed gulls / karoro
- a rapid increase in the abundance of wrybills / ngutu parore (*Anarhynchus frontalis*), pied stilt / poaka (*Himantopus himantopus leucocephalus*), black-billed gulls / tarāpuka (*Chroicocephalus bulleri*), and white-fronted terns / tara (*Sterna striata striata*).

Overall, 2 species rapidly declined, one species showed little change, and 11 species increased in density, although support for these trends was moderate or lower for 5 species (Table 5).

Table 5. Trend summary for braided river birds in the mid Waimakariri River based on the change in density estimates. Change estimates represent the percentage change over a 10-year period from survey midpoints, i.e. 2008.5 to 2018.5. The initial estimate corresponds to the midpoint of the first survey period, i.e. 2008.5. Evidence strength is categorised as: ●●●●● = very strong, ●●●●○ = strong, ●●●○○ = moderate, ●●○○○ = weak, ●○○○○ = very weak, ○○○○○ = insufficient. Median estimates are presented alongside their 90% confidence intervals in brackets. Species are listed alphabetically within feeding guilds (Figure 5).

Species	Initial estimate (Number of birds/km ²)	Trend							Evidence strength	Change estimate
		Rapid decline	Moderate decline	Shallow decline	No or little change	Shallow increase	Moderate increase	Rapid increase		
Banded dotterel / Tūturiwhatu	5.69 [5.49; 5.89]								●●●●●	20% [14; 27]
Wrybill / Ngutu parore	1.21 [1.13; 1.31]								●●●●○	93% [115; 135]
Pied stilt / Poaka	0.52 [0.43; 0.61]								●●●●●	212% [151; 257]
South Island pied oystercatcher / Tōrea	0.93 [0.85; 1.00]								●●●○○	58% [39; 75]
Spur-winged plover	4.21 [3.88; 4.57]								●●○○○	107% [83; 128]
White-faced heron / Matuku	0.10 [0.07; 0.13]								●●○○○	72% [-18; 126]
Black-billed gull / Tarāpuka	0.93 [0.80; 1.07]								●●●●●	1589% [1212; 1875]
Black-fronted tern / Tarapirohe	5.88 [5.67; 6.09]								●●●●●	42% [34; 49]
Southern black- backed gull / Karoro	93.82 [87.14; 97.26]								●●●●●	12% [10; 13]
White-fronted tern / Tara	1.36 [0.84; 1.86]								●●●●○	60% [334; 442]
Black shag / Māpunga	0.08 [0.05; 0.10]								●○○○○	-52% [-85; -30]
Canada goose	3.33 [3.04; 3.62]								●●●○○	1% [-11; 9]
Grey duck-mallard hybrid	1.63 [1.49; 1.75]								●●●●●	-64% [-70; -58]
Paradise shelduck / Pūtakitaki	0.29 [0.24; 0.34]								●●●●●	49% [17; 74]

On a feeding guild level, incorporating data from all species, we have very strong evidence for (Table 6):

- a rapid decline in open water divers
- a moderate decline in dabbling waterfowl
- a shallow increase in shallow water waders
- a moderate increase in aerial gulls and terns, and deep water waders.

There was moderate evidence of a moderate increase in riparian wetland specialists.

Table 6. Trend summary for feeding guilds (after O'Donnell 2000) of braided river birds in the mid Waimakariri River based on the change in abundance estimates. Change estimate represent the percentage change over a 10-year period from survey midpoints, i.e. 2008.5 to 2018.5. The initial estimate corresponds to the midpoint of the first survey period, i.e. 2008.5. Evidence strength is categorised as: ●●●●● = very strong, ●●●●○ = strong, ●●●○○ = moderate, ●●○○○ = weak, ●○○○○ = very weak, ○○○○○ = insufficient. Median estimates are presented alongside their 90% confidence intervals in brackets.

Guild	Initial estimate (Number of birds/km ²)	Trend						Evidence strength	Change estimate
		Rapid decline	Moderate decline	Shallow decline	No or little change	Shallow increase	Moderate increase		
Shallow water waders	7.23 [7.00; 7.46]							●●●●●	39% [32; 44]
Deep water waders	6.68 [6.36; 6.95]							●●●●●	91% [80; 101]
Aerial gulls and terns	119.65 [118.76; 120.56]							●●●●●	59% [57; 61]
Open water divers	0.38 [0.31; 0.44]							●●●●●	-61% [-73; -50]
Dabbling waterfowl	7.06 [6.85; 7.29]							●●●●●	-32% [-35; -28]
Riparian wetland species	0.11 [<0.18; 0.15]							●●●○○	84% [-3; 152]

At a threat classification level, incorporating data from all species, there was very strong evidence (Table 7) for:

- no change or little change in Introduced & Naturalised species
- a shallow increase in Not Threatened and Threatened species
- a rapid increase in At Risk species.

Table 7. Trend summary of braided river birds based on their threat classification (after Robertson et al. 2021) in the mid Waimakariri River based on the change in abundance estimates. Change estimates represent the percentage change over a 10-year period from survey midpoints, i.e. 2008.5 to 2018.5. The initial estimate corresponds to the midpoint of the first survey period, i.e. 2007.5. Evidence strength is categorised as: ●●●●● = very strong, ●●●●○ = strong, ●●●○○ = moderate, ●●○○○ = weak, ●○○○○ = very weak, ○○○○○ = insufficient. Median estimates are presented alongside their 90% confidence intervals in brackets.

Threat classification	Initial estimate (Number of birds/km ²)	Trend						Evidence strength	Change estimate
		Rapid decline	Moderate decline	Shallow decline	No or little change	Shallow increase	Moderate increase		
Threatened	7.45 [7.22; 7.69]							●●●●●	48% [42; 54]
At Risk	10.66 [10.38; 10.94]							●●●●●	173% [164; 181]
Not Threatened	117.89 [116.96; 118.75]							●●●●●	23% [21; 24]
Introduced & Naturalised	3.81 [3.58; 4.03]							●●●●●	1% [-6; 8]

4.3 Upper Waimakariri River

4.3.1 Summary statistics

A total of 16 species from 5 feeding guilds were detected in both river sections in the upper Waimakariri River (Figure 7). Species presence and abundance varied between river sections. Specialist native braided river bird species were recorded in both survey sections (Figure 7, Table A3.5), along with species classified as Threatened or At Risk (Figure 8, Table A3.6).

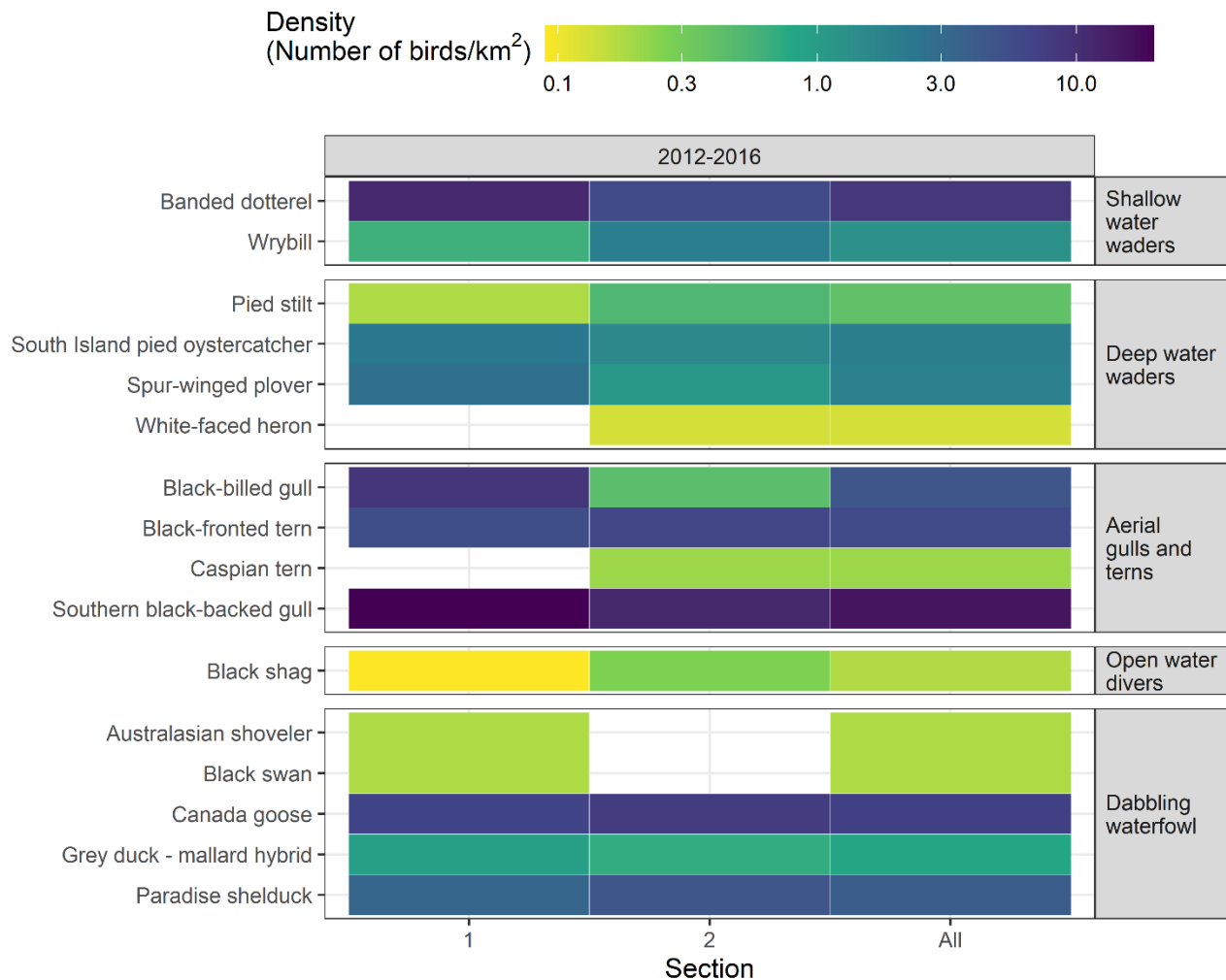


Figure 7. Mean density of freshwater bird species from river surveys during 2012–2016 on the upper Waimakariri River by species and feeding guild. Coloured squares represent the mean density (number of birds per km²) on a log₁₀ scale during spring surveys. [Note: Panel rows represent bird species grouped by feeding guild (see O'Donnell 2000) and columns correspond to river sections, with the vertical grey line separating the total across all ($n = 2$) sections. White squares indicate that no individuals of a species were detected in a river section during the survey period. For simplicity, only the English common name for each species is given.]

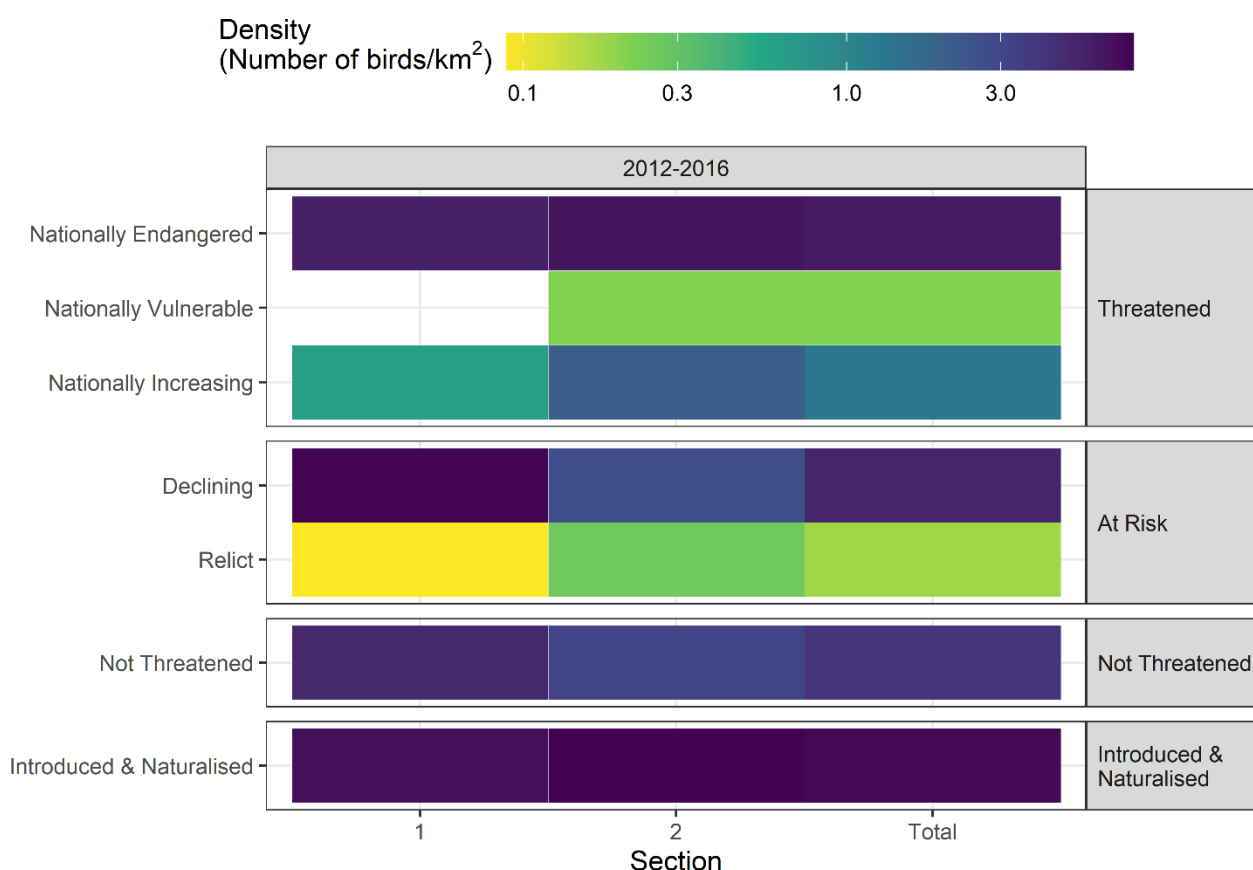


Figure 8. Mean density of freshwater bird species from river surveys from 2012–2016 on the upper Waimakariri River by threat status category (see Table A1.1). Coloured squares represent the mean density (number of birds per km²) on a log₁₀ scale during spring surveys. [Note: Panel rows represent threat status grouped by threat category (after Robertson et al. 2021) and columns correspond to river sections, with the vertical grey line separating the total across all ($n = 2$) sections. White squares indicate that no species of a given threat classification status were detected in a river section during the survey period.]

We did not undertake trend assessments were for the upper-Waimakariri River as data was only available for a 5-year period.

5 Conclusions

The braided river bird count data provide an important update on the state of braided river avifauna in the Waiau Uwha and Waimakariri rivers and have enabled an assessment of population trends across the bird community. Our results show that key braided river bird species, as well as Threatened and At Risk species, are present in all survey sections in the Waiau Uwha River, and the mid and upper Waimakariri Rivers. However, species composition and abundance differ between rivers, among sections within rivers, and over time. Overall, over 10-year periods, the Waiau Uwha and mid Waimakariri rivers have shown different trends for braided river bird species, feeding guilds and threat classifications. Trajectories for Threatened and At Risk species, particularly species such as wrybill / ngutu parore, black-fronted tern / tarapirohe and banded dotterel / tūturiwhatu, were increasing in the mid Waimakariri River, in contrast to the patterns observed in the Waiau Uwha River.

One important consideration when interpreting percentage change estimates is that species with relatively low initial abundances can exhibit large proportional changes even when the absolute

changes are small. For example, the rapid increase in kingfisher / kōtare abundance in the Waiau Uwha River reflects the fact that the species was initially only recorded infrequently, whereas species such as southern black-backed gulls / karoro, often encountered in large breeding colonies, are at much higher densities and therefore require larger absolute changes to produce comparable percentage shifts. Species with low initial abundances (<1 bird/km²) are black-billed gull, black shag, and white-faced heron in both rivers. In addition, wrybills / ngutu parore, kingfishers / kōtare and swamp harriers / kahu are at low initial abundances in the Waiau Uwha River and pied stilts / poaka, South Island pied oystercatchers / tōrea and paradise shelducks / pūtakitaki are at low initial abundances in the mid Waimakariri River. Braided river species also display different traits that affect their movement behaviour and general ecology – such as colony nesting in black-fronted terns / tarapirohe and black-billed gulls / tarāpuka (Schlesselmann et al. 2024). Hence, careful interpretation of change estimates at the reach level is required for species known to move over larger scales and especially those nesting in colonies.

The analysis approach employed here maximises the use of available data while accounting for differences of survey coverage. Regular surveys of braided river birds are logistically challenging due to the required coordination of suitable river flows, fine weather, and the availability of experienced observers. It is therefore not always possible to survey every river section during each scheduled survey because of access constraints and/or safety considerations for surveyors. The adoption in 2018 of 1 km survey sections, which are compatible with existing longer survey sections, will reduce data loss from partially surveyed sections in future monitoring and will provide a more fine-scaled overview of distribution of braided river bird species.

6 Recommendations

- ECan should continue monitoring of braided river birds using the km-section method and annual surveys during a 3–4-year survey period for a river. This would enable ongoing assessment of trends of braided river bird species and guide management.
 - Specifically, an additional survey round in the upper Waimakariri River would enable trend analyses.
- Always instruct observers to record *all* species to avoid having to omit data from analyses.
- For reporting, continue to assess trend directions together with evidence strength in future assessments. Such an approach could also be developed more widely to enable reporting at regional and reach levels.

7 Acknowledgements

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Appendix 1 – Braided river bird species

Table A1.1. Freshwater birds known to occur in the Waiau Uwha, mid and upper Waimakariri rivers. Nomenclature, and threat category and status (Threatened - T, At Risk - AR) from Robertson et al. (2021); te reo Māori names following Ngāi Tahu Claims Settlement Act 1998 where listed or Robertson et al. (2021) * indicates taonga species status under Schedule 97 of the Ngāi Tahu Claims Settlement Act 1998; † indicates species managed as pests. Guilds and habitats based on O'Donnell (2000; lakes & ponds (L), rivers (R), estuaries, river mouths & hāpua (E).

Guild	Common Name / Māori Name	Species	Threat category	Threat status	Habitat
Shallow water waders	Banded dotterel / Tūturiwhatu	<i>Charadrius bicinctus bicinctus</i>	At Risk	Declining	RE
	Black-fronted dotterel	<i>Elseyaornis melanops</i>	At Risk	Naturally Uncommon	RE
	Red knot / Huahou	<i>Calidris canutus rogersi</i>	At Risk	Declining	E
	Sharp-tailed sandpiper / Kohutapu	<i>Calidri acuminata</i>	Non-resident Native	Migrant	RE
	Wrybill / Ngutuparore	<i>Anarhynchus frontalis</i>	Threatened	Nationally Vulnerable	RE
Deep water waders	Black stilt / Kakī *	<i>Himantopus novaezelandiae</i>	Threatened	Nationally Critical	LR
	Pied stilt / Poaka *	<i>Himantopus himantopus leucocephalus</i>	Not Threatened	Not Threatened	LRE
	Royal spoonbill / Kōtuku ngutupapa	<i>Platalea regia</i>	At Risk	Naturally Uncommon	E
	South Island pied oystercatcher / Tōrea	<i>Haematopus finschi</i>	At Risk	Declining	RE
	Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened	Not Threatened	RE
	Variable oystercatcher / Tōrea pango	<i>Haematopus unicolor</i>	At Risk	Recovering	E
	White-faced heron / Matuku	<i>Egretta novaehollandiae</i>	Not Threatened	Not Threatened	LRE
Aerial gulls and terns	Black-billed gull / Tarāpuka	<i>Chroicocephalus bulleri</i>	At Risk	Declining	RE
	Black-fronted tern / Tarapirohe *	<i>Chlidonias albostratus</i>	Threatened	Nationally Endangered	RE
	Caspian tern / Taranui *	<i>Hydroprogne caspia</i>	Threatened	Nationally Vulnerable	RE
	Red-billed gull / Tarāpunga	<i>Larus novaehollandiae scopulinus</i>	At Risk	Declining	RE
	Southern black-backed gull / Karoro†	<i>Larus dominicanus dominicanus</i>	Not Threatened	Not Threatened	LRE
	Subantarctic skua / Hākoakoa	<i>Stercorarius antarctica lonnbergi</i>	Threatened	Nationally Vulnerable	E
	White-fronted tern / Tara *	<i>Sterna striata striata</i>	At Risk	Declining	RE
	White-winged black tern *	<i>Chlidonias leucopterus</i>	Non-resident Native	Migrant	RE

Guild	Common Name / Māori Name	Species	Threat category	Threat status	Habitat
Open water divers	Black shag / Māpunga *	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk	Naturally Uncommon	LRE
	Little black shag / Kawau tūī	<i>Phalacrocorax sulcirostris</i>	At Risk	Naturally Uncommon	LRE
	Little shag / Kawaupaka *	<i>Microcarbo melanoleucos brevirostris</i>	At Risk	Relict	LRE
	New Zealand scaup / Pāpango	<i>Aythya novaeseelandiae</i>	Not Threatened	Not Threatened	L
	Pied shag / Kāruhiruhi *	<i>Phalacrocorax varius</i>	At Risk	Recovering	E
	Spotted shag / Kawau tikitiki *	<i>Stictocarbo punctatus punctatus</i>	Threatened	Nationally Vulnerable	E
Dabbling waterfowl	Australasian shoveler / Kuruwhengu *	<i>Spatula rhynchotis</i>	Not Threatened	Not Threatened	LRE
	Black swan / Kākīānau	<i>Cygnus atratus</i>	Not Threatened	Not Threatened	LE
	Canada goose†	<i>Branta canadensis</i>	Introduced & Naturalised	Introduced & Naturalised	LRE
	Grey duck-mallard hybrid	<i>Anas superciliosa x platyrhynchus</i>	Not Threatened	Not Threatened	LRE
	Grey teal / Tete *	<i>Anas gracilis</i>	Not Threatened	Not Threatened	LRE
	Paradise shelduck / Pūtakitaki *	<i>Tadorna variegata</i>	Not Threatened	Not Threatened	LRE
Riparian wetland species	California quail / Tikaokao	<i>Callipepla californica</i>	Introduced & Naturalised	Introduced & Naturalised	R
	Falcon / Kārearea *	<i>Falco novaeseelandiae</i>	At Risk	Recovering	R
	New Zealand kingfisher / Kōtare *	<i>Todiramphus sanctus vagans</i>	Not Threatened	Not Threatened	LRE
	New Zealand pipit / Pīhoihoi	<i>Anthus novaeseelandiae</i>	At Risk	Naturally Uncommon	RE
	Rock pigeon / Kererū aropari	<i>Columba livia</i>	Introduced & Naturalised	Introduced & Naturalised	R
	Swamp harrier / Kāhu *	<i>Circus approximans</i>	Not Threatened	Not Threatened	LRE
	Welcome swallow / Warou	<i>Hirundo neoxena neoxena</i>	Not Threatened	Not Threatened	LRE
Swamp specialists	Swamp hen / Pūkeko *	<i>Porphyrio melanotus melanotus</i>	Not Threatened	Not Threatened	LRE

Appendix 2 – Data overview

Table A2.1 Overview of available bird count data from the Waiau Uwha River

Year	Survey start date	Survey method	Survey completion	Completed sections
1975	01/10/1975	River section	Partial measure	4 5 6 7 8
2008	16/10/2008	River section	Partial measure	1 2 3 4 5 6 7 8 10 11 12 13 14 15
2009	27/10/2009	River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2010	26/10/2010	River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2016	25/10/2016	River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2017	17/10/2017	River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2018	23/10/2018	KM reach & River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2022	15/11/2022	KM reach & River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2023	7/11/2023	KM reach & River section	Full measure	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2024	19/11/2024	KM reach & River section	Partial measure	1 2 3 4 5 6 7 11 12 13 14 15

Table A2.2. Overview of available bird count data from the mid Waimakariri River.

Year	Survey start date	Survey method	Survey completion	Completed sections
1980	01/10/1980	River section	Partial measure	1 2 3
2006	21/12/2006	River section	Partial measure	1 2 3
2007	07/11/2007	River section	Current full measure	1 2 3 4
2008	28/10/2008	River section	Current full measure	1 2 3 4
2009	20/10/2009	River section	Partial measure	1 2 3
2017	21/11/2017	River section	Current full measure	1 2 3 4
2018	30/10/2018	KM reach & River section	Partial measure	Part of 1 2 3 4
2020	17/11/2020	KM reach & River section	Current full measure	1 2 3 4

Table A2.3. Overview of available bird count data from the upper Waimakariri River

Year	Survey start date	Survey method	Survey completion	Completed sections
1981	25/11/1981	River Section Method	Current full Measure	1 2
1995	25/11/1995	River Section Method	Current full Measure	1 2
2012	05/11/2012	River Section Method	Current full Measure	1 2
2014	10/11/2014	River Section Method	Current full Measure	1 2
2016	16/10/2016	River Section Method	Current full Measure	1 2

Appendix 3 – Summary statistics

Table A3.1. Number of birds per km² (± standard error) counted in each section and the entire Waiau Uwha River during each survey. Species are grouped within guilds and totals for guilds are shown after all species details from each guild. Species are ordered alphabetically within guilds (see Table A1.1) and totals for each guild provided. If no standard error is shown, the species was only recorded once during the survey period. No record means the species was not detected. Values displayed to 1 decimal place and otherwise noted as <0.1.

Common Name / Māori Name	Survey	Section															Total	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shallow water waders																		
Banded dotterel / Tūturiwhatu	2008-2010	11.6 ± 1.3	8.5 ± 4.8	1.8 ± 1.1	12 ± 3.1	4.3 ± 0.9	9.4 ± 2.7	6.1 ± 1.4	12.3 ± 2.1	19 ± 0.7	6.6 ± 3.1	10.4 ± 1.9	14 ± 3.2	21.5 ± 4.5	4.7 ± 1.7	17.4 ± 2.3	10.7 ± 1.0	
	2016-2018	9.7 ± 1.6	3.7 ± <0.1	16.6 ± 1.9	9.1 ± 4.3	7.4 ± 3.2	11.3 ± 1.8	18.6 ± 3.7	16 ± 5.4	15.7 ± 4.9	21.6 ± 3.2	19.3 ± 5.8	17.9 ± 7.2	20.7 ± 6.3	19 ± 4.9	31.8 ± 10.9	16.2 ± 1.5	
	2022-2024	6.1 ± 1.9	5.4 ± 0.7	6.2 ± 2.5	3.9 ± 0.3	3.9 ± 0.8	4.7 ± 0.1	8.0 ± 0.7	3.8 ± 2.1	4.9 ± 3.6	4.9 ± 0.7	7.7 ± 2.7	9.2 ± 2.0	3.8 ± 1.6	2.9 ± 1.9	14.8 ± 2.7	6.1 ± 0.6	
Black-fronted dotterel	2016-2018								0.4	0.7			0.5		1.3 ± <0.1	0.3 ± <0.1	0.7 ± 0.2	
	2022-2024	0.3 ± 0.1					0.4	0.3 ± 0.1	0.4 ± 0.1	0.4 ± <0.1	0.7	0.5 ± 0.2	1.1 ± 0	0.5 ± 0.3	2.1 ± 0.2	0.5 ± 0.2		1.1
Red knot / Huahou	2016-2018													0.5			0.5	
Sharp-tailed sandpiper / Kohutapu	2016-2018													0.5				
Wrybill / Ngutu parore	2008-2010	0.3 ± 0.1					0.2	0.6 ± 0.2					1.3 ± 0.2	1.1 ± 0.6	1.3 ± 0.6	0.7	0.8 ± 0.2	
	2016-2018	0.6 ± 0.4					0.4 ± 0.2	0.3		0.2	0.5		2.7 ± 1.4	1.9 ± 0.5	1.9	0.8 ± 0.5	1.1	1.2 ± 0.3
	2022-2024	0.3 ± 0.1					0.2 ± 0.1	0.2 ± <0.1	0.9 ± 0.3					2.2 ± <0.1	0.6 ± 0.3	0.3 ± <0.1		0.6 ± 0.2
All shallow water waders	2008-2010	5.9 ± 2.6	8.5 ± 4.8	1.8 ± 1.1	12.0 ± 3.1	3.3 ± 1.2	5.0 ± 2.3	6.1 ± 1.4	12.3 ± 2.1	19.0 ± 0.7	6.6 ± 3.1	5.8 ± 2.2	8.9 ± 3.6	11.4 ± 5.0	3.7 ± 1.5	17.4 ± 2.3	8.0 ± 0.9	
	2016-2018	6.1 ± 2.4	3.7 ± <0.1	16.6 ± 1.9	9.1 ± 4.3	3.9 ± 2.1	11.3 ± 1.8	14.0 ± 5.3	9.8 ± 4.9	15.7 ± 4.9	13.2 ± 5.4	11 ± 4.6	6.8 ± 3.5	11.1 ± 5.1	8.5 ± 4.2	24.2 ± 10.9	10.4 ± 1.3	

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
All shallow water waders (cont.)	2022-2024	2.8 ± 1.4	5.4 ± 0.7	6.2 ± 2.5	3.9 ± 0.3	1.8 ± 0.8	2.2 ± 0.9	3.4 ± 1.4	2.1 ± 1.3	3.5 ± 2.5	2.7 ± 1.3	4.2 ± 1.6	3.8 ± 1.7	3 ± 0.8	1.5 ± 0.9	11.4 ± 3.9	3.5 ± 0.4
Deep water waders																	
Black stilt / Kakī	2016-2018	2.6															2.6
	2008-2010	2.2 ± 0.8	3 ± 1.5	2.9	4.4 ± 2.8	0.7 ± 0.2	1.2 ± 0.4	4.9 ± 2.0	4 ± 0.2	7.2	0.9 ± 0.7	3.2 ± 1.6	4.8 ± 3.2	3.4 ± 0.8	1.2 ± 0.5	1<0.1 ± 2.8	3.5 ± 0.6
Pied stilt / Poaka	2016-2018	3.6 ± 0.4	10.4	4.3 ± 1.4	5.4 ± 4.3	3.2 ± 2.6	3.6 ± 1.5	1.8 ± 0.9	8.6 ± 1.0	13.8 ± 10.5	7.3 ± 6.4	21.9 ± 15.4	24.3 ± 0.9	20.5 ± 8.3	9.7 ± 5.4	8.9 ± 5.6	9.1 ± 1.7
	2022-2024	1.1 ± 0.6	1.5 ± <0.1	3.1 ± 1.7	3.3 ± 1.6	2.5 ± 0.3	1.7 ± <0.1	1.2 ± 0.7	1.3 ± 0.8	3.3	1.7 ± 0.8	3.2 ± <0.1	4.4 ± 1.3	1.5 ± 0.2	2.8 ± 0.8	2.6 ± 1.5	2.4 ± 0.3
Royal spoonbill / Kōtuku ngutupapa	2008-2010																1.1
	2022-2024	0.1															2.0 ± 1.8
South Island pied oystercatcher / Tōrea	2008-2010	5.2 ± 0.5	2 ± 0.5	1.1 ± 0.4	4.4 ± 1.2	1.6 ± 0.5	3.6 ± 0.4	1.9 ± 0.7	6.2 ± 1.5	2.3 ± 0.3	1.0 ± 0.3	0.5	2 ± 0.2	5.1 ± 2.6	2.0 ± 0.3	2.2	2.9 ± 0.4
	2016-2018	2.1 ± 0.9	3 ± 0.7	2.4 ± 0.6	1.9 ± 0.2	3.7 ± 0.4	2.7 ± 0.5	4.9 ± 1.8	4 ± 0.9	5.5 ± 2.1	2.4 ± 0.4	2 ± 0.2	5.8 ± 1.0	1.3 ± <0.1	1.6 ± 0.4	2.2 ± <0.1	3.1 ± 0.3
	2022-2024	0.7 ± 0.1	1.8 ± 0.4	2.2 ± 0.7	0.8 ± 0.3	1.6 ± 0.8	1.0 ± 0.4	1.0 ± 0.3	2.2 ± 1.0	3.3	1.2 ± 0.5	1.4 ± 0.2	2.9 ± 1.8	2.2 ± 1.6	0.7	1.1	1.5 ± 0.2
Spur-winged plover	2008-2010	5.1 ± 2.4	3.7 ± 0.7	0.7	5.6 ± 2.4	5.0 ± 3.2	4.9 ± 2.7	6.3 ± 5.1	9.1 ± 6.2	8.5 ± 5.2	2.2 ± 0.6	1.1	11.5 ± 5.2	18.3 ± 6.9	2.7 ± 2.0	2.2	6.5 ± 1.2
	2016-2018	1.1 ± 0.5	3.7 ± 1.9	4.6 ± 2.4	1.1 ± 0.3	1.7 ± 1.1	3.6 ± 1.4	14.7 ± 11.2	2.3 ± 0.9	11.8 ± 9.2	4.7 ± 0.9	1.6 ± 0.5	16.8 ± 10.1	8.9 ± 7.7	2.2 ± 0.4	3.3	5.6 ± 1.4
	2022-2024	1.8 ± 1.7	3.9 ± 2.2	3.6 ± 1.7	2.1 ± 0.1	7.0 ± 3.8	3.4 ± 1.4	15.2 ± 4.1	3.0 ± 0.6	2.6 ± 2.0	6.1 ± 3.6	0.5	14.7 ± 6.5	3.4 ± 1.5	1.1 ± 0.4		5.3 ± 1.0
Variable oystercatcher / Tōrea pango	2008-2010																5.2 ± 0.7
	2016-2018																3.3 ± 1.1
	2022-2024																3.3 ± 0.6

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
White-faced heron / Matuku	2008-2010	0.1 ± <0.1	0.7		0.5 ± 0.4	0.2 ± 0.1	0.5	1.2	0.8		0.3 ± 0.1	1.1	0.3	0.6			0.5 ± 0.1
	2016-2018	0.7 ± 0.2		0.7 ± <0.1	0.2 ± <0.1	0.1 ± <0.1	0.4 ± 0.3	1.1 ± 0.5	0.2	0.7	1.2 ± 0.2	1.1	0.5	1.3	0.3 ± <0.1		0.6 ± 0.1
	2022-2024	0.2 ± 0.1	0.7	0.7 ± <0.1	0.3 ± 0.1	0.3 ± <0.1	0.2 ± <0.1	0.5 ± 0.2	1.0 ± 0.7	0.7 ± <0.1	0.9 ± 0.5	0.5 ± <0.1	1.3 ± 0.5		0.8 ± 0.3	1.1	0.6 ± 0.1
All deep water waders	2008-2010	3.4 ± 0.9	2.5 ± 0.6	1.4 ± 0.5	3.7 ± 1.0	2.0 ± 1.0	3.0 ± 0.9	4.0 ± 1.7	5.6 ± 1.8	5.8 ± 2.2	1.2 ± 0.3	2.1 ± 0.9	5.5 ± 2.1	8.1 ± 3	2.0 ± 0.6	5.7 ± 1.5	3.8 ± 0.4
	2016-2018	1.8 ± 0.4	4.3 ± 1.3	3.1 ± 0.8	2.3 ± 1.2	2.4 ± 0.8	2.7 ± 0.6	5.6 ± 2.9	4.1 ± 1.0	8.9 ± 3.6	4.2 ± 1.7	6.7 ± 4.4	13 ± 4.1	8.1 ± 3.6	2.9 ± 1.3	4.4 ± 1.5	4.8 ± 0.6
	2022-2024	0.9 ± 0.3	2.4 ± 0.9	2.6 ± 0.7	1.6 ± 0.5	2.6 ± 1.1	1.7 ± 0.5	4.4 ± 2.1	1.9 ± 0.4	2.2 ± 0.7	2.5 ± 1.1	1.6 ± 0.4	5.7 ± 2.2	2.4 ± 0.7	1.3 ± 0.4	2.8 ± 0.6	2.5 ± 0.3
Aerial gulls and terns																	
Black-billed gull / Tarāpuka	2008-2010	20.2 ± 17.1			70.8 ± 67.9	3.3 ± 1.9	2.3	208.7	8.5	1.3		2.2	22.2 ± 13.9		0.7	83.7 ± 61	39.2 ± 15.7
	2016-2018	18.6 ± 18.4	5.2		3.0 ± 0.7	0.5 ± 0.4	1.8 ± 0.8	1.6 ± 1.3	111.2 ± 100.8	62.9	11.4 ± 8.6	1.3 ± 0.5	21.4 ± 1.5		1.3 ± 1.0	22.2 ± 17.9	18.5 ± 8.2
	2022-2024	2.5 ± 2.4		15.5 ± 12.6	3.2 ± 1.8	1.1	0.8 ± 0.3	4.3	0.8 ± 0.6	0.7	17.4	7.8 ± 6.7	158.2	0.6	1.0	18.3 ± 5.0	12.9 ± 7.1
Black-fronted tern / Tarapirohe	2008-2010	13.7 ± 2.3	2.2	66.7 ± 4.6	16.3 ± 3.6	2.1 ± 0.7	21.4 ± 11.0	3.1 ± 0.8	12.6 ± 2.6	36.7 ± 14.4	1.7 ± 1.2	0.9 ± 0.2	15.9 ± 12.6	5.8 ± 2.0	1.6 ± 0.2	23.3 ± 11.0	15.0 ± 3.0
	2016-2018	6.8 ± 1.7	15.5 ± 13.7	92.9 ± 4.8	18.9 ± 16.3	2.4 ± 0.9	7.7 ± 2.8	11.3 ± 5.1	15.4 ± 5.7	2.6	16.6 ± 3.5	6.2 ± 0.8	11.4 ± 7.9	8.3 ± 5.1	9.4 ± 5.8	32.2 ± 9.7	18.1 ± 3.8
	2022-2024	7.5 ± 1.5	7.6 ± 6.5	88.1 ± 12.4	11.7 ± 5.6	3.7 ± 3.1	2.8 ± 1.0	6.3 ± 4.1	0.7 ± 0.1		3.6 ± 2.9	5.4 ± 2.2	4.4 ± 1.9	10.7 ± 6.3	2.9 ± 1.9	2.2 ± 1.1	11.9 ± 3.8
Caspian tern / Taranui	2008-2010	0.1									0.2					3.3 ± 2.2	1.8 ± 1.3
	2016-2018								0.2						0.7	6.7	2.5 ± 2.1
	2022-2024				0.2		0.2									1.1	0.5 ± 0.3

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Red-billed gull / Tarāpunga	2008-2010		0.7													17.8 ± 7.7	13.5 ± 6.9
Red-billed gull / Tarāpunga	2016-2018												0.3		0.3	15.5 ± 6.7	7.9 ± 5.2
	2022-2024															5 ± 0.6	5 ± 0.6
Southern black- backed gull / Karoro	2008-2010	53.6 ± 9.0	1.1 ± 0.4	0.7 ± <0.1	49.6 ± 9.9	101.7 ± 13.9	17.5 ± 4.0	16.1 ± 5.4	36.1 ± 25.5	9.8 ± 2.6	3.9 ± 0.2	53.3 ± 23.4	75.2 ± 11.3	22.7 ± 11.2	3.1 ± 1.2	118.8 ± 27.8	39.5 ± 6.6
	2016-2018	66.7 ± 30.8	3.9 ± 2.1	2.2	114.8 ± 8.0	206.7 ± 93	16.3 ± 5.0	2 ± 0.4	94.4 ± 47.3	108.1 ± 89.1	16.9 ± 4.2	59 ± 52.8	266.9 ± 48	2.3 ± 0.8	1.7 ± 0.3	61.8 ± 16.5	70.4 ± 14.9
	2022-2024	27.3 ± 4.0	3 ± 0.9		98.1 ± 10.3	186.2 ± 7.7	31.3 ± 11.7	4 ± 2.6	109.5 ± 31.3	4.3 ± 0.3	39.7 ± 35.3	3.8 ± 2.5	242.5 ± 12.8	2.6 ± 1.0	7.2 ± 2.8	37.8 ± 6.7	59.3 ± 12.9
Subantarctic skua / Hākoakoa	2008-2010															1.1	1.1
White-fronted tern / Tara	2008-2010						0.2	0.3								68.8 ± 12.6	41.4 ± 18.2
	2016-2018	0.1			1.1 ± 0.8		0.6 ± 0.3		0.2		0.5	0.8 ± 0.3	0.3 ± <0.1		2.3	7 ± 3.8	1.9 ± 0.9
	2022-2024							0.3				0.5 ± <0.1	1.0		0.3	7.8	1.7 ± 1.2
All aerial gulls and terns	2008-2010	26.3 ± 8.0	1.3 ± 0.4	40.3 ± 16.4	45.6 ± 21.4	35.7 ± 17	14.9 ± 4.9	33.3 ± 25.2	22.1 ± 10.9	18.9 ± 8.8	2.4 ± 0.7	23.5 ± 13.7	33.1 ± 11.3	12.5 ± 5.6	2.1 ± 0.6	52.5 ± 14.0	28.2 ± 4.0
	2016-2018	27.6 ± 12.7	9.1 ± 5.7	70.2 ± 22.9	40.9 ± 16.9	78.5 ± 48.3	7.7 ± 2.6	5.4 ± 2.4	55.2 ± 24.9	70.4 ± 44.1	13.7 ± 2.8	19.5 ± 16.2	73.2 ± 35.3	5.3 ± 2.7	3.6 ± 1.8	27.2 ± 6.9	32 ± 5.5
	2022-2024	13.7 ± 4.3	5.3 ± 3.1	59 ± 19.4	33.9 ± 14.4	81.5 ± 37.1	11.6 ± 6.0	4.4 ± 1.7	37 ± 24.3	3.1 ± 1.2	20.8 ± 13.8	4.3 ± 1.6	112.5 ± 42.5	5.8 ± 3.0	3.5 ± 1.4	12.5 ± 4.3	27.2 ± 5.3
Open water divers																	
Black shag / Māpunga	2008-2010	0.1 ± <0.1	0.7	2.2 ± 1.4	0.4 ± 0.2	0.9 ± 0.7	0.3	3.6 ± 1.0	0.7 ± 0.4		0.6 ± 0.3			2.9 ± 0.3	2.5 ± 1.0	11.1	1.9 ± 0.5
	2016-2018	0.6			1.8	0.1	1.3 ± 1.1	1.3 ± 1.0		1.3	0.5 ± <0.1		1 ± 0.5		1.3 ± 0.3	1.1 ± <0.1	1.1 ± 0.2

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Black shag / Māpunga (cont.)	2022-2024	0.1 ± <0.1	0.7		0.2	0.6 ± 0.2	0.3 ± 0.2	1.2 ± 0.9		1.3	0.2			0.6 ± <0.1	2.5 ± 1.5	1.1	0.8 ± 0.2
Little black shag / Kawau tūtī	2022-2024															1.1	1.1
Little shag / Kawaupaka	2008-2010		0.7											1.9 ± 1.3			1.5 ± 0.8
	2016-2018														0.3		0.3
	2022-2024															2.2	2.2
Scaup / Pāpango	2008-2010															15 ± 0.6	15 ± 0.6
Pied shag / Kāruhiruhi	2008-2010													7.7	3.9 ± 0.5	3.9 ± 2.8	4.5 ± 1.0
	2016-2018				0.2										2.0 ± 0.8	3.3 ± 1.1	2.3 ± 0.7
	2022-2024														3.8 ± 1.6	7.8 ± 2.9	5.8 ± 1.7
Spotted shag / Kawau tikitiki	2016-2018															3.3	3.3
All open water divers	2008-2010	0.1 ± <0.1	0.7 ± <0.1	2.2 ± 1.4	0.4 ± 0.2	0.9 ± 0.7	0.3	3.6 ± 1.0	0.7 ± 0.4		0.6 ± 0.3			3.5 ± 1.2	3.2 ± 0.6	9.8 ± 2.7	3.1 ± 0.7
	2016-2018	0.6			1.0 ± 0.8	0.1	1.3 ± 1.1	1.3 ± 1.0		1.3	0.5 ± 0		1.0 ± 0.5		1.5 ± 0.5	2.6 ± 0.7	1.5 ± 0.3
	2022-2024	0.1 ± <0.1	0.7		0.2	0.6 ± 0.2	0.3 ± 0.2	1.2 ± 0.9		1.3	0.2			0.6 ± <0.1	3.3 ± 1.0	4.6 ± 1.9	2.1 ± 0.6
Dabbling waterfowl																	
Black swan / Kakīānau	2008-2010															5.0 ± 3.9	5.0 ± 3.9
	2016-2018				0.2											6.7	3.4 ± 3.2
Canada goose	2008-2010	18.3 ± 5.4			2.3 ± 0.9	7.6 ± 2.9	4.2 ± 0.4	3.3 ± 3.0	6.0 ± 0.7	5.2 ± 0.7	1.2 ± 0.2		3.6 ± 1.4	2.6 ± 0.7	0.3	6.1 ± 2.8	5.5 ± 1.1

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Canada goose (cont.)	2016-2018	7.1 ± 1.0		2.2	6.3 ± 1.9	9.5 ± 4.8	9.7 ± 6.3	4.4 ± 2.2	20.9 ± 0.6	20.1 ± 10.1	2.7 ± 1.0	1.6 ± 0.5	12.3 ± 2.4	1 ± 0.3	0.6 ± 0.2	1.1 ± <0.1	8 ± 1.5
	2022-2024	4.9 ± 2.3			4.0 ± 1.5	6.1 ± 1.4	3.4 ± 1.6	5.8 ± 0.7	19.4 ± 1.0	3.3	5.2 ± 2.2	3.2	21.5 ± 7.8	1.6 ± 0.3	4.5 ± 0.7	13.3 ± 3.3	7.8 ± 1.4
Grey duck - mallard hybrid	2008-2010	0.7 ± 0.3	5.9 ± 1.5		4.1 ± 0.3	1.5 ± 0.3	1.2 ± 0.5	3.5 ± 1.1	4.4 ± 0.4	2.9 ± 1.6	2 ± 1.7	4.3 ± 0.5	1.8 ± 0.5	10.4 ± 6.1	3.5 ± 1.2	6.1 ± 2.8	3.8 ± 0.7
	2016-2018	1.0 ± 0.3	7.0 ± 4.8	3.4 ± 1.6	3.7 ± 1.8	2.6 ± 1.9	4 ± 1.4	1.8 ± 0.5	4 ± 2.1	49.8 ± 43.6	4.7 ± 1.6	2.3 ± 1.3	4.3 ± 2.8	4.3 ± 2.0	4.7 ± 1.0	2.2 ± 0.6	6.8 ± 3.3
	2022-2024	0.6 ± 0.5	12.1 ± 3.9	6.2 ± 2.5	1.4 ± 0.9	2.4 ± 1.2	1.2	0.9	1.5 ± <0.1	46.5	5.8 ± 0.7	8.1 ± 4.3	6.9 ± 3.8	4.5 ± 1.3	1.5 ± 0.8	3.3 ± 2.2	5.8 ± 1.5
Grey teal / Tete	2022-2024													1.9			1.9
Paradise shelduck / Pūtakitaki	2008-2010	0.6 ± 0.3		1.4	1.1 ± 0.1	0.6	2.5 ± 0.4	1.9 ± 0.7	1.4 ± 0.3	7.2 ± 0.7	1.9 ± 0.7	4.3 ± 2.2	0.8 ± 0.3	5.5 ± 2.0	1.5 ± 0.8	5.6 ± 3.3	2.6 ± 0.5
	2016-2018	0.4 ± 0.2	6.7		0.8 ± 0.3	0.7	0.7 ± 0.2	1.2 ± 0.3	4.4 ± 2.9	4.4 ± 1.7	4.3 ± 1.5	4.6 ± 3.0	2.4 ± 0.9	9.6 ± 8.3	3.6 ± 1.6	5.9 ± 1.5	3.4 ± 0.6
	2022-2024	0.4	0.7 ± <0.1	1.4	0.5 ± 0.2	1.4 ± 1.2	0.3	2.0 ± 0.9	1.9 ± 1.3	6.5 ± 1.3	1 ± 0.3	2.3 ± 0.5	6 ± 4.6	14.7 ± 5.9	4.2 ± 1.5	7.2 ± 5.0	3.9 ± 1.0
All dabbling waterfowl	2008-2010	7.2 ± 3.7	5.9 ± 1.5	1.4	2.5 ± 0.5	3.9 ± 1.7	2.6 ± 0.6	2.9 ± 0.8	4 ± 0.8	5.1 ± 0.9	1.7 ± 0.5	4.3 ± 1.2	2.1 ± 0.7	6.2 ± 2.2	2.0 ± 0.7	5.7 ± 1.2	3.9 ± 0.4
	2016-2018	3.2 ± 1.2	6.9 ± 2.8	3.1 ± 1.2	3.2 ± 1.0	5.3 ± 2.5	4.8 ± 2.3	2.5 ± 0.8	10.5 ± 3.2	24.7 ± 14.5	4 ± 0.8	2.8 ± 0.9	6.6 ± 2.0	4.8 ± 2.4	2.7 ± 0.9	3.7 ± 0.9	6.1 ± 1.3
	2022-2024	2.4 ± 1.2	7.5 ± 3.5	5.0 ± 2.1	2.0 ± 0.8	3.5 ± 1.0	2.1 ± 1.0	3.5 ± 0.9	7.6 ± 3.8	15.7 ± 10.3	4.0 ± 1.1	4.4 ± 1.6	11.5 ± 3.8	7.0 ± 2.6	3.6 ± 0.7	8.0 ± 2.5	5.7 ± 0.7
Riparian wetland specialists																	
California quail / Tikaokao	2016-2018							0.6		2.6				0.6			1.3 ± 0.7
	2022-2024	0.2 ± 0.1			0.9 ± 0.2	0.2 ± <0.1	0.5	0.3 ± <0.1	0.3 ± 0.1	1.6 ± 1		1.6	0.3 ± <0.1	1.7 ± 0.6			0.8 ± 0.2
Falcon / Kārearea	2016-2018			0.7							0.2						0.5 ± 0.2

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
New Zealand or sacred kingfisher / Kōtare	2008-2010				0.2 ± <0.1			0.3	0.2					2.6	0.3		0.6 ± 0.4
	2016-2018				0.2 ± <0.1		0.6 ± 0.1	0.3	0.4 ± 0.2	0.7	0.6 ± 0.3	0.5	0.3	1.3			0.5 ± 0.1
	2022-2024	0.2 ± 0.1	0.7 ± <0.1	0.7 ± <0.1	0.5 ± 0.4	0.4 ± 0.2	0.2 ± 0	0.4 ± 0.1	0.7 ± 0.1	0.7 ± <0.1	0.2 ± <0.1	0.9 ± 0.4	0.5 ± 0.3	3 ± 1.2	2.5 ± 2.2	1.1	0.9 ± 0.2
New Zealand pipit / Pīhoihoi	2008-2010	0.6 ± 0.2		0.7	0.2		0.4 ± 0.1										0.5 ± 0.1
	2016-2018	1 ± 0.4			1.1	0.6 ± 0.4	0.9 ± 0.5										0.9 ± 0.2
	2022-2024	0.4 ± <0.1		0.7	0.4 ± 0.2	0.2	0.3 ± 0.1	0.3			0.2	1.1	0.4 ± 0.1				0.4 ± 0.1
Rock pigeon / Kererū aropari	2016-2018		0.7 ± <0.1								0.7		1.0				0.8 ± 0.1
Swamp harrier / Kāhu	2008-2010				0.5 ± 0.2	0.4	0.2		0.2 ± <0.1	0.7	0.2	0.5	0.5	0.6			0.4 ± 0.1
	2016-2018	0.1		0.7	0.3 ± 0.1	0.3 ± 0.2	0.2 ± 0.1	0.4 ± 0.1	0.2	0.7	1 ± 0.3	0.5	0.3 ± <0.1	0.6	0.5 ± 0.2		0.5 ± 0.1
	2022-2024	0.1 ± <0.1	1.2 ± 0.5	0.7 ± <0.1	0.2 ± <0.1	0.1 ± <0.1	0.2 ± <0.1	0.3 ± <0.1			0.5 ± 0.2	0.8 ± 0.3	0.3	0.6	0.3 ± <0.1		0.5 ± 0.1
Welcome swallow / Warou	2008-2010				0.2												0.2
	2016-2018	0.1	0.7	0.7			0.6 ± 0.4				1.6				1.0		0.8 ± 0.2
All riparian wetland specialists	2008-2010	0.6 ± 0.2		0.7	0.3 ± 0.1	0.4	0.3 ± 0.1	0.3	0.2 ± 0	0.7	0.2	0.5	0.5	1.6 ± 1.0	0.3		0.5 ± 0.1
	2016-2018	0.7 ± 0.3	0.7 ± <0.1	0.7 ± <0.1	0.4 ± 0.1	0.4 ± 0.2	0.5 ± 0.1	0.4 ± 0.1	0.4 ± 0.1	1.3 ± 0.7	0.8 ± 0.2	0.5 ± 0	0.4 ± 0.2	0.9 ± 0.2	0.7 ± 0.2		0.6 ± 0.1
	2022-2024	0.2 ± <0.1	1 ± 0.3	0.7 ± <0.1	0.5 ± 0.1	0.2 ± 0.1	0.2 ± <0.1	0.3 ± <0.1	0.5 ± 0.1	1.1 ± 0.5	0.3 ± 0.1	1.0 ± 0.2	0.4 ± 0.1	2.1 ± 0.6	1.4 ± 1.1	1.1	0.7 ± 0.1
Swamp hen / Pūkeko - Swamp specialists	2008-2010						0.2										0.2

Common Name / Māori Name	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
All species	2008-2010	9.9 ± 2.6	3.1 ± 0.7	14.5 ± 7.0	12.6 ± 5.3	11.4 ± 5.0	5.4 ± 1.4	11.3 ± 6.7	8.7 ± 2.9	10.1 ± 2.7	2.1 ± 0.5	9.4 ± 4.1	11.9 ± 3.6	7.8 ± 1.5	2.4 ± 0.3	26.6 ± 6.7	10.3 ± 1.1
	2016-2018	9.1 ± 3.6	5.6 ± 1.9	15.7 ± 6.2	11.9 ± 4.7	19.4 ± 11.2	4.4 ± 0.9	5 ± 1.3	20.6 ± 7.9	22 ± 8	6.3 ± 1.2	10.2 ± 5.0	25.3 ± 10.4	6.7 ± 1.6	3.5 ± 0.9	14 ± 3.1	11.8 ± 1.5
	2022-2024	3.6 ± 1.1	4.0 ± 1.0	13.5 ± 5.4	8.9 ± 3.8	14.1 ± 6.8	3.7 ± 1.5	3.2 ± 0.7	10.5 ± 5.6	4.8 ± 2.1	5.5 ± 2.6	3.1 ± 0.6	25.1 ± 9.7	4 ± 0.9	2.5 ± 0.4	7.7 ± 1.6	7.8 ± 1.1

Table A3.2. Number of birds per km² ($\pm$ standard error) counted in each section and the entire Waiau Uwha River categorised by threat classification (Robertson et al. 2021) during each survey period. If no standard error is shown, the species was only recorded once during the survey period. No record means the species was not detected. Values displayed to 1 decimal place and otherwise noted as <0.1.

Threat status	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Threatened Nationally Critical	2016-2018	2.6															2.6
Threatened Nationally Endangered	2008-2010	13.7 $\pm$ 2.3	2.2	66.7 $\pm$ 4.6	16.3 $\pm$ 3.6	2.1 $\pm$ 0.7	21.4 $\pm$ 11	3.1 $\pm$ 0.8	12.6 $\pm$ 2.6	36.7 $\pm$ 14.4	1.7 $\pm$ 1.2	0.9 $\pm$ 0.2	15.9 $\pm$ 12.6	5.8 $\pm$ 2.0	1.6 $\pm$ 0.2	23.3 $\pm$ 11	15 $\pm$ 3
	2016-2018	6.8 $\pm$ 1.7	15.5 $\pm$ 13.7	92.9 $\pm$ 4.8	18.9 $\pm$ 16.3	2.4 $\pm$ 0.9	7.7 $\pm$ 2.8	11.3 $\pm$ 5.1	15.4 $\pm$ 5.7	2.6	16.6 $\pm$ 3.5	6.2 $\pm$ 0.8	11.4 $\pm$ 7.9	8.3 $\pm$ 5.1	9.4 $\pm$ 5.8	32.2 $\pm$ 9.7	18.1 $\pm$ 3.8
	2022-2024	7.5 $\pm$ 1.5	7.6 $\pm$ 6.5	88.1 $\pm$ 12.4	11.7 $\pm$ 5.6	3.7 $\pm$ 3.1	2.8 $\pm$ 1	6.3 $\pm$ 4.1	0.7 $\pm$ 0.1		3.6 $\pm$ 2.9	5.4 $\pm$ 2.2	4.4 $\pm$ 1.9	10.7 $\pm$ 6.3	2.9 $\pm$ 1.9	2.2 $\pm$ 1.1	11.9 $\pm$ 3.8
Threatened Nationally Vulnerable	2008-2010	0.1									0.2					2.6 $\pm$ 1.5	1.6 $\pm$ 1.0
	2016-2018			0.7					0.2		0.2				0.7	5 $\pm$ 1.7	2 $\pm$ 1.1
	2022-2024				0.2		0.2									1.1	0.5 $\pm$ 0.3
Threatened Nationally Increasing	2008-2010	0.3 $\pm$ 0.1				0.2	0.6 $\pm$ 0.2					1.3 $\pm$ 0.2	1.1 $\pm$ 0.6	1.3 $\pm$ 0.6	0.7		0.8 $\pm$ 0.2
	2016-2018	0.6 $\pm$ 0.4				0.4 $\pm$ 0.2		0.3	0.2		0.5	2.7 $\pm$ 1.4	1.9 $\pm$ 0.5	1.9	0.8 $\pm$ 0.5	1.1	1.2 $\pm$ 0.3
	2022-2024	0.3 $\pm$ 0.1				0.2 $\pm$ 0.1	0.2 $\pm$ <0.1	0.9 $\pm$ 0.3				2.2 $\pm$ <0.1	0.6 $\pm$ 0.3		0.3 $\pm$ <0.1		0.6 $\pm$ 0.2
At Risk Declining	2008-2010	9.4 $\pm$ 4.3	3.9 $\pm$ 1.9	1.3 $\pm$ 0.4	26.2 $\pm$ 20.1	3.1 $\pm$ 0.7	4.2 $\pm$ 1.4	29.1 $\pm$ 25.7	9.6 $\pm$ 1.6	8.8 $\pm$ 4.2	4.4 $\pm$ 2.2	6.8 $\pm$ 2.5	12.7 $\pm$ 5.1	13.3 $\pm$ 4.3	3.1 $\pm$ 1.0	43.5 $\pm$ 15.2	14.3 $\pm$ 3.2
	2016-2018	7.2 $\pm$ 4.2	3.6 $\pm$ 0.5	9.5 $\pm$ 3.3	3.8 $\pm$ 1.4	3.5 $\pm$ 1.3	4.1 $\pm$ 1.4	9.2 $\pm$ 3.1	31.4 $\pm$ 22.7	18.1 $\pm$ 8.0	10.6 $\pm$ 3.5	6.3 $\pm$ 2.9	8.9 $\pm$ 2.9	12.9 $\pm$ 5.9	6.7 $\pm$ 3.0	16.8 $\pm$ 5.2	9.9 $\pm$ 1.7
	2022-2024	2.6 $\pm$ 1.0	4 $\pm$ 1	6.8 $\pm$ 3.2	2.2 $\pm$ 0.6	2.2 $\pm$ 0.6	1.9 $\pm$ 0.6	3.5 $\pm$ 1.2	2.3 $\pm$ 0.8	3.4 $\pm$ 1.8	5 $\pm$ 2.6	4.1 $\pm$ 1.5	19.6 $\pm$ 15.5	2.8 $\pm$ 1.0	1.8 $\pm$ 1.0	11.1 $\pm$ 2.4	5.2 $\pm$ 1.4
At Risk Recovering	2008-2010													7.7	3.9 $\pm$ 0.5	4.7 $\pm$ 1	4.7 $\pm$ 0.7

Threat status	Survey	Section															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
At Risk Recovering (cont)	2016-2018				0.2										2 ± 0.8	3.3 ± 0.7	2.6 ± 0.6
	2022-2024														3.8 ± 1.6	5.6 ± 1.7	5 ± 1.2
At Risk Relict	2008-2010	0.1 ± <0.1	0.7 ± <0.1	2.2 ± 1.4	0.4 ± 0.2	0.9 ± 0.7	0.3	3.6 ± 1.0	0.7 ± 0.4		0.6 ± 0.3			2.4 ± 0.6	2.5 ± 1.0	11.1	1.8 ± 0.5
	2016-2018	0.6			1.8	0.1	1.3 ± 1.1	1.3 ± 1.0		1.3	0.5 ± <0.1		1.0 ± 0.5		1 ± 0.4	1.1 ± <0.1	1 ± 0.2
	2022-2024	0.1 ± <0.1	0.7		0.2	0.6 ± 0.2	0.3 ± 0.2	1.2 ± 0.9		1.3	0.2			0.6 ± 0	2.5 ± 1.5	1.7 ± 0.6	0.9 ± 0.2
At Risk Naturally Uncommon	2008-2010															1.1	1.1
	2016-2018								0.4		0.7		0.5	1.3 ± <0.1	0.3 ± <0.1		0.7 ± 0.2
	2022-2024	0.3 ± 0.1				0.2 ± 0.1	0.3 ± 0.1	0.4 ± 0.1	0.4 ± <0.1	0.7	0.5 ± 0.2	1.1 ± <0.1	0.4 ± 0.2	2.1 ± 0.2	0.5 ± 0.2	2.6 ± 1.5	0.9 ± 0.2
Not Threatened	2008-2010	11.6 ± 5.4	3.1 ± 0.7	1.3 ± 0.4	8.6 ± 3.6	20.5 ± 10.3	4.7 ± 1.7	5.9 ± 1.8	9.5 ± 5.3	6.5 ± 1.4	1.8 ± 0.4	13.8 ± 7.1	13.8 ± 6.7	9.6 ± 2.5	2.2 ± 0.5	30.1 ± 12.8	10.1 ± 1.5
	2016-2018	12.7 ± 7.7	5 ± 1.2	2.9 ± 0.7	16.5 ± 8.2	37.9 ± 23.9	3.7 ± 1.2	3.3 ± 1.7	19.4 ± 11.2	27.7 ± 14.0	5.1 ± 1.3	16.2 ± 10.9	53.9 ± 25.8	6.7 ± 2.2	2.9 ± 0.8	18.3 ± 7.7	15.1 ± 2.9
	2022-2024	4.6 ± 2.2	3.5 ± 1.1	2.8 ± 0.8	14.4 ± 7.4	27.2 ± 13.8	6.5 ± 3.4	3.4 ± 1.3	17 ± 11	6.6 ± 3.7	7 ± 4.6	2.6 ± 0.7	41.4 ± 19.5	4.6 ± 1.3	2.5 ± 0.6	9.7 ± 4.4	10.7 ± 2.2
Non-resident native Migrant	2016-2018												0.5				0.5
Introduced & Naturalised	2008-2010	18.3 ± 5.4			2.3 ± 0.9	7.6 ± 2.9	4.2 ± 0.4	3.3 ± 3.0	6 ± 0.7	5.2 ± 0.7	1.2 ± 0.2		3.6 ± 1.4	2.6 ± 0.7	0.3	6.1 ± 2.8	5.5 ± 1.1
	2016-2018	7.1 ± 1.0	0.7 ± <0.1	2.2	6.3 ± 1.9	9.5 ± 4.8	9.7 ± 6.3	3.5 ± 1.8	20.9 ± 0.6	15.7 ± 8.4	2.0 ± 0.9	1.6 ± 0.5	9.5 ± 3.3	0.9 ± 0.2	0.6 ± 0.2	1.1 ± <0.1	6.9 ± 1.3
	2022-2024	3.0 ± 1.7			2.5 ± 1.0	3.1 ± 1.5	2.4 ± 1.3	3.6 ± 1.4	9.9 ± 5.5	2.2 ± 0.8	5.2 ± 2.2	2.4 ± 0.8	13.0 ± 6.7	1.7 ± 0.3	4.5 ± 0.7	13.3 ± 3.3	4.9 ± 0.9

Table A3.3. Number of birds per km² ($\pm$ standard error) counted in each section and the entire mid Waimakariri River. If no standard error is shown, the species was only recorded once during the survey period. No record means the species was not detected. Values displayed to 1 decimal place and otherwise noted as <0.1. Note that survey periods are 2018–2020 for southern black-backed gull, overall aerial gulls and terns, and all species combined as southern black-backed gulls have not been counted in 2017.

Common Name / Māori Name	Survey	Section				Total
		1	2	3	4	
Shallow water waders						
Banded dotterel / Tūturiwhatu	2006-2009	5.8 ± 1.7	4.7 ± 1.7	8.2 ± 2	14.5 ± 1.4	7.4 ± 1.2
	2017-2020	4.7 ± <0.1	7.1 ± 1.8	8 ± 2.9	9.4 ± 1.9	7.6 ± 1
Black-fronted dotterel	2006-2009			0.1		0.1
	2017-2020			0.1		0.1
Wrybill / Ngutu parore	2006-2009	1.1 ± 0.3	1.2 ± 0.4	1.6 ± 0.7	1.7 ± 0.1	1.4 ± 0.2
	2017-2020	1.3 ± 1.1	2.4 ± 0.9	5.6 ± 1.2	3.5 ± 1	3.4 ± 0.7
All shallow water waders	2006-2009	3.4 ± 1.2	2.9 ± 1	4.4 ± 1.5	8.1 ± 3.8	4.2 ± 0.8
	2017-2020	3 ± 1.1	4.7 ± 1.4	5.9 ± 1.6	6.5 ± 1.6	5.2 ± 0.8
Deep water waders						
Pied stilt / Poaka	2006-2009	0.4 ± 0.2	1.2 ± 0.2	2.1 ± 1.5	2.2 ± 0.1	1.4 ± 0.4
	2017-2020	0.4 ± 0.2	1.5 ± 0.8	2.4 ± 1.0	4.7 ± 1.6	2.4 ± 0.7
South Island pied oystercatcher / Tōrea	2006-2009	1.3 ± 0.6	0.9 ± 0.2	0.7 ± 0.2	1.7 ± 0	1.1 ± 0.2
	2017-2020	1.1 ± 0.5	1.3 ± 0.2	2.2 ± 0.2	1.5 ± 0.2	1.6 ± 0.2
Spur-winged plover	2006-2009	7.5 ± 6.2	3.2 ± 1.4	12.4 ± 7.2	27.0 ± 10	11.0 ± 3.6
	2017-2020	2.3 ± 1.9	3.0 ± 1.5	44.9 ± 25.3	27.6 ± 5.8	21 ± 8.3
White-faced heron / Matuku	2006-2009	0.2 ± 0.1	0.3	0.2 ± <0.1	0.4 ± 0.1	0.2 ± <0.1
	2017-2020	<0.1 ± <0.1	0.1	1.1 ± 0.4	0.7 ± 0.3	0.6 ± 0.2
All deep water waders	2006-2009	2.6 ± 1.8	1.6 ± 0.5	4.2 ± 2.4	7.8 ± 4.6	3.7 ± 1.2
	2017-2020	1.0 ± 0.5	1.8 ± 0.5	13.7 ± 8.5	8.6 ± 3.6	6.8 ± 2.6
Aerial gulls and terns						
Black-billed gull / Tarāpuka	2006-2009	0.4 ± 0.1	0.9 ± 0.8	3.5 ± 2.8	5.5 ± 1.9	2.6 ± 1.2
	2017-2020	3.1 ± 0.3	27.1 ± 13.5	16.0 ± 7.2	117.9 ± 67	44.5 ± 21.6
Black-fronted tern / Tarapirohe	2006-2009	4.2 ± 1.2	3 ± 1.4	11.8 ± 0.9	13.6 ± 2.5	7.4 ± 1.4
	2017-2020	2.7 ± 1.1	8.3 ± 3.2	14.8 ± 7.1	22.2 ± 5.4	12.8 ± 3.1
Caspian tern / Taranui	2006-2009				0.1	0.1
	2017-2020	0.1 ± <0.1	0.2	0.1		0.1 ± <0.1
Southern black- backed gull / Karoro	2006-2009	92.1 ± 18.3	149.4 ± 31	100 ± 25.5	205.5 ± 78.4	126.9 ± 17.8
	2018-2020*	139.7	248.4 ± 118.5	139.9 ± 23.7	86.3 ± 58.5	155.5 ± 38.9
White-fronted tern / Tara	2006-2009		0.4	1.0 ± 0.8	3.7 ± 1.9	2.0 ± 1.0
	2017-2020	<0.1	0.1	2.7 ± 0.5	4.8 ± 2.2	2.9 ± 1.2
White-winged black tern	2017-2020			0.4		0.4
All aerial gulls and terns	2006-2009	35.1 ± 14.9	55.6 ± 24.7	33.1 ± 13.5	50.8 ± 32.1	42.6 ± 10.1
	2018-2020*	28.8 ± 27.7	75.1 ± 44.3	38.1 ± 19.9	65.2 ± 30.7	53.7 ± 15.8

Common Name / Māori Name	Survey	Section				Total
		1	2	3	4	
Open water divers						
Black shag / Māpunga	2006-2009	0.2 ± 0.1		0.2 ± 0.1	0.2	0.2 ± 0.1
	2017-2020	0.1 ± <0.1			0.2 ± 0.1	0.2 ± 0.1
Little black shag / Kawau tūt	2006-2009	<0.1			0.1	0.1 ± <0.1
	2017-2020		0.1	0.1	0.8 ± 0.6	0.4 ± 0.3
Little shag / Kawaupaka	2006-2009	<0.1		0.1	0.1	0.1 ± <0.1
	2017-2020			0.5	0.6	0.5 ± 0.1
Pied shag / Kāruhiruhi	2006-2009				0.2 ± 0.1	0.2 ± 0.1
	2017-2020	0.2 ± 0.1	0.1	0.2 ± 0.1	0.6 ± 0.3	0.3 ± 0.1
All open water divers	2006-2009	0.1 ± <0.1		0.1	0.2 ± <0.1	0.1 ± <0.1
	2017-2020	0.2 ± 0.1		0.2 ± 0.1	0.2	0.2 ± 0.1
Dabbling waterfowl						
Canada goose	2006-2009	3.4 ± 1.7	12.4 ± 5.3	8.1 ± 2.9	7.1 ± 1.7	7.8 ± 1.9
	2017-2020	1.6 ± 0.1	9.0 ± 3.2	3.8 ± 0.7	2.8 ± 1.3	4.6 ± 1.2
Grey duck - mallard hybrid	2006-2009	0.8 ± 0.5	1.1 ± 0.5	5.3 ± 0.9	1.1 ± 0.2	2.2 ± 0.6
	2017-2020	0.8 ± 0.5	1.1 ± 0.5	5.3 ± 0.9	1.1 ± 0.2	2.2 ± 0.6
Paradise shelduck / Pūtakitaki	2006-2009	0.9 ± 0.4	0.5 ± 0.1	0.3 ± <0.1	1.2 ± 1.0	0.7 ± 0.2
	2017-2020	0.3 ± 0.2	0.2 ± 0.1	0.9 ± 0.2	0.6 ± 0.2	0.5 ± 0.1
All dabbling waterfowl	2006-2009	1.7 ± 0.7	5.1 ± 2.5	5.0 ± 1.4	3.2 ± 1.4	3.8 ± 0.9
	2017-2020	0.8 ± 0.3	3.6 ± 1.9	2.4 ± 0.5	1.4 ± 0.5	2.1 ± 0.5
Riparian wetland species						
New Zealand kingfisher / Kōtare	2006-2009	<0.1		0.1	0.1	0.1 ± <0.1
	2017-2020			0.1		0.1
New Zealand pipit / Pīhoihoi	2006-2009	0.1 ± <0.1	0.1 ± <0.1	0.3 ± 0.1		0.2 ± <0.1
	2017-2020	0.5			0.1	0.3 ± 0.2
Rock pigeon / Kererū aropari	2006-2009	0.3				0.3
	2017-2020		0.4	2.3 ± 0.3	1.9	1.7 ± 0.5
Swamp harrier / Kāhu	2006-2009	<0.1		0.1 ± <0.1		0.1 ± <0.1
	2017-2020	<0.1	0.1 ± <0.1	0.8 ± 0.5		0.3 ± 0.2
Welcome swallow / Warou	2006-2009	0.3 ± 0.1	0.2 ± 0.1	0.4 ± 0.2		0.3 ± 0.1
	2017-2020			1.0	1.7	1.4 ± 0.4
All riparian wetland species	2006-2009	0.2 ± <0.1	0.1 ± <0.1	0.2 ± 0.1	0.1	0.2 ± <0.1
	2017-2020	0.3 ± 0.2	0.2 ± 0.1	1.2 ± 0.4	1.2 ± 0.6	0.8 ± 0.2
All species	2006-2009	8.6 ± 3.4	15.4 ± 6.6	10.1 ± 3.5	17.9 ± 9.5	12.2 ± 2.6
	2018-2020*	9.5 ± 8.7	24.8 ± 14.6	15.2 ± 6.7	19.6 ± 8.5	18.1 ± 5.1

Table A3.4 Number of birds per km² ($\pm$ standard error) counted in each section and the entire mid Waimakariri River grouped by threat classification (Robertson et al. 2021) for each survey. If no standard error is shown, the species was only recorded once during the survey period. No record means the species was not detected. Values displayed to 1 decimal place and otherwise noted as <0.1 .

Status	Survey	Section 1	Section 2	Section 3	Section 4	Total
Threatened – Nationally Endangered	2006-2009	4.2 $\pm$ 1.2	3 $\pm$ 1.4	11.8 $\pm$ 0.9	13.6 $\pm$ 2.5	7.4 $\pm$ 1.4
	2017-2020	2.7 $\pm$ 1.1	8.3 $\pm$ 3.2	14.8 $\pm$ 7.1	22.2 $\pm$ 5.4	12.8 $\pm$ 3.1
Threatened – Nationally Vulnerable	2006-2009				0.1	0.1
	2017-2020	0.1 $\pm$ <0.1	0.2	0.1		0.1 $\pm$ <0.1
Threatened – Nationally Increasing	2006-2009	1.1 $\pm$ 0.3	1.2 $\pm$ 0.4	1.6 $\pm$ 0.7	1.7 $\pm$ 0.1	1.4 $\pm$ 0.2
	2017-2020	1.3 $\pm$ 1.1	2.4 $\pm$ 0.9	5.6 $\pm$ 1.2	3.5 $\pm$ 1	3.4 $\pm$ 0.7
At Risk – Declining	2006-2009	2.3 $\pm$ 0.9	1.9 $\pm$ 0.7	3.3 $\pm$ 1.1	6.4 $\pm$ 1.9	3.1 $\pm$ 0.6
	2017-2020	2.3 $\pm$ 0.7	10.7 $\pm$ 5.1	7.7 $\pm$ 2.5	30.9 $\pm$ 19.1	14.5 $\pm$ 6.1
At Risk – Recovering	2006-2009			0.5	0.6	0.5 $\pm$ 0.1
	2017-2020				0.2 $\pm$ 0.1	0.2 $\pm$ 0.1
At Risk – Relict	2006-2009	0.2 $\pm$ 0.1	0.1	0.1 $\pm$ 0	0.6 $\pm$ 0.4	0.3 $\pm$ 0.1
	2017-2020	0.1 $\pm$ <0.1		0.1	0.2 $\pm$ 0.1	0.1 $\pm$ 0
At Risk – Naturally Uncommon	2006-2009			0.1		0.1
	2017-2020	<0.1		0.1	0.1	0.1 $\pm$ <0.1
Not Threatened	2006-2009	16.3 $\pm$ 7.3	30.9 $\pm$ 14.7	17.8 $\pm$ 7.6	36.6 $\pm$ 22.8	23.3 $\pm$ 5.8
	2017-2020	23.5 $\pm$ 23.2	42.1 $\pm$ 31.4	27.9 $\pm$ 15.6	21.5 $\pm$ 11.8	29.5 $\pm$ 10.8
Non-resident Native Migrant	2006-2009					
	2017-2020			0.4		0.4
Introduced & Naturalised	2006-2009	2.8 $\pm$ 1.4	12.4 $\pm$ 5.3	8.1 $\pm$ 2.9	7.1 $\pm$ 1.7	7.3 $\pm$ 1.8
	2017-2020	1.6 $\pm$ 0.1	6.9 $\pm$ 3.1	3.2 $\pm$ 0.6	2.6 $\pm$ 0.9	3.8 $\pm$ 0.9

Table A3.5. Number of birds per km² ($\pm$ standard error) counted in each section and the entire upper Waimakariri River. If no standard error is shown, the species was only recorded once during the survey period. No record means the species was not detected. Values displayed to 1 decimal place and otherwise noted as <0.1. For simplicity, only common names given (see Table A1.1 for binomials).

Common Name / Māori Name	Survey	Section		Total
		1	2	
Shallow water waders				
Banded dotterel / Tūturiwhatu	2012-2016	11.2 ± 2.1	5.9 ± 0.9	8.6 ± 1.8
Wrybill / Ngutu parore	2012-2016	0.6 ± 0.2	2 ± 0.5	1.3 ± 0.5
All shallow water waders	2012-2016	5.9 ± 3.2	4 ± 1.2	4.9 ± 1.6
Deep water waders				
Pied stilt / Poaka	2012-2016	0.2	0.5 ± 0.4	0.4 ± 0.3
South Island pied oystercatcher / Tōrea	2012-2016	2.3 ± 0.3	1.6 ± 0.2	1.9 ± 0.2
Spur-winged plover	2012-2016	2.7 ± 1.4	1.1 ± 0.2	1.9 ± 0.7
White-faced heron / Matuku	2012-2016		0.1 ± 0.1	0.1 ± 0.1
All deep water waders	2012-2016	2 ± 0.7	0.8 ± 0.2	1.3 ± 0.3
Aerial gulls and terns				
Black-billed gull / Tarāpuka	2012-2016	8.9 ± 7.2	0.4 ± 0.2	4.7 ± 3.8
Black-fronted tern / Tarapirohe	2012-2016	5.5 ± 5.1	6.4 ± 3.1	6 ± 2.4
Caspian tern / Taranui	2012-2016		0.2	0.2
Southern black-backed gull / Karoro	2012-2016	19.8 ± 3.9	11.5 ± 1.2	15.7 ± 2.9
All aerial gulls and terns	2012-2016	11.4 ± 3.7	5.3 ± 2.0	8.1 ± 2.1
Open water divers				
Black shag / Māpunga	2012-2016	0.1	0.3	0.2 ± 0.1
All open water divers				
Dabbling waterfowl				
Australasian shoveler / Kuruwhengu*	2012-2016	0.2		0.2
Black swan / Kakīānau	2012-2016	0.2		0.2
Canada goose	2012-2016	6.7 ± 4.9	7.7 ± 0.6	7.2 ± 2
Grey duck - mallard hybrid	2012-2016	0.9 ± 0.1	0.7 ± 0.3	0.8 ± 0.1
Paradise shelduck / Pūtakitaki	2012-2016	3.3 ± 0.8	4.6 ± 2.3	4 ± 1.1
All dabbling waterfowl	2012-2016	2.8 ± 1.3	4.3 ± 1.4	3.5 ± 1.0
All species	2012-2016	5.2 ± 1.3	3.3 ± 0.7	4.2 ± 0.8

Table A3.6. Number of birds per km² ($\pm$ standard error) counted in each section and the entire upper Waimakariri River grouped by threat classification (Robertson et al. 2021) for each survey. If no standard error is shown, the species was only recorded once during the survey period. No record means the species was not detected. Values displayed to 1 decimal place and otherwise noted as <0.1.

Status	Survey	1	2	Total
Threatened				
Nationally Endangered	2012-2016	5.5 $\pm$ 5.1	6.4 $\pm$ 3.1	6.0 $\pm$ 2.4
Threatened				
Nationally Vulnerable	2012-2016		0.2	0.2
Threatened				
Nationally Increasing	2012-2016	0.6 $\pm$ 0.2	2 $\pm$ 0.5	1.3 $\pm$ 0.5
At Risk				
Declining	2012-2016	7.5 $\pm$ 2.6	2.7 $\pm$ 1.1	5.1 $\pm$ 1.5
At Risk				
Relict	2012-2016	0.1	0.3	0.2 $\pm$ 0.1
Not Threatened	2012-2016	4.9 $\pm$ 2.3	3.1 $\pm$ 1.3	4.0 $\pm$ 1.3
Introduced & Naturalised	2012-2016	6.7 $\pm$ 4.9	7.7 $\pm$ 0.6	7.2 $\pm$ 2.0