

State and trends in the abundance and distribution of riverbed-nesting shorebirds on the Tutaekuri, Ngaruroro and Tukituki Rivers

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State and trends in the abundance and distribution of riverbed-nesting shorebirds on the Tutaekuri, Ngaruroro and Tukituki Rivers.

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Cover Image: Ngaruroro River, showing the recently harvested vineyards along River Road, Maraekakaho and looking back towards Te Mata Peak. Image credit: Bruce Jenkins/photonezealand.

Executive Summary

The Tutaekuri, Ngaruroro and Tukituki Rivers provide breeding habitat for internationally, nationally and regionally significant populations of indigenous shorebirds including banded dotterels, black-fronted dotterels and South Island pied oystercatchers. Hawke's Bay Regional Council (HBRC) has a statutory responsibility for flood and erosion mitigation in Hawke's Bay, and this includes carrying out a range of activities on the riverbeds of these three rivers which have the potential to adversely impact these shorebird populations. To address this risk, HBRC has developed an Ecological Management and Enhancement Plan for each river, identifying key ecological values and outlining a set of rules and guidelines to be applied to flood mitigation activities, to avoid or minimise the adverse impacts of these activities. To effectively and efficiently manage these impacts, HBRC needs to maintain an accurate, detailed and up-to-date understanding of the spatial distribution of shorebird values along these rivers. To achieve this, HBRC commissioned a systematic shorebird survey along 262 km of the Tutaekuri and Ngaruroro Rivers, and the Tukituki River and its tributaries in November 2019.

A total of 62 bird species was recorded during this survey, including 39 native or endemic species, 16 of which are ranked as either Nationally or Regionally Threatened or At Risk under the New Zealand Threat Classification System. Five of these species are native or endemic shorebird species that breed on open gravel habitats on the beds of these rivers: banded dotterel, black-fronted dotterel, South Island pied oystercatcher, pied stilt and black-billed gull.

A total of 2308 adult banded dotterels was counted during this survey, representing 12% of the global population of this species. The Tukituki, Ngaruroro and Tutaekuri Rivers respectively support the second, third and twelfth largest single-river populations of this species in New Zealand. Banded dotterel numbers on these rivers appear to have been stable since 1962, providing evidence that current measures being taken by HBRC to maintain shorebird values on these rivers are proving effective. A total of 1168 black-fronted dotterels were counted during this survey, representing 45% of the national population of this species, and 1041 pied stilts were counted, representing 3.5% of the national population. Thirty-one South Island pied oystercatchers were also counted, and these birds represent the only population of this species currently breeding in the North Island.

We identified ten individual reaches of the Tutaekuri, Ngaruroro and Tukituki Rivers that support relatively high numbers and densities of one or more of these shorebird species, and we suggest that these reaches could be used to develop spatially-explicit rules or consent conditions designed to avoid or minimise adverse impacts to shorebirds associated with flood mitigation or commercial gravel extraction activities. These reaches should also be considered high-priority areas for conservation management actions aimed at reducing populations of mammalian predators or managing human activities likely to result in the disturbance or destruction of nests or chicks.

We recommend that HBRC undertakes a review of its existing Ecological Management and Enhancement Plans for these rivers, to incorporate our updated and improved knowledge of the shorebird values of these rivers. We also recommend that this shorebird survey be developed into an ongoing monitoring programme, with surveys to be carried out on a three-years-on, three-years-off cycle to monitor ongoing changes in shorebird population size and distribution on these rivers.

Keywords: banded dotterel, black-billed gull, black-fronted dotterel, flood mitigation, Hawke's Bay Regional Council, Ngaruroro River, pied stilt, South Island pied oystercatcher, Tukituki River, Tutaekuri River

1. Introduction

The Tutaekuri, Ngaruroro and Tukituki Rivers support a high diversity of indigenous bird species, including a significant number of species classified as Nationally Threatened or At Risk under the New Zealand Threat Classification System (Forbes 2015; 2017a; 2017b). Key features of the avifauna values of these rivers include the nationally significant populations of several species of inland-breeding shorebirds that breed on the unvegetated riverbed gravels during the spring and summer months. For example, in a recent review of shorebird surveys carried out on 119 braided rivers throughout New Zealand since 1962, the Ngaruroro River was found to support the largest number of banded dotterels (*Charadrius bicinctus*) of any river in the country, with the Tukituki and Tutaekuri Rivers supporting the 3rd and 7th largest single-river populations respectively (O'Donnell & Monks, *in press*). These three rivers also support an estimated 40% of the national population of black-fronted dotterels (*Elseyornis melanops*), and the only breeding population of South Island pied oystercatchers (*Haematopus finschi*) to be found in the North Island (Heather & Robertson, 2015; Stephenson, 2010).

Hawke's Bay Regional Council (HBRC) has statutory responsibilities for flood and erosion mitigation in the Hawke's Bay region under Section 30 of the Resource Management Act (1991) and Sections 10 and 126 of the Soil Conservation and Rivers Control Act (1941). To meet these responsibilities, HBRC carries out a range of river drainage and flood control activities on the Tutaekuri, Ngaruroro and Tukituki Rivers, some of which have the potential to adversely impact the ecological values of these rivers, including their indigenous bird values. To avoid or minimise these potential adverse impacts, HBRC has prepared an Ecological Management and Enhancement Plan (EMEP) for each of these three rivers, the purpose of which is to identify existing ecological, recreational and drainage values, and to specify the management standards to be applied to river drainage and flood control activities. These plans include a description of the shorebird values of these rivers, and a set of management standards aimed at minimising any adverse impacts on these shorebird values caused by flood mitigation activities (Forbes, 2015; 2017a; 2017b).

However, the existing descriptions of the spatial patterns in shorebird values present on these three rivers contained within these EMEPs are based on a set of systematic shorebird surveys that have been carried out at varying times in the past, and by different agencies. For example, the most recent shorebird survey carried out on the Tutaekuri River was conducted in 1986 by staff and volunteers from the Wildlife Service and Birds New Zealand (Stephenson, 2011; Forbes & Whitesell, 2015). Similarly, the most recent shorebird survey to be carried out on the Tukituki River was done in November 2014 by HBRC contractors and volunteers from Birds New Zealand (HBRC, unpublished data; Forbes, 2017b). In contrast, the most recent survey carried out on the Ngaruroro River was done in November 2018 by the Department of Conservation (DOC, unpublished data), but the description of shorebird values in HBRC's Ngaruroro River EMEP is based on surveys carried out between 1962 and 1993 by the Wildlife Service, the Department of Conservation and Birds New Zealand (Stephenson, 2010; Forbes, 2017a).

In order to manage the potential adverse impacts of HBRC's flood mitigation activities on these riverbed-nesting shorebird populations, HBRC needs to maintain an accurate, detailed and up to date understanding of the distribution of shorebird values within the flood control scheme areas in all three of these river catchments. To achieve this, Hawke's Bay Regional Council has commissioned a complete survey of riverbed-breeding shorebirds along the Tutaekuri, Ngaruroro and Tukituki Rivers, to be carried out during the 2019-2020 summer breeding season. This report summarises the results

of this survey and provides recommendations for further management and monitoring actions aimed at further improving HBRC's management of these nationally significant shorebird populations.

2. Methods

2.1 Survey area

Between the 29th of October and 8th of November 2019 we carried out bird surveys along a total of 262 km of riverbed habitat in the Tutaekuri, Ngaruroro and Tukituki River catchments (Figure 2.1). Our survey area included reaches of river on which shorebird surveys have been carried out on several previous occasions since 1962 (Parrish, 1988). Our survey area also included the river reaches in each of the three catchments that fall within HBRC's flood control scheme (Forbes & Whitesell, 2015; Forbes 2017a; Forbes 2017b) and incorporated the majority of the Department of Conservation's Tukituki River banded dotterel management prescription area (Appendix Two; Denise Fastier, personal communication, 13th August 2019).

To create the opportunity to use these data to map river bird values to a high level of spatial detail, we divided each river into a network of shorter survey sections varying in length from between 220 and 2170 metres. The boundaries of these survey sections were aligned with established river cross sections from HBRC's river cross section monitoring network. These cross sections have been systematically surveyed by HBRC since 1990, in order to assess gravel availability and flood control performance for individual sub-reaches along each river (Clode & Beya, 2018).

2.2 Survey methods

Each survey section was surveyed by a team of between one and six experienced observers, with the number of observers per team varying according to the width of the active riverbed in each survey section. Typically, observers were spaced ≤ 100 m apart across the width of the riverbed, so survey sections with active riverbed widths of ≤ 100 m were surveyed by a team of one or two observers, whereas survey sections with active riverbed widths of >100 m were surveyed by teams of up to six observers.

Each team typically walked line-abreast up or down the river, recording the identity and cumulative counts of all adult birds seen or heard in the bed of the river, or in the adjacent riparian vegetation, within each survey section. Any birds seen flying overhead that were obviously associated with the river habitat (e.g. waterfowl or shorebirds) were also counted, provided they were flying in a direction perpendicular or opposite to the direction of travel of the observers. Birds flying in the same direction that the observers were travelling in were not counted, to minimise the risk of double-counting birds. Special care was taken to systematically search all areas of dry, un-vegetated gravels and all muddy backwaters, temporary pools or minor channels to minimise the risk of missing territorial pairs of banded and black-fronted dotterels, and pied stilts (*Himantopus himantopus*). Adjacent team members maintained regular communication with one another using either hand-held radios, mobile phones or hand signals to avoid double-counting or missing any individual birds detected. Although the primary aim of this survey was to record the presence of all bird species on the river and to carry out complete counts of the adult populations of riverbed-nesting shorebird species, the locations of any nests, broods of chicks or breeding colonies located either by luck or on an opportunistic basis were also recorded using handheld GPS devices.

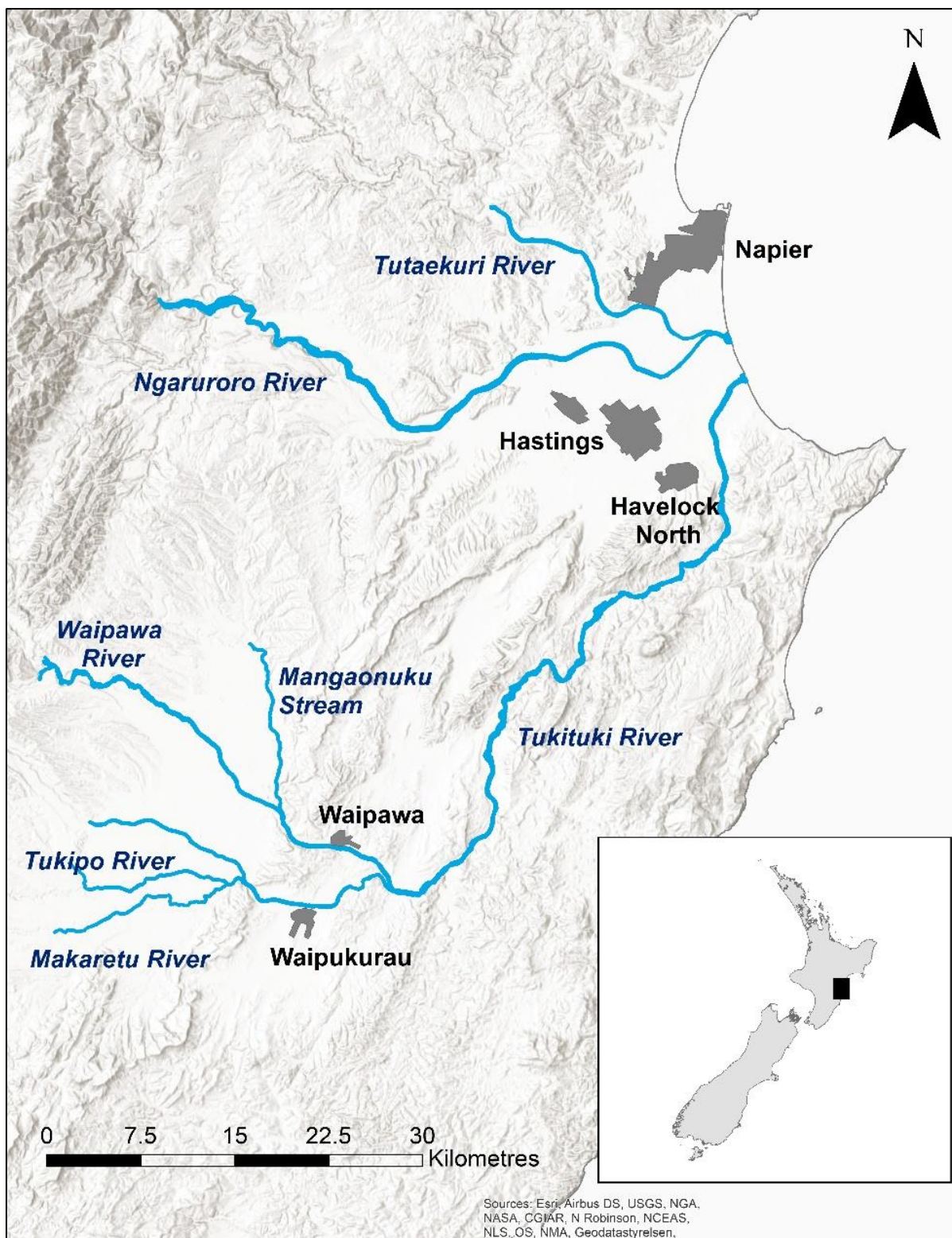


Figure 2.1: Map of Hawke's Bay showing the spatial extent of bird surveys (marked in blue) carried out in the Tutaekuri, Ngaruroro and Tukituki River catchments in November 2019.

In addition to collecting data on the presence and abundance of all bird species present within each survey section, observers also collected data to describe both woody weed cover and the percent cover of individual substrate size classes on dry gravel beaches and islands within each survey section. Woody weed cover was quantified by visually estimating the percentage of dry gravel beaches or islands covered in vegetation >5 cm in height, at 200 m intervals along each survey section. Observers measured these 200 m intervals out using a handheld GPS, and at each 200 m interval observers would estimate the percent cover of woody weeds within an imaginary box extending 50 m upstream and downstream of the 200 m mark, and across the entire width of the active riverbed. These individual woody weed cover estimates were then used to calculate a single mean woody weed cover estimate for each survey section. If a 200 m interval sampling point contained no dry gravel beaches or islands, no woody weed cover estimate was recorded. The percent cover and size class structure of dry gravels and sediments were also recorded at the same 200m intervals. At each 200 m mark observers would visually estimate the percentage of dry gravel beaches and islands covered in each of seven modified Wentworth Scale substrate size classes (Table 2.2.1; Harding et al, 2009), within an imaginary box extending 20 m upstream and downstream of the 200 m mark, and across the entire width of the active riverbed. These individual substrate size class cover estimates were then used to calculate mean substrate size class cover estimates for each survey section. If a 200 m interval sampling point contained no dry gravel beaches or islands, no substrate size class cover estimates were recorded.

Table 2.2.1: Modified Wentworth Scale substrate size classes used during this survey (reproduced from Harding et al, 2009).

Size category	Particle diameter range
Bedrock	>4000 mm
Boulder	>256 mm to 4000 mm
Cobble	>64 mm to 256 mm
Pebble	>16 mm to 64 mm
Gravel	>2 mm to 16 mm
Sand	>0.063 mm to 2 mm
Silt	<0.063 mm

Each team would typically survey between six and twelve contiguous survey sections per day (approximately 4-10 km of river), with up to four teams working simultaneously on contiguous reaches of river. The entire survey was carried out during a relatively short, eleven day window of fine, dry weather with normal river flows, and at a time of year in which the majority of riverbed-nesting shorebirds would have been “anchored” to nests or broods of young chicks and therefore relatively sedentary on the riverbeds. For these reasons, we are confident that the potential to double-count or miss adult riverbed-nesting shorebirds that move from one river reach to another was kept to a minimum for the duration of our survey.

2.3 Data management and analysis

These survey data were double-entered into a Microsoft Excel™ spreadsheet for two-pass data verification, and the verified dataset was then used to calculate total and mean bird counts for individual survey sections.

Spatial patterns in shorebird values were mapped using ArcMap version 10.7.1. We first delimited the boundaries of the active riverbeds by using the ArcMap “create polygon” tool, then “cut” the resulting polygon using the survey section boundaries layer, creating a separate polygon for each survey section. We used ArcMap’s “calculate geometry” tool to calculate the planar area of each survey section polygon in hectares, then divided the number of birds counted within each survey section by its area, to calculate the number of birds per hectare present within each survey section.

A copy of the Microsoft Excel™ data spreadsheet, together with scanned copies of the field datasheets, have been provided to HBRC.

3. Results

3.1 Species diversity

A total of 62 bird species was detected during this survey of the Tutaekuri, Ngaruroro and Tukituki Rivers. Thirty-nine species (63%) were either native or endemic to New Zealand and the remaining 23 species (37%) were introduced and naturalised species (see Appendix One for a full list of the bird species encountered).

Sixteen of the native or endemic bird species detected (41%) are ranked as either Nationally Threatened or At Risk under the New Zealand Threat Classification System, including two species ranked as Nationally Critical (grey duck, *Anas superciliosa* and black-billed gull, *Larus bulleri*); two species ranked as Nationally Vulnerable (banded dotterel, *Charadrius bicinctus* and Caspian tern, *Hydroprogne caspia*); four species ranked as At Risk, Recovering; three species ranked as At Risk, Naturally Uncommon and five species ranked as At Risk, Declining (Appendix One).

Four of the 16 Nationally Threatened or At Risk bird species detected during this survey are shorebird species that specialise in nesting on open gravel beaches and islands on the beds of rivers, and are largely restricted to these habitats during all, or part of their life cycles. These species are dealt with individually in sections 3.2, 3.3, 3.4 and 3.6 of this report below. One further shorebird species (pied stilt) is ranked as Regionally Vulnerable in Hawke's Bay under the New Zealand Threat Classification System, and this species is dealt with in section 3.5 below.

3.2 Banded dotterel (*Charadrius bicinctus*)



Image courtesy of Rebecca Bowater/NZ Birds Online

National conservation status: Nationally Vulnerable (Robertson et al, 2017)

Regional conservation status: Regionally Vulnerable (HBRC, unpublished data)

A total of 2308 banded dotterels were counted during this survey, including 280 birds counted on the Tutaekuri River, 916 birds on the Ngaruroro River and 1112 birds on the Tukituki River and its tributaries. 888 of the 1112 banded dotterels encountered on the Tukituki River (80%) were located within DOC's banded dotterel management prescription area (Appendix Two).

This result confirms that these three rivers continue to act as the stronghold¹ for breeding banded dotterels in the North Island. In comparison to the 2308 birds counted along 262 km of braided rivers in Hawke's Bay during this survey, only 344 banded dotterels were counted along 211 km of braided

¹ We define a stronghold as any site that supports >20% of the breeding population of a species within a defined geographic area (in this case the North Island). This definition has been adapted from that used by DOC's Regional Threat Classification System (DOC/GWRC unpublished data; DOC/HBRC unpublished data).

rivers in the Wairarapa in January 2017 (McArthur & Burgin, 2017). This result also confirms that these rivers continue to support some of the largest single-river populations of banded dotterels in New Zealand. According to a review of shorebird counts carried out on 119 rivers throughout New Zealand (O'Donnell & Monks, *in press*), our counts indicate that the Tukituki and Ngaruroro Rivers currently support the 2nd and 3rd largest single-river banded dotterel populations in New Zealand respectively, and the Tutaekuri River supports the 12th largest population (Table 3.2.1). Given that the national/global banded dotterel population is estimated to be around 19,000 birds (Hansen et al, 2016), we calculate that that the Tutaekuri, Ngaruroro and Tukituki Rivers collectively support approximately 12% of the global population of this species.

Table 3.2.1: List of the twelve largest single-river banded dotterel populations in New Zealand

River	Region	Number of banded dotterels counted	Year of most recent count	Source
Wairau	Marlborough	1178	2006	O'Donnell & Monks, <i>in press</i>
Tukituki	Hawke's Bay	1112	2019	This survey
Ngaruroro	Hawke's Bay	916	2019	This survey
Tasman	Canterbury	741	2017	O'Donnell & Monks, <i>in press</i>
Godley	Canterbury	705	2015	O'Donnell & Monks, <i>in press</i>
Rakaia	Canterbury	660	2013-2017	O'Donnell & Monks, <i>in press</i>
Rangitata	Canterbury	534	2009-2010	O'Donnell & Monks, <i>in press</i>
Ashburton	Canterbury	526	2009-2017	O'Donnell & Monks, <i>in press</i>
Oreti	Southland	416	2010	O'Donnell & Monks, <i>in press</i>
Cass	Canterbury	412	2015	O'Donnell & Monks, <i>in press</i>
Tekapo	Canterbury	284	2017	O'Donnell & Monks, <i>in press</i>
Tutaekuri	Hawke's Bay	280	2019	This survey

The total number of banded dotterels counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019 is the largest single-survey total yet recorded on these rivers (Table 3.2.2). Although both single river and total banded dotterel counts on Hawke's Bay rivers have varied substantially between 1962 and 2019, there is no evidence to suggest that these local banded dotterel populations have declined over this almost 60-year period (Table 3.2.2). This result is particularly significant given that O'Donnell and Monks (*in press*) have reported that banded dotterel populations on 33 South Island rivers have declined by 3.7% per annum (equivalent to a 52% decline every 20 years) over the same time period. Indeed, the Hawke's Bay river counts summarised in Table 3.2.2 below suggest that banded dotterel numbers on both the Ngaruroro and Tukituki Rivers have increased between 1962

and 2019, while banded dotterel counts on the Tutaekuri River have been relatively stable. However, it is possible that these apparent increases are more likely a result of the relatively incomplete survey coverage achieved during some of the pre-2014 surveys (Parrish, 1988; Stephenson, 2010). This apparently stable population trend on Hawke’s Bay rivers appears similar to recent population trends observed on rivers in the Wairarapa. Banded dotterel counts on selected reaches in the Ruamāhanga Catchment in the Wairarapa increased by 12% between 2010-2012 and 2016-2018, suggesting that local banded dotterel populations have been either stable or slowly increasing in this river catchment over the past decade (McArthur et al, 2019). This in turn suggests that breeding populations of banded dotterels on North Island rivers in general may not be suffering the same declines being observed on South Island rivers.

Table 3.2.2: Trends in the numbers of banded dotterels counted on the Tutaekuri, Ngaruroro and Tukituki Rivers between 1962 and 2019. Note: (+) signs indicate banded dotterel counts considered to be underestimates, due to incomplete survey coverage.

Year	Tutaekuri River	Ngaruroro River	Tukituki River & Tributaries	Total
1962	372 ¹	514 ¹	-	-
1967	299 ¹	246(+) ¹	500 ¹	1045(+) ¹
1972	174 ¹	216(+) ¹	310 ¹	700(+) ¹
1984	237 ¹	438(+) ¹	939 ¹	1614(+) ¹
1986	509 ³	480 ²	1149 ⁴	2138
1993	-	570(+) ²	-	-
2014	-	-	979 ⁵	-
2018	-	1160 ⁶	-	-
2019	280 ⁷	916 ⁷	1112 ⁷	2308 ⁷

Data sources: ¹ Parrish, (1988); ² Stephenson, (2010); ³ Stephenson, (2011); ⁴ Hugh Robertson, personal communication; ⁵ HBRC, unpublished data; ⁶ DOC, unpublished data; ⁷ This survey.

A mean of 8.2 (\pm 9.5 s.d.) banded dotterels/km were counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019, with counts ranging between 0.6 and 46 banded dotterels/km. The mean number of banded dotterels counted per kilometre on these Hawke’s Bay rivers is almost twice the national average of 4.5 (\pm 7.5 s.d.) banded dotterels/km reported by O’Donnell & Monks, (*in press*). The mean density of banded dotterels on all three rivers was 0.5 (\pm 0.5 s.d.) birds/ha, with densities ranging from 0.03 to 2.31 birds/ha.

Banded dotterels were widely distributed in all three river catchments, however total counts and densities of bird varied considerably between individual survey sections (Figure 3.2.1). Relatively high counts and high densities of banded dotterels were found along five river reaches, namely the Tutaekuri River between XS20 and XS49; the Ngaruroro River between XS18 and XS50; the lower

Tukituki River between XS07 and XS24; the mid Tukituki River between XS20 and XS32 and the mid-upper Tukituki River between (TTM) XS42 and (TTU) XS02. Relatively high counts but low densities of banded dotterels were found along two further river reaches, namely the Ngaruroro River between XS53 and XS59, and between XS65 and XS68 (the Whanawhana Reach).

Banded dotterels were generally more abundant, and occurred at higher densities, on relatively wide reaches of river with large areas of unvegetated gravels, and were considerably less abundant on narrower riverbeds and the more 'channelised' sections of the wider rivers with far smaller contiguous areas of unvegetated gravels. These habitat preferences are similar to those observed by McArthur and Burgin (2017) during a survey of 211km of braided river habitats in the Wairarapa in January 2017.

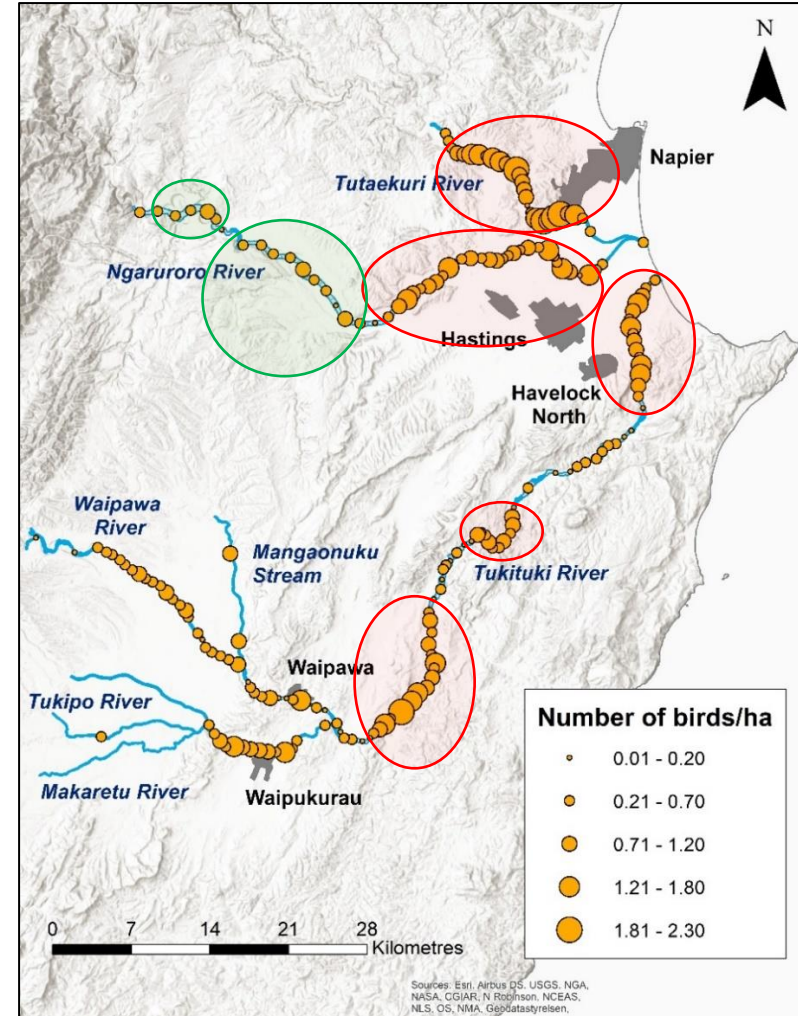
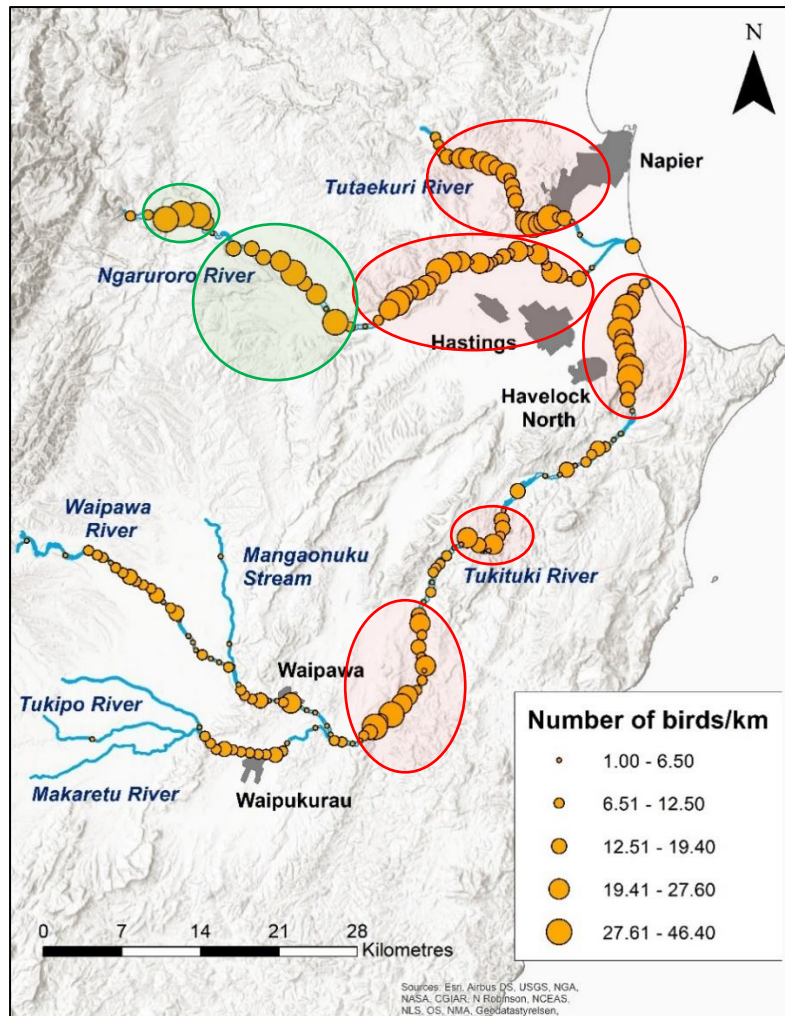


Figure 3.2.1: Spatial patterns in the relative abundance and densities of banded dotterels on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019. The left-hand map shows spatial patterns in the numbers of banded dotterels per km of river (abundance), whereas the right-hand map shows patterns in the numbers of banded dotterels per hectare of riverbed habitat (density). Red areas represent river reaches with relatively high numbers and high densities of banded dotterels; green areas represent river reaches with relatively high numbers but low densities of banded dotterels.

3.3 Black-fronted dotterel (*Elseyornis melanops*)



Image courtesy of Neil Fitzgerald/NZ Birds Online

National conservation status: At Risk, Naturally Uncommon (Robertson et al, 2017)

Regional conservation status: Coloniser (HBRC, unpublished data)

A total of 1168 black-fronted dotterels were counted during this survey, including 138 birds counted on the Tutaekuri River, 272 birds on the Ngaruroro River and 758 birds on the Tukituki River and its tributaries.

This result confirms that these three rivers continue to act as the stronghold for this species in the North Island, and in New Zealand. In comparison to the 1168 birds counted along 262 km of braided rivers in Hawke's Bay during this survey, a total of 514

black-fronted dotterels were counted along 211 km of braided rivers in the Wairarapa in January 2017 (McArthur & Burgin, 2017). Black-fronted dotterels are a relatively recent addition to New Zealand's avifauna, having colonised New Zealand from Australia during the 1950s. The first New Zealand bird was observed at the Ahuriri Estuary in August 1954 (Brathwaite, 1955), and black-fronted dotterels were subsequently confirmed to be breeding on the Tutaekuri River from 1961 (MacKenzie, 1962). Following their establishment in Hawke's Bay, black-fronted dotterels quickly spread to the rivers of the Manawatu and Wairarapa, and then to rivers in Marlborough, Tasman, Canterbury, Otago and Southland (Bull et al, 1985; Robertson et al, 2007). The lower North Island remains the national stronghold for this species (Heather & Robertson, 2015). We estimate a national population of 2600 black-fronted dotterels in New Zealand, which is an upwards revision of the estimate of 2200 birds reported by Heather & Robertson (2015), taking into account the results of this survey and those reported by McArthur & Burgin (2017). Based on this new national population estimate, the Tutaekuri, Ngaruroro and Tukituki Rivers currently support an estimated 45% of the national black-fronted dotterel population, with a further 20% of the national population present on braided rivers in the Wairarapa.

The total number of black-fronted dotterels counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019 is the largest single-survey total yet recorded on these rivers (Table 3.3.1). Although single river black-fronted dotterel counts on Hawke's Bay rivers have varied substantially between 1962 and 2019, it appears that there has been a steady increase in the total number of black-fronted dotterels counted in all three catchments combined over this almost 60-year period (Table 3.3.1). Although it's likely that some of this apparent increase in numbers is a consequence of the relatively incomplete survey coverage achieved during some of the pre-2014 surveys (Parrish, 1988; Stephenson, 2010), this steady increase mirrors a similar rate of increase observed on braided rivers in the Wairarapa since 1972 (McArthur & Burgin, 2017).

Table 3.3.1: Trends in the numbers of black-fronted dotterels counted on the Tutaekuri, Ngaruroro and Tukituki Rivers between 1962 and 2019. Note: (+) signs indicate black-fronted dotterel counts considered to be underestimates, due to incomplete survey coverage.

Year	Tutaekuri River	Ngaruroro River	Tukituki River & Tributaries	Total
1962	63 ¹	39 ¹	7 ¹	109
1967	105 ¹	96(+) ¹	122 ¹	323(+) ¹
1972	120 ¹	134(+) ¹	95 ¹	349(+) ¹
1984	134 ¹	127(+) ¹	368 ¹	629(+) ¹
1986	200 ³	145 ²	341 ⁴	686
1993	-	137(+) ²	-	-
2014	-	-	314 ⁵	-
2018	-	217 ⁶	-	-
2019	138 ⁷	272 ⁷	758 ⁷	1168 ⁷

Data sources: ¹ Parrish, (1988); ² Stephenson, (2010); ³ Stephenson, (2011); ⁴ Hugh Robertson, personal communication; ⁵ HBRC, unpublished data; ⁶ DOC, unpublished data; ⁷ This survey.

A mean of 4.4 (\pm 3.4 s.d.) black-fronted dotterels/km were counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019, with counts ranging between 0.6 and 13.8 black-fronted dotterels/km. The mean number of black-fronted dotterels counted per kilometre on these Hawke’s Bay rivers is almost twice the average of 2.4 black-fronted dotterels/km counted on Wairarapa rivers in January 2017 (McArthur & Burgin, 2017). The mean density of black-fronted dotterels on all three Hawke’s Bay rivers was 0.4 (\pm 0.4 s.d.) birds/ha, with densities ranging from 0.02 to 2.41 birds/ha.

Black-fronted dotterels were widely distributed in all three river catchments, however total counts and densities of bird varied considerably between individual survey sections (Figure 3.3.1). Relatively high counts and high densities of black-fronted dotterels were found along five river reaches, namely the Tutaekuri River between XS15 and XS54; the lower Ngaruroro River between XS13 and XS40; the lower Tukituki River between XS07 and XS26; the mid-upper Tukituki River between (TTM) XS44 and (TTU) XS03 and the upper Tukituki River/lower Tukipo River between (TTU) XS08 and (TUK) XS32. Relatively high counts but low densities of black-fronted dotterels were found along three further river reaches, namely the upper Ngaruroro River between XS44 and XS67 (including the Whanawhana Reach); the mid Tukituki River between (TTL) XS28 and (TTM) XS44 and the lower Waipawa River between XS06 and XS24.

Black-fronted dotterels now appear to be more spatially widespread than banded dotterels on Hawke’s Bay rivers, due to an apparent preference for relatively narrow and/or channelised rivers on which banded dotterels are typically rare or absent. Despite this, banded dotterels remain twice as abundant as black-fronted dotterels across all three Hawke’s Bay rivers combined. In comparison, black-fronted dotterels are now both more abundant and more widespread than banded dotterels on rivers in the Wairarapa (McArthur & Burgin, 2017).

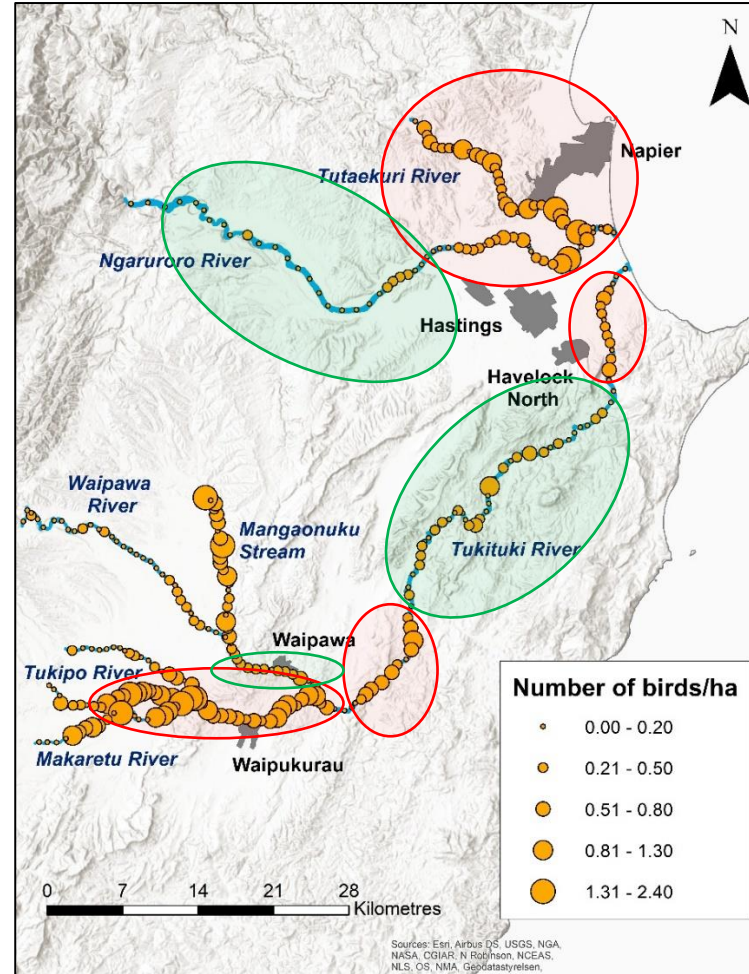
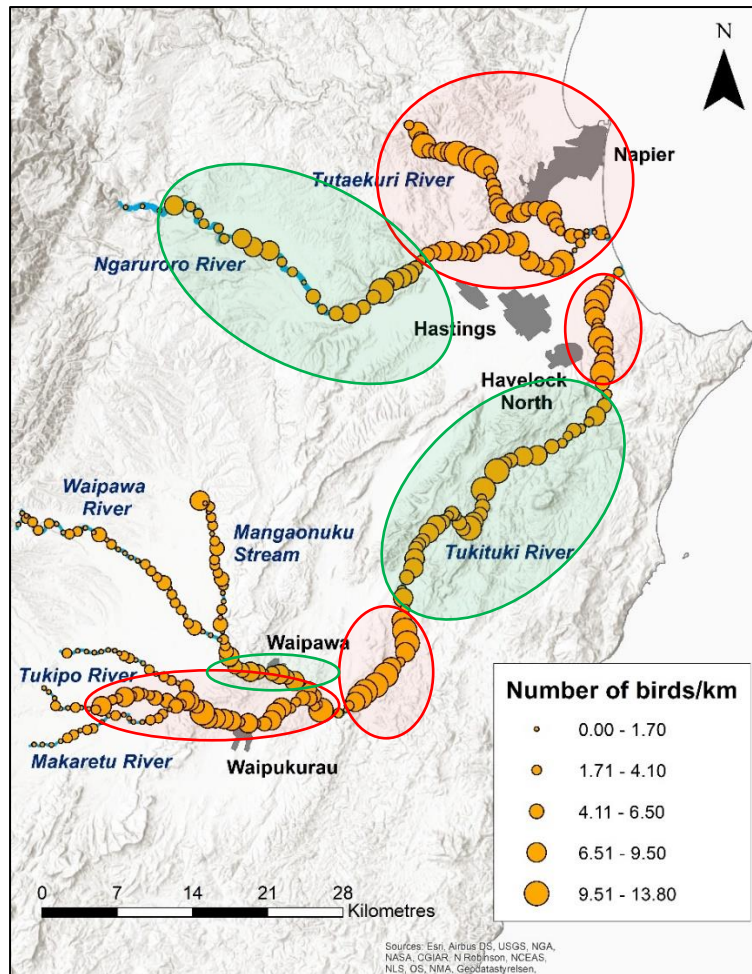


Figure 3.3.1: Spatial patterns in the relative abundance and densities of black-fronted dotterels on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019. The left-hand map shows spatial patterns in the numbers of black-fronted dotterels per km of river (abundance), whereas the right-hand map shows patterns in the numbers of black-fronted dotterels per hectare of riverbed habitat (density). Red areas represent river reaches with relatively high numbers and high densities of black-fronted dotterels; green areas represent river reaches with relatively high numbers but low densities of black-fronted dotterels.

3.4 South Island pied oystercatcher (*Haematopus finschi*)



Image courtesy of Steve Attwood/NZ Birds Online

National conservation status: At Risk, Declining (Robertson et al, 2017)

Regional conservation status: Regionally Critical (HBRC, unpublished data)

A total of 31 South Island pied oystercatchers (SIPO) were counted during this survey, including 25 birds on the Ngaruroro River and 6 birds on the Tukituki River and its tributaries. No oystercatchers were encountered on the Tutaekuri River.

In addition to the six SIPO detected on the Tukituki River and its tributaries, a hybrid SIPO x variable oystercatcher (*Haematopus finschi* x *unicolor*) was

encountered on the mid-Tukituki River, associating with an adult SIPO. This bird appeared to be similar in size to the SIPO it was associating with, but had only a very indistinct white “hook” at the shoulder, had a conspicuously smudgy demarcation between the black chest and white belly, and conspicuous black smudges on the belly and towards the vent (Patrick Crowe, personal communication). Hybridisation has been recorded occurring between these two species in the past, most notably in the case of a small “hybrid swarm” that has been monitored at Ashworth’s Lagoon and the Ashley Estuary in North Canterbury since 1989 (Crocker et al, 2010). However, this is the first observation of a hybrid oystercatcher in the Hawke’s Bay region that we are aware of.

The 31 SIPO that we encountered during this survey represent the only SIPO known to be breeding in the North Island at the present time. SIPO have previously bred at Onoke Spit in South Wairapa (Stephenson, 2010) but no longer appear to be breeding at this site (Joanna McVeagh, personal communication). A single oystercatcher was resident on the Ruamāhanga River, north of Masterton for at least three consecutive breeding seasons between 2014 and 2017, but no evidence of breeding was observed (McVeagh, 2014; McArthur, 2017).

The total number of SIPO counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019 is the second largest single-survey total yet recorded on these rivers, and is the first time that SIPO have been recorded on the Tukituki River and its tributaries (Table 3.4.1). SIPO were first recorded on the Ngaruroro River in 1978; local breeding was first confirmed in 1980 and the North Island’s first SIPO nest was located in 1982 (Stephenson, 2010). During the 1984 shorebird survey carried out on the Tutaekuri, Ngaruroro and Tukituki Rivers, a total of 10 adult SIPO was counted on the Ngaruroro River (Parrish, 1988; Table 3.4.1). Since then, it appears that this local breeding population has increased by at least 200%, although at least some of this apparent increase in numbers is likely a consequence of the relatively incomplete survey coverage achieved during some of the pre-2014 surveys (Parrish, 1988; Stephenson, 2010; Table 3.4.1).

Table 3.4.1: Trends in the numbers of South Island pied oystercatchers counted on the Tutaekuri, Ngaruroro and Tukituki Rivers between 1962 and 2019. Note: (+) signs indicate South Island pied oystercatcher counts considered to be underestimates, due to incomplete survey coverage.

Year	Tutaekuri River	Ngaruroro River	Tukituki River & Tributaries	Total
1962	0 ¹	0 ¹	0 ¹	0
1967	0 ¹	0(+) ¹	0 ¹	0(+) ¹
1972	0 ¹	0(+) ¹	0 ¹	0(+) ¹
1984	0 ¹	10(+) ¹	0 ¹	10(+) ¹
1986	0 ³	8 ²	0 ⁴	8
1993	-	6(+) ²	-	-
2014	-	-	0 ⁵	-
2018	-	46 ⁶	-	-
2019	0 ⁷	25 ⁷	6 ⁷	31 ⁷

Data sources: ¹ Parrish, (1988); ² Stephenson, (2010); ³ Stephenson, (2011); ⁴ Hugh Robertson, personal communication; ⁵ HBRC, unpublished data; ⁶ DOC, unpublished data; ⁷ This survey.

South Island pied oystercatchers were found on three discrete reaches of the Ngaruroro, Tukituki and Waipawa Rivers in November 2019 (Figure 3.4.1). Twenty-five SIPO were encountered on the Upper Ngaruroro River, between XS51 and the Cableway (including the Whanawhana Reach); three SIPO (and one hybrid bird) were encountered on the mid Tukituki River between XS40 and XS46 and a further three SIPO were encountered on the Waipawa River, between XS50 and XS53. SIPO were confirmed to be breeding on the Ngaruroro River during this survey with the discovery of an active nest containing a single egg.

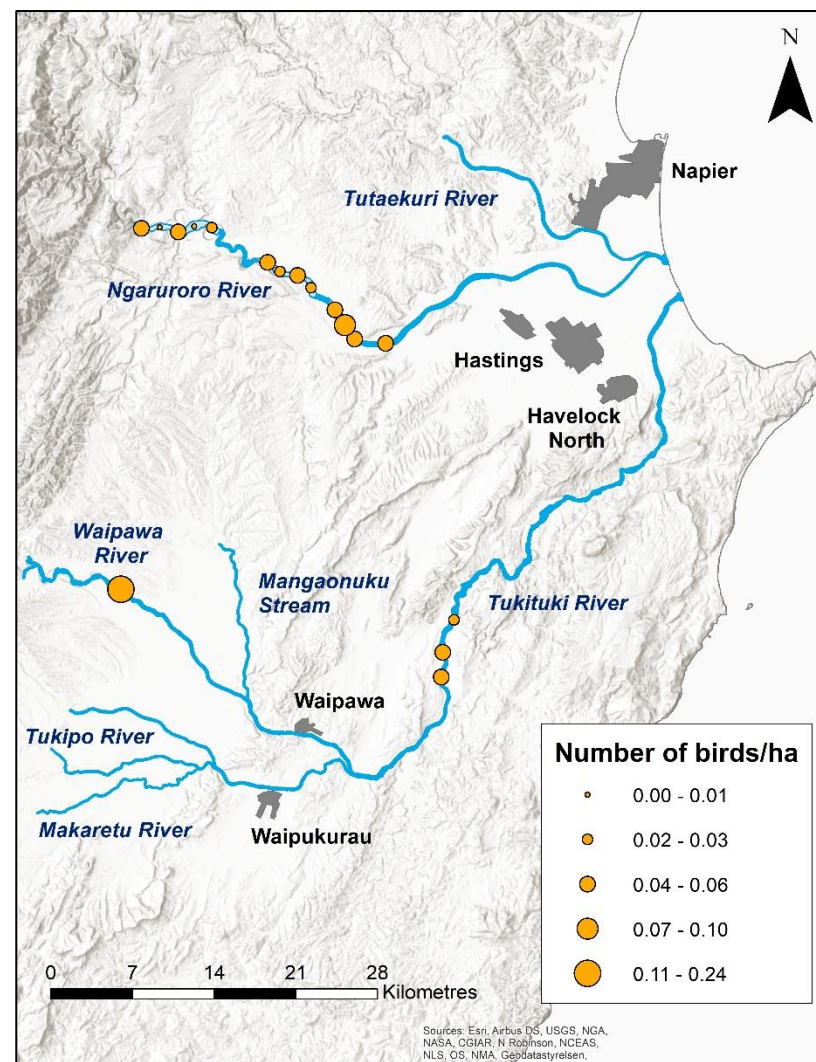
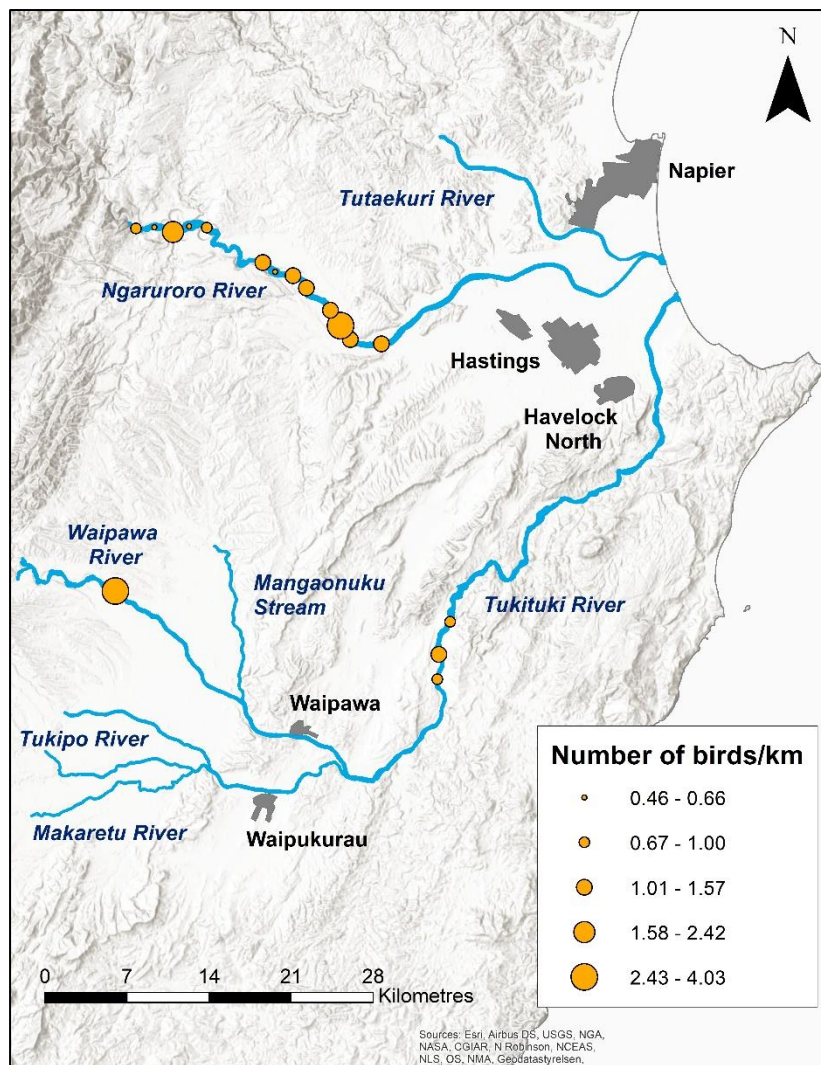


Figure 3.4.1: Spatial patterns in the relative abundance and densities of South Island pied oystercatchers on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019. The left-hand map shows spatial patterns in the number of SI pied oystercatchers per km of river (abundance), whereas the right-hand map shows patterns in the numbers of SI pied oystercatchers per hectare of riverbed habitat (density).

3.5 Pied stilt (*Himantopus himantopus*)



Image courtesy of Tony Whitehead/NZ Birds Online

National conservation status: Not Threatened (Robertson et al, 2017)

Regional conservation status: Regionally Vulnerable (HBRC, unpublished data)

A total of 1041 pied stilts were counted during this survey, including 209 birds counted on the Tutaekuri River, 312 birds on the Ngaruroro River and 520 birds on the Tukituki River and its tributaries.

Unlike banded and black-fronted dotterels, which are both largely restricted to riverbed and coastal habitats in the Hawke's Bay region, pied stilts have much more general habitat requirements and are known to breed on

riverbeds and at coastal estuaries and river mouths, but also in freshwater wetlands, on the shores of freshwater lakes and irrigation dams, and in flat, poorly-drained paddocks (Heather & Robertson, 2015). For this reason, it is more difficult to create an accurate regional pied stilt population estimate for Hawke's Bay, however it is currently estimated to be between 1000 and 5000 birds (HBRC/DOC unpublished data). Based on this, the 1041 pied stilts counted on these three rivers represents at least 21% of the regional pied stilt population in Hawke's Bay. The national pied stilt population is similarly estimated to total around 30,000 birds (Heather & Robertson, 2015). Based on this estimate, the 1041 pied stilts counted during this survey represents 3.5% of the total number of pied stilts in New Zealand.

The total number of pied stilts counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019 is the second largest single-survey total yet recorded on these rivers (Table 3.5.1). Although single-river pied stilt counts on both the Ngaruroro and Tukituki rivers have varied substantially between 1962 and 2019, it appears that pied stilt numbers across all three river catchments have been relatively stable over this almost 60-year period (Table 3.3.1). Although some of the pre-2014 pied stilt counts possibly underestimated pied stilt numbers due to incomplete survey coverage (Parrish, 1988; Stephenson, 2010), these apparently stable numbers of pied stilts on Hawke's Bay rivers are mirrored by similarly stable pied stilt population trends reported from the Ruamāhanga River catchment between 2010 and 2018 (McArthur et al, 2019).

A mean of 3.9 (± 6.1 s.d.) pied stilts/km were counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019, with counts ranging between 0.7 and 34.8 pied stilts/km. The mean number of pied stilts counted per kilometre on these Hawke's Bay rivers is over twice the average of 1.5 pied stilts/km counted on Wairarapa rivers in January 2017 (McArthur & Burgin, 2017). The mean density of pied stilts on all three Hawke's Bay rivers was 0.3 (± 0.5 s.d.) birds/ha, with densities ranging from 0.1 to 3.7 birds/ha.

Unlike both banded and black-fronted dotterels, pied stilts were not uniformly distributed along the rivers that we surveyed. Many breeding pairs appeared to be clustered together in small, loose breeding colonies, or were found roosting in flocks of up to 25 birds at discrete locations on the riverbed. Relatively high counts and high densities of pied stilts were found along three river reaches, namely the Tutaekuri River between XS14 and XS54; the lower Ngaruroro River between XS13 and

XS40, and the lower Tukituki River between XS05 and XS24. Relatively high counts but low densities of pied stilts were found along two further river reaches, namely the upper Ngaruroro River between XS58 and the Cableway (including the Whanawhana Reach), and the mid-upper Tukituki River between (TTM) XS16 and (TTU) XS02 (Figure 3.5.1).

Table 3.5.1: Trends in the numbers of pied stilts counted on the Tutaekuri, Ngaruroro and Tukituki Rivers between 1962 and 2019. Note: (+) signs indicate pied stilt counts considered to be underestimates, due to incomplete survey coverage.

Year	Tutaekuri River	Ngaruroro River	Tukituki River & Tributaries	Total
1962	274 ¹	323 ¹	-	-
1967	344 ¹	181(+) ¹	464 ¹	989(+) ¹
1972	302(+) ¹	173(+) ¹	323 ¹	798(+) ¹
1984	239 ¹	461(+) ¹	1106 ¹	1806(+) ¹
1986	310 ³	220 ²	482 ⁴	1012
1993	-	270(+) ²	-	-
2014	-	-	682 ⁵	-
2018	-	625 ⁶	-	-
2019	209 ⁷	312 ⁷	520 ⁷	1041 ⁷

Data sources: ¹ Parrish, (1988); ² Stephenson, (2010); ³ Stephenson, (2011); ⁴ Hugh Robertson, personal communication; ⁵ HBRC, unpublished data; ⁶ DOC, unpublished data; ⁷ This survey.

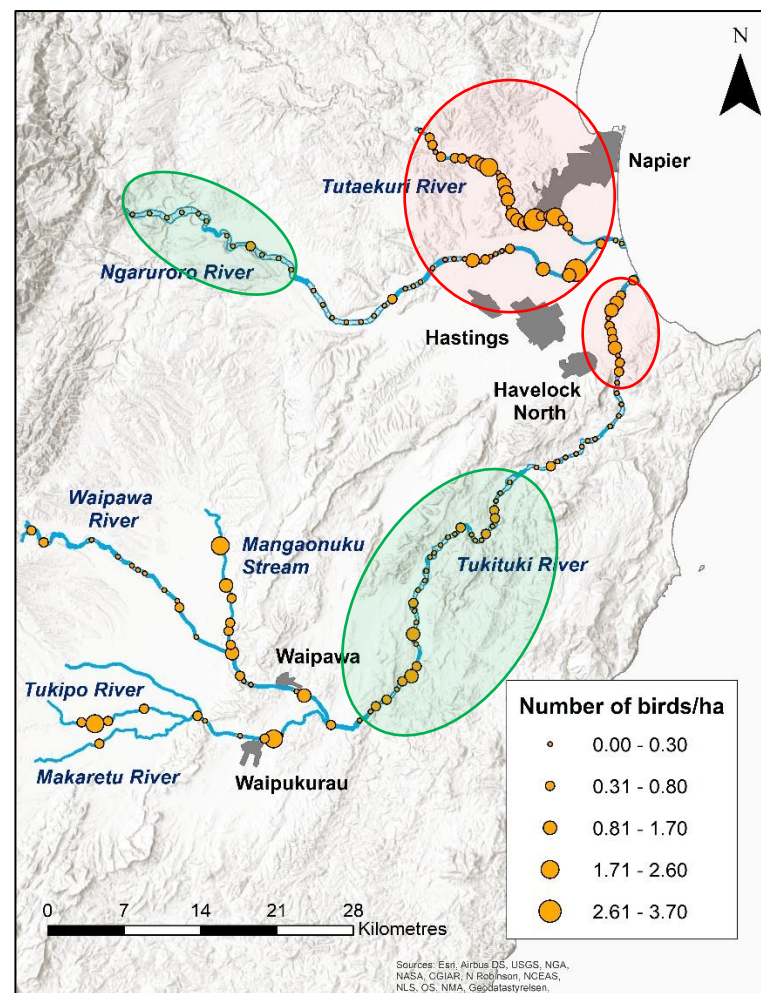
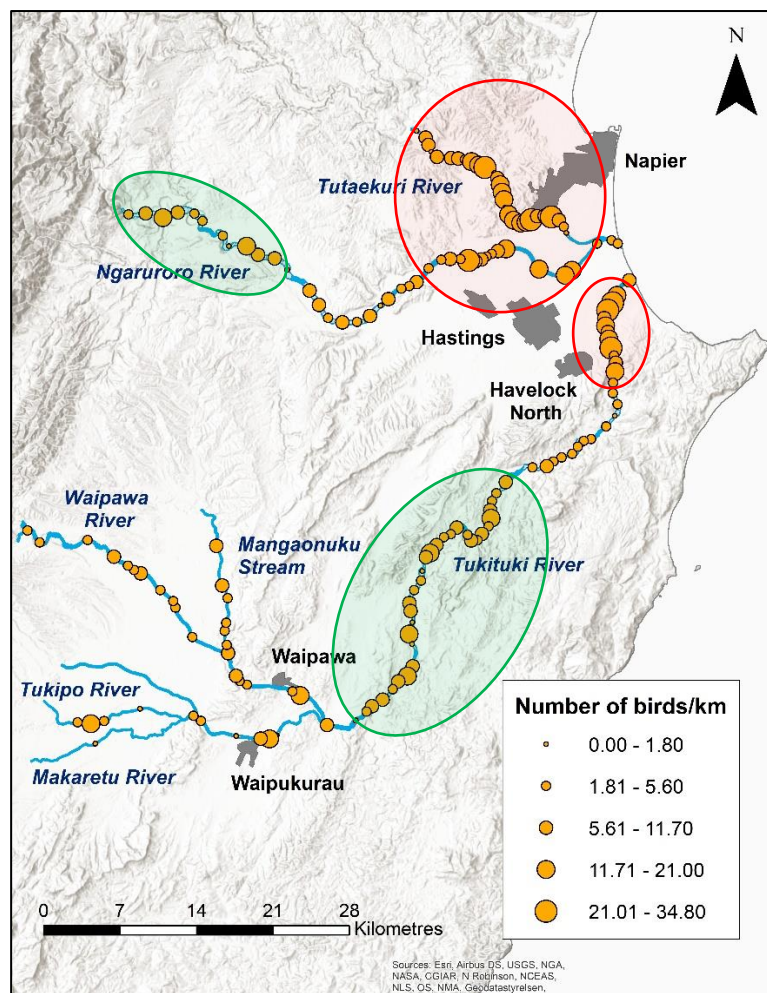


Figure 3.5.1: Spatial patterns in the relative abundance and densities of pied stilts on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019. The left-hand map shows spatial patterns in the numbers of pied stilts per km of river (abundance), whereas the right-hand map shows patterns in the numbers of pied stilts per hectare of riverbed habitat (density). Red areas represent river reaches with relatively high numbers and high densities of pied stilts; green areas represent river reaches with relatively high numbers but low densities of pied stilts.

3.6 Black-billed gull (*Larus bulleri*)



Image courtesy of Steve Attwood/NZ Birds Online

National conservation status: Nationally Critical (Robertson et al, 2017)

Regional conservation status: Regionally Critical (HBRC, unpublished data)

A total of 79 black-billed gulls were counted during this survey, including 72 birds on the Ngaruroro River and 7 birds on the Tukituki River and its tributaries. No black-billed gulls were encountered on the Tutaekuri River. The majority of the gulls encountered on the Ngaruroro River were at the Ngaruroro River mouth (Waitangi) and were associated with a mixed breeding colony of black-billed gulls and white-fronted terns (*Sterna*

striata). No additional black-billed gull breeding colonies were located along any of the rivers that we surveyed, however a second breeding colony was present at Pandora Pond (Ahuriri Estuary) during Nov-Dec 2019, with up to 350 attendant adult birds (Kelly, 2019). A group of 100 black-billed gulls had also been observed on the mid-Ngaruroro River in early September 2019 but did not subsequently attempt to nest at this site (Gardiner, 2019).

The Hawke's Bay regional black-billed gull breeding population appears to fluctuate in size and change in distribution from year to year. For instance, the number of active nests in the region varied between 37 and 250 nests between 1995 and 1998, and from 19 to 320 nests between 2014 and 2018 (Hashiba, 2018; Mischler, 2018). Breeding colony locations have tended to move from year to year, with colonies previously having been located on the Tukituki River near Kahuranaki Road and at the Tukituki Estuary; on the Ngaruroro River at the Mangatahi Stream confluence; on Portland Island; at Ahuriri Estuary and at the Napier Port (Keiko Hashiba, personal communication 23/04/2020; Hashiba, 2018; Mischler, 2018).

The total number of black-billed gulls counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019 is the second smallest single-survey total yet recorded on these rivers, and there appears to have been a substantial decline in the number of adult black-billed gulls counted on these three rivers since 1962 (Table 3.6.1). However, single-river black-bill gull counts have fluctuated significantly from one survey to the next; some pre-2014 surveys didn't achieve complete coverage (Parrish, 2018; Stephenson, 2010), and variable proportions of the regional breeding population breed at off-river sites each year (Mischler, 2018). For these reasons, the apparent decline in the number of black-billed gulls counted on these three rivers since 1962 does not necessarily indicate that the local breeding population has declined over the same period.

Black-billed gulls were concentrated within three discrete reaches of the Ngaruroro, Tukituki and Waipawa Rivers in November 2019, namely the upper Ngaruroro River between XS65 and the Cableway (the 'Whanawhana' Reach); the lower Ngaruroro River between XS00 and XS15, and the lower Tukituki River between XS00 and XS23 (Figure 3.6.1). Black-billed gulls were confirmed to be nesting at the Ngaruroro River mouth (Waitangi), in a mixed colony with white-fronted terns.

Table 3.6.1: Trends in the numbers of black-billed gulls counted on the Tutaekuri, Ngaruroro and Tukituki Rivers between 1962 and 2019. Note: (+) signs indicate black-billed gull counts considered to be underestimates, due to incomplete survey coverage.

Year	Tutaekuri River	Ngaruroro River	Tukituki River & Tributaries	Total
1962	4 ¹	0 ¹	-	-
1967	366 ¹	16(+) ¹	258 ¹	640(+) ¹
1972	10 ¹	16(+) ¹	28 ¹	54(+) ¹
1984	1 ¹	25(+) ¹	107 ¹	133(+) ¹
1986	62 ³	8 ²	-	-
1993	-	15(+) ²	-	-
2014	-	-	119 ⁴	-
2018	-	268 ⁵	-	-
2019	0 ⁶	72 ⁶	7 ⁶	79 ⁶

Data sources: ¹ Parrish, (1988); ² Stephenson, (2010); ³ Stephenson, (2011); ⁴ HBRC, unpublished data; ⁵ DOC, unpublished data; ⁶ This survey.

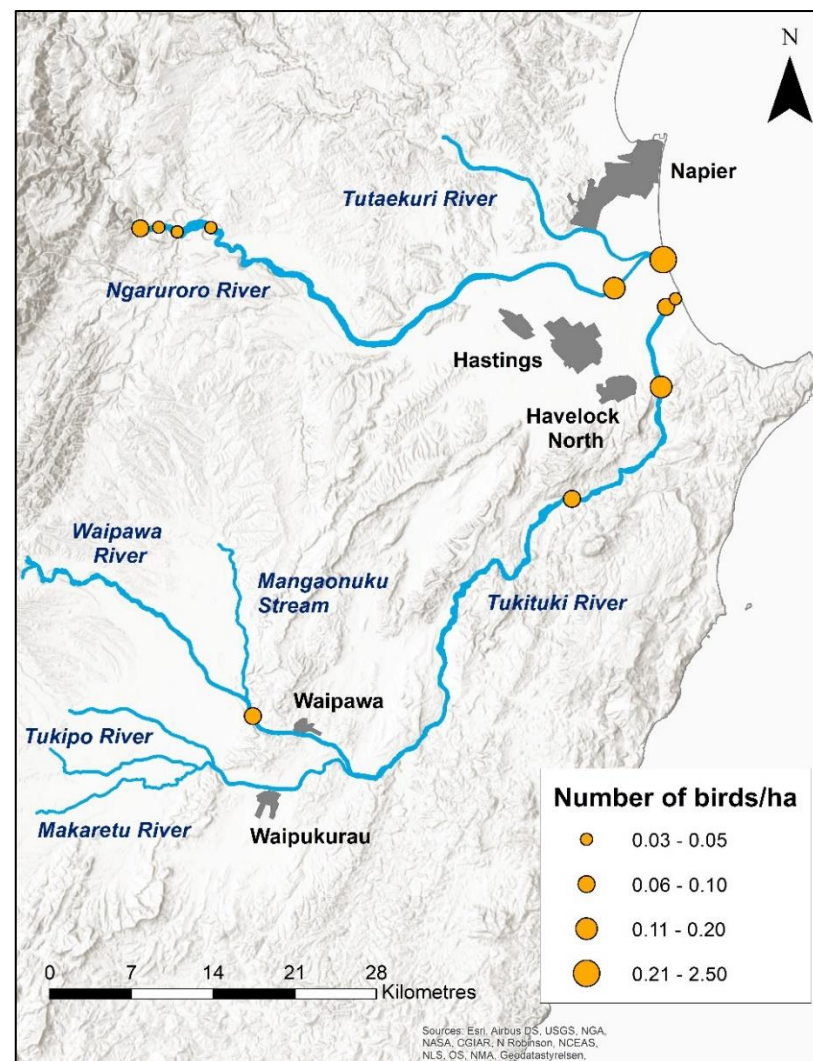
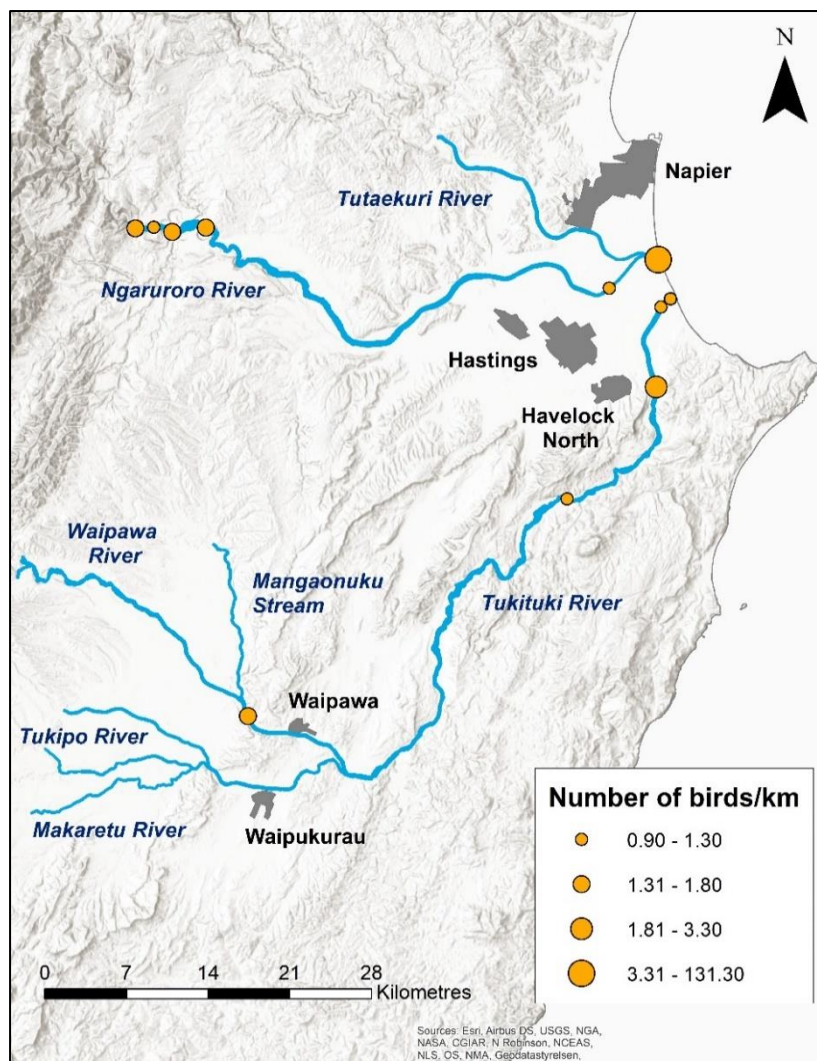


Figure 3.6.1: Spatial patterns in the relative abundance and densities of black-billed gulls on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019. The left-hand map shows spatial patterns in the number of black-billed gulls per km of river (abundance), whereas the right-hand map shows patterns in the numbers of black-billed gulls per hectare of riverbed habitat (density).

4. Discussion

4.1 Shorebird values of the Tutaekuri, Ngaruroro and Tukituki Rivers

The results of this survey confirm that the Tutaekuri, Ngaruroro and Tukituki Rivers continue to support internationally, nationally and regionally significant populations of riverbed-nesting shorebirds. For example, these rivers collectively support an estimated 12% of the global breeding population of banded dotterels, triggering Criterion Six for identifying wetlands of international importance under the Ramsar Convention on Wetlands (Ramsar Convention Secretariat, 2016)². The Tukituki, Ngaruroro and Tutaekuri Rivers respectively support the 2nd, 3rd and 12th largest single-river populations of banded dotterels in the country. Furthermore, in contrast to the declining population trends of banded dotterels on South Island rivers (O'Donnell & Monks, *in press*), populations on these three Hawke's Bay rivers appear to have been comparatively stable over the past 60 years. The Tutaekuri, Ngaruroro and Tukituki Rivers are also a national stronghold for black-fronted dotterels, supporting an estimated 45% of the national population of this species. These rivers also support the North Island's only breeding population of South Island pied oystercatchers.

These shorebird values are not uniformly distributed along each of these three rivers, however. This survey has identified several discrete reaches of river that support relatively high numbers and high densities of riverbed-nesting shorebirds, with a high degree of overlap between individual species (Table 4.1.1; Figure 4.1.1). These sites have the potential to be used to improve the existing rules and conditions guiding flood mitigation and gravel extraction activities on these rivers, so that robust measures aimed at avoiding or minimising adverse impacts on these bird species are deployed where they're most needed.

One of the high value reaches that we have identified (Site 4; Table 4.1.1) includes a short stretch of the upper Ngaruroro River called the Whanawhana Reach. This reach of the Ngaruroro River is a rare example of North Island braided river habitat that has an active channel width of >600 m (see cover photo). Most North Island braided rivers have active channel widths of <300 m, whereas those river reaches that exceed 600 m are extremely rare in the North Island and are usually relatively short in length. In addition to the Whanawhana Reach on the Ngaruroro River, other examples of North Island braided river habitat that exceed 600 m in width include the lower reaches of the Motu and Waiapu Rivers (East Cape), short sections of the Rangitikei River (Manawatu) and the Opouawe River (Wairarapa).

² Criterion Six of the Ramsar Convention states that "a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird."

Table 4.1.1: River reaches containing relatively high shorebird values on the Tutaekuri, Ngaruroro and Tukituki Rivers, November 2019. Site numbers in this table correspond to those on the map in Figure 4.1.1

Site name	Site number	Upstream boundary	Downstream boundary	Shorebird values summary
Mid Tutaekuri River	1	XS54	XS14	High numbers and <u>high densities</u> of banded dotterels High numbers and <u>high densities</u> of black-fronted dotterels High numbers and <u>high densities</u> of pied stilts
Ngaruroro River mouth (Waitangi)	2	XS01	XS00	High numbers and <u>high densities</u> of black-billed gulls High numbers and <u>high densities</u> of white-fronted terns
Lower Ngaruroro River	3	XS50	XS13	High numbers and <u>high densities</u> of banded dotterels High numbers and <u>high densities</u> of black-fronted dotterels High numbers and <u>high densities</u> of pied stilts Low numbers and <u>low densities</u> of black-billed gulls
Upper Ngaruroro River (including the Whanawhana Reach)	4	Cableway	XS44	High numbers and <u>low densities</u> of banded dotterels High numbers and <u>low densities</u> of black-fronted dotterels High numbers and <u>low densities</u> of pied stilts 80% of North Island breeding population of SI pied oystercatchers Low numbers and <u>low densities</u> of black-billed gulls

Site name	Site number	Upstream boundary	Downstream boundary	Shorebird values summary
Lower Tukituki River, including Tukituki Estuary	5	XS26	XS00	High numbers and <u>high densities</u> of banded dotterels High numbers and <u>high densities</u> of black-fronted dotterels High numbers and <u>high densities</u> of pied stilts Low numbers and <u>low densities</u> of black-billed gulls Breeding New Zealand dotterels present
Mid Tukituki River	6	XS46	XS20	High numbers and <u>high densities</u> of banded dotterels High numbers and <u>low densities</u> of black-fronted dotterels High numbers and <u>low densities</u> of pied stilts 10% of North Island breeding population of SI pied oystercatchers
Mid/Upper Tukituki River	7	(TTU) XS03	(TTM) XS42	High numbers and <u>high densities</u> of banded dotterels High numbers and <u>high densities</u> of black-fronted dotterels High numbers and <u>low densities</u> of pied stilts
Upper Tukituki/lower Tukipo River	8	(TUK) XS32	(TTU) XS08	High numbers and <u>high densities</u> of black-fronted dotterels
Lower Waipawa River	9	XS24	XS06	High numbers and <u>low densities</u> of black-fronted dotterels
Mid Waipawa River	10	XS53	XS50	10% of North Island breeding population of SI pied oystercatchers

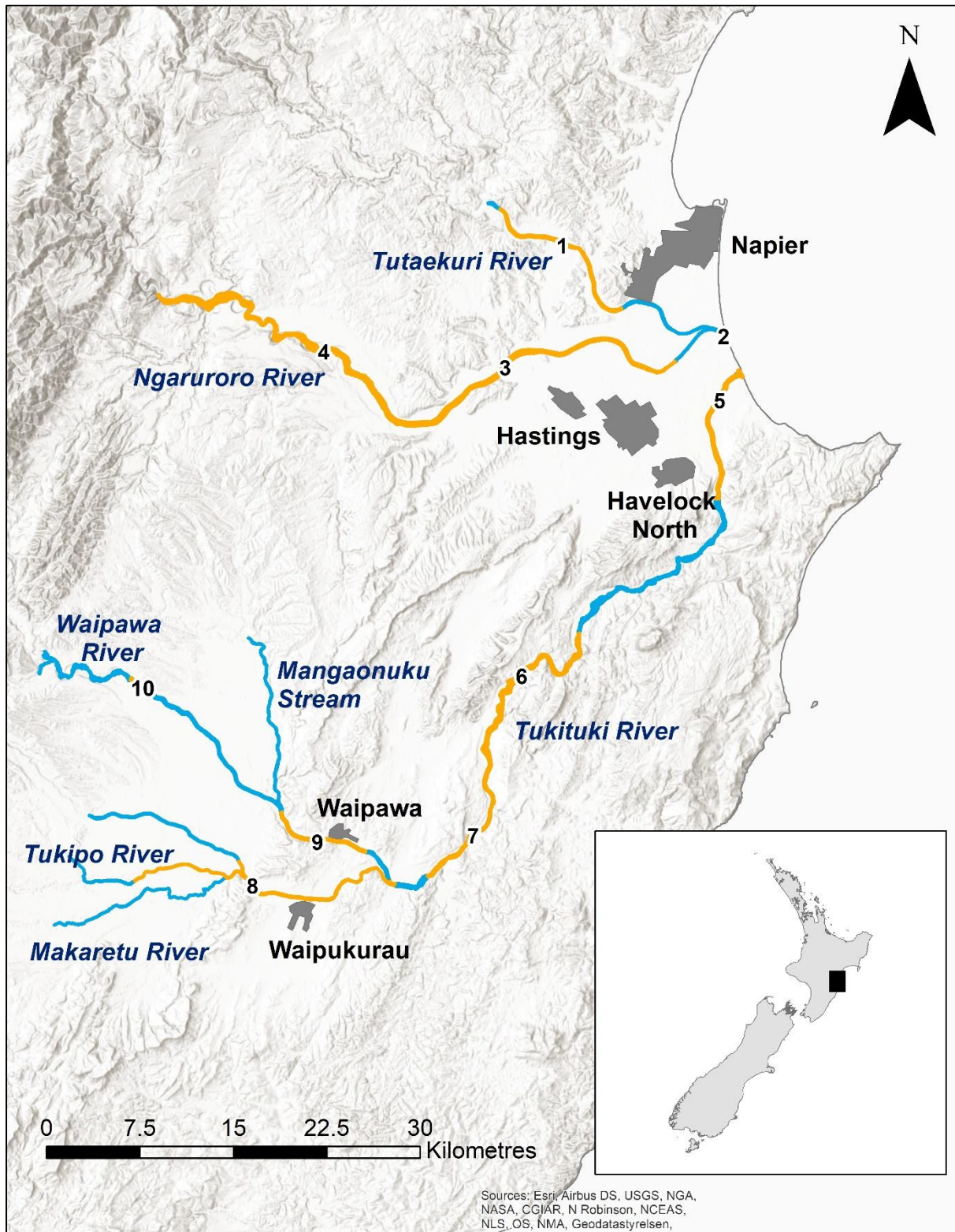


Figure 4.1.1: River reaches containing relatively high shorebird values on the Tutaekuri, Ngaruroro and Tukituki Rivers, November 2019. Site numbers on the map correspond to those listed in Table 4.1.1

4.2 Implications for HBRC's flood mitigation activities

The results of this survey have several important implications for HBRC's flood mitigation activities, and for the regulation of commercial gravel extraction activities under the Resource Management Act. By demonstrating that these three rivers support internationally, nationally and regionally significant shorebird populations, they also underscore the importance of HBRC designing, implementing and enforcing rules, policies and resource consent conditions that effectively avoid, minimise or remedy the potential adverse impacts of flood mitigation and gravel extraction activities on riverbed nesting shorebirds on each of these three rivers.

Given that the results of this survey suggest that shorebird populations on Hawke's Bay rivers are likely to have been either stable, or increasing over the past 60 years, this suggests that HBRC's existing rules, policies and consent conditions, including the Council's three Environmental Management and Enhancement Plans have succeeded in maintaining shorebird values on the Tutaekuri, Ngaruroro and Tutaekuri Rivers over the past several decades.

Flood mitigation and gravel extraction activities carried out on braided riverbeds during summer likely have a combination of both negative and positive impacts on riverbed-nesting shorebird species. The disturbance of dry gravel habitats during woody weed removal, gravel extraction, gravel ripping or contouring activities during the shorebird breeding season can lead to the local destruction of nests and chicks, reducing the productivity of shorebird populations (McArthur & Bell, 2016). Likewise, other activities such as the construction of stop banks, rock groynes, willow planting, gravel island removal and channel straightening can also increase river channelisation and reduce habitat quality for shorebirds (O'Donnell, 2000). However, in the absence of large, regular flood events, the mechanical disturbance of dry gravels during gravel extraction, gravel ripping or contouring activities can help reduce woody weed encroachment and maintain open habitats for shorebirds and help reduce predation by mammalian predators (O'Donnell, 2000; Rebergen, 2012; McArthur et al, 2019). The fact that banded dotterel populations in both Hawke's Bay and the Wairarapa appear to be either stable or increasing (McArthur et al, 2019) while those on South Island rivers are decreasing (O'Donnell & Monks, *in press*) provides some circumstantial evidence that the widespread use of beach raking and contouring, and gravel extraction on North Island riverbeds at worst has a net neutral impact on riverbed-nesting shorebirds, and at best a net positive impact.

The current survey method (i.e. quantifying bird abundance and density between cross-sections) enables us to understand spatial patterns in shorebird values at a higher resolution than has been done before. Such a dataset creates the opportunity for HBRC to develop more spatially explicit rules, policies or consent conditions designed to avoid, mitigate or remedy adverse impacts on riverbed-nesting shorebirds. By doing so, HBRC will be able to maintain existing levels of protection for riverbed-nesting shorebirds while potentially reducing costs associated with the implementation of these measures to both the ratepayers of Hawke's Bay, and to private gravel extraction companies. The results of this survey indicate that the spatial distribution of shorebird values have already changed in relation to those described in the existing EMEPs for each river. For example, this survey has confirmed that black-billed gulls haven't nested within the black-billed gull/SI pied oystercatcher management zone on the Ngaruroro River for the sixth consecutive season (Hashiba, 2018), and that SI pied oystercatcher values now extend many kilometres upstream from this management zone. For this reason, we recommend that HBRC undertakes a review of its existing EMEPs for the Tutaekuri, Ngaruroro and Tukituki Rivers, using the data collected during this survey to update the descriptions

of existing shorebird values on each river, and to develop new spatially-explicit rules, policies and conditions that reflect the current distribution of shorebird values on these rivers.

In order to ensure such rules, policies and consent conditions continue to accurately reflect the spatial distribution of shorebird values on these rivers, and to provide a means of measuring the long-term impact of this new spatially-explicit shorebird management model, we also recommend that these surveys be repeated on a continuous 3-year-on, 3-year-off cycle, using the methods outlined in this report. The advantages of adopting a six-year survey cycle are twofold. Firstly, carrying out repeat surveys over three consecutive years will enable HBRC to reduce levels of uncertainty in how well these survey results reflect true shorebird populations, caused by short term changes in population size and distribution (Brown & Robinson, 2009). In extreme cases, three consecutive annual surveys will safeguard this monitoring programme against the possibility of any one survey being severely disrupted by a major flood event. Secondly, repeating these surveys on a six-year cycle will enable HBRC to identify longer term trends in population size and distribution, above and beyond the spatial and temporal variation that occurs from one year to the next. By measuring the status of these shorebird populations once every six years, HBRC will be well placed to detect population declines in a timely manner and to implement management actions to address these declines, when and where needed. With this in mind, we recommend that a second shorebird survey of the Tutaekuri, Ngaruroro and Tukituki Rivers be scheduled to be carried out during October-November 2020.

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Appendix One

The following table contains a list of all the bird species encountered during this survey of the birds of the Tutaekuri, Ngaruroro and Tukituki Rivers. Species names and taxonomic order are those listed in Gill et al, (2010), with additional Māori names sourced from the Māori Dictionary Project (<https://maoridictionary.co.nz/>). National threat rankings are those listed in Robertson et al., (2017) and regional threat rankings are from HBRC, unpublished data.

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Total number of individuals counted
California quail	koera	<i>Callipepla californica</i>	Introduced and Naturalised	Introduced and Naturalised	280
common pheasant	peihana	<i>Phasianus colchicus</i>	Introduced and Naturalised	Introduced and Naturalised	147
peafowl	pīkau	<i>Pavo cristatus</i>	Introduced and Naturalised	Introduced and Naturalised	13
feral turkey	korukoru	<i>Meleagris gallopavo</i>	Introduced and Naturalised	Introduced and Naturalised	1
black swan	kakīānau	<i>Cygnus atratus</i>	Not Threatened	Not Threatened	68
greylag goose		<i>Anser anser</i>	Introduced and Naturalised	Introduced and Naturalised	227
Canada goose	kuihi	<i>Branta canadensis</i>	Introduced and Naturalised	Introduced and Naturalised	30
paradise shelduck	pūtangitangi	<i>Tadorna variegata</i>	Not Threatened	Not Threatened	717
grey teal	tētē moroiti	<i>Anas gracilis</i>	Not Threatened	Not Threatened	305
mallard	rakiraki	<i>A. platyrhynchos</i>	Introduced and Naturalised	Introduced and Naturalised	1165

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Total number of individuals counted
grey duck	pārera	<i>A. superciliosa</i>	Nationally Critical	Regionally Critical	1
Australasian shoveler	kuruwhengi	<i>A. rhynchos</i>	Not Threatened	Not Threatened	89
Australasian gannet	tākupu	<i>Morus serrator</i>	Not Threatened	Not Threatened	1
little shag	kawau paka	<i>Phalacrocorax melanoleucos</i>	Not Threatened	Regionally Endangered	81
black shag	kawau	<i>P. carbo</i>	At Risk, Naturally Uncommon	Data Deficient	170
ped shag	kāruhiruhi	<i>P. varius</i>	At Risk, Recovering	Vagrant	1
white-faced heron	matuku moana	<i>Egretta novaehollandiae</i>	Not Threatened	Regionally Vulnerable	98
royal spoonbill	kotuku ngutupapa	<i>Platalea regia</i>	At Risk, Naturally Uncommon	Regionally Critical	9
swamp harrier	kāhu	<i>Circus approximans</i>	Not Threatened	Not Threatened	221
New Zealand falcon	kārearea	<i>Falco novaeseelandiae</i>	At Risk, Recovering	Regionally Endangered	2
pukeko	pūkeko	<i>Porphyrio melanotus</i>	Not Threatened	Not Threatened	79
bar-tailed godwit	kuaka	<i>Limosa lapponica</i>	At Risk, Declining	Regionally Endangered	4
ruddy turnstone		<i>Arenaria interpres</i>	Migrant	Migrant	1

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Total number of individuals counted
variable oystercatcher	tōrea pango	<i>Haematopus unicolor</i>	At Risk, Recovering	Regionally Critical	7
South Island pied oystercatcher	tōrea	<i>H. finschi</i>	At Risk, Declining	Regionally Critical	31
pied stilt	poaka	<i>Himantopus himantopus</i>	Not Threatened	Regionally Vulnerable	1041
New Zealand dotterel	tūturiwhatu	<i>Charadrius obscurus</i>	At Risk, Recovering	Regionally Critical	5
banded dotterel	pohowera	<i>C. bicinctus</i>	Nationally Vulnerable	Regionally Vulnerable	2308
black-fronted dotterel		<i>Euseyornis melanops</i>	At Risk, Naturally Uncommon	Coloniser	1168
spur-winged plover		<i>Vanellus miles</i>	Not Threatened	Not Threatened	991
southern black-backed gull	karoro	<i>Larus dominicanus</i>	Not Threatened	Not Threatened	4917
red-billed gull	tarāpunga	<i>L. novaehollandiae</i>	At Risk, Declining	Regionally Vulnerable	14
black-billed gull	tarāpuka	<i>L. bulleri</i>	Nationally Critical	Regionally Critical	79
Caspian tern	taranui	<i>Hydroprogne caspia</i>	Nationally Vulnerable	Regionally Critical	6
white-fronted tern	tara	<i>Sterna striata</i>	At Risk, Declining	Not Threatened	560
rock pigeon		<i>Columba livia</i>	Introduced and Naturalised	Introduced and Naturalised	756

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Total number of individuals counted
New Zealand pigeon (kererū)	kererū	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	Not Threatened	4
eastern rosella		<i>Platycercus eximius</i>	Introduced and Naturalised	Introduced and Naturalised	8
shining cuckoo	pīpīwharau	<i>Chrysococcyx lucidus</i>	Not Threatened	Not Threatened	92
morepork	ruru	<i>Ninox novaeseelandiae</i>	Not Threatened	Not Threatened	1
New Zealand kingfisher	kōtare	<i>Todiramphus sanctus</i>	Not Threatened	Not Threatened	436
grey warbler	riroriro	<i>Gerygone igata</i>	Not Threatened	Not Threatened	544
bellbird	korimako	<i>Anthornis melanura</i>	Not Threatened	Not Threatened	33
tūī	tūī	<i>Prothemadera novaeseelandiae</i>	Not Threatened	Not Threatened	125
Australian magpie	makipai	<i>Gymnorhina tibicen</i>	Introduced and Naturalised	Introduced and Naturalised	205
New Zealand fantail	pīwakawaka	<i>Rhipidura fuliginosa</i>	Not Threatened	Not Threatened	1026
rook		<i>Corvus frugilegus</i>	Introduced and Naturalised	Introduced and Naturalised	2
skylark		<i>Alauda arvensis</i>	Introduced and Naturalised	Introduced and Naturalised	588
silveryeye	tauhou	<i>Zosterops lateralis</i>	Not Threatened	Not Threatened	918

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Total number of individuals counted
welcome swallow	warou	<i>Hirundo neoxena</i>	Not Threatened	Not Threatened	1679
Eurasian blackbird	manu pango	<i>Turdus merula</i>	Introduced and Naturalised	Introduced and Naturalised	806
song thrush		<i>T. philomelos</i>	Introduced and Naturalised	Introduced and Naturalised	438
common starling	tāringi	<i>Sturnus vulgaris</i>	Introduced and Naturalised	Introduced and Naturalised	380
common myna	maina	<i>Acridotheres tristis</i>	Introduced and Naturalised	Introduced and Naturalised	245
house sparrow	tiu	<i>Passer domesticus</i>	Introduced and Naturalised	Introduced and Naturalised	1036
New Zealand pipit	pīhoihoi	<i>Anthus novaeseelandiae</i>	At Risk, Declining	Not Threatened	82
dunnock		<i>Prunella modularis</i>	Introduced and Naturalised	Introduced and Naturalised	330
chaffinch	pahirini	<i>Fringilla coelebs</i>	Introduced and Naturalised	Introduced and Naturalised	1792
greenfinch		<i>Carduelis chloris</i>	Introduced and Naturalised	Introduced and Naturalised	1265
goldfinch		<i>C. carduelis</i>	Introduced and Naturalised	Introduced and Naturalised	1761
common redpoll		<i>C. flammea</i>	Introduced and Naturalised	Introduced and Naturalised	123
yellowhammer		<i>Emberiza citrinella</i>	Introduced and Naturalised	Introduced and Naturalised	302

Appendix Two

Implications for DOC's Tukituki River banded dotterel management prescription

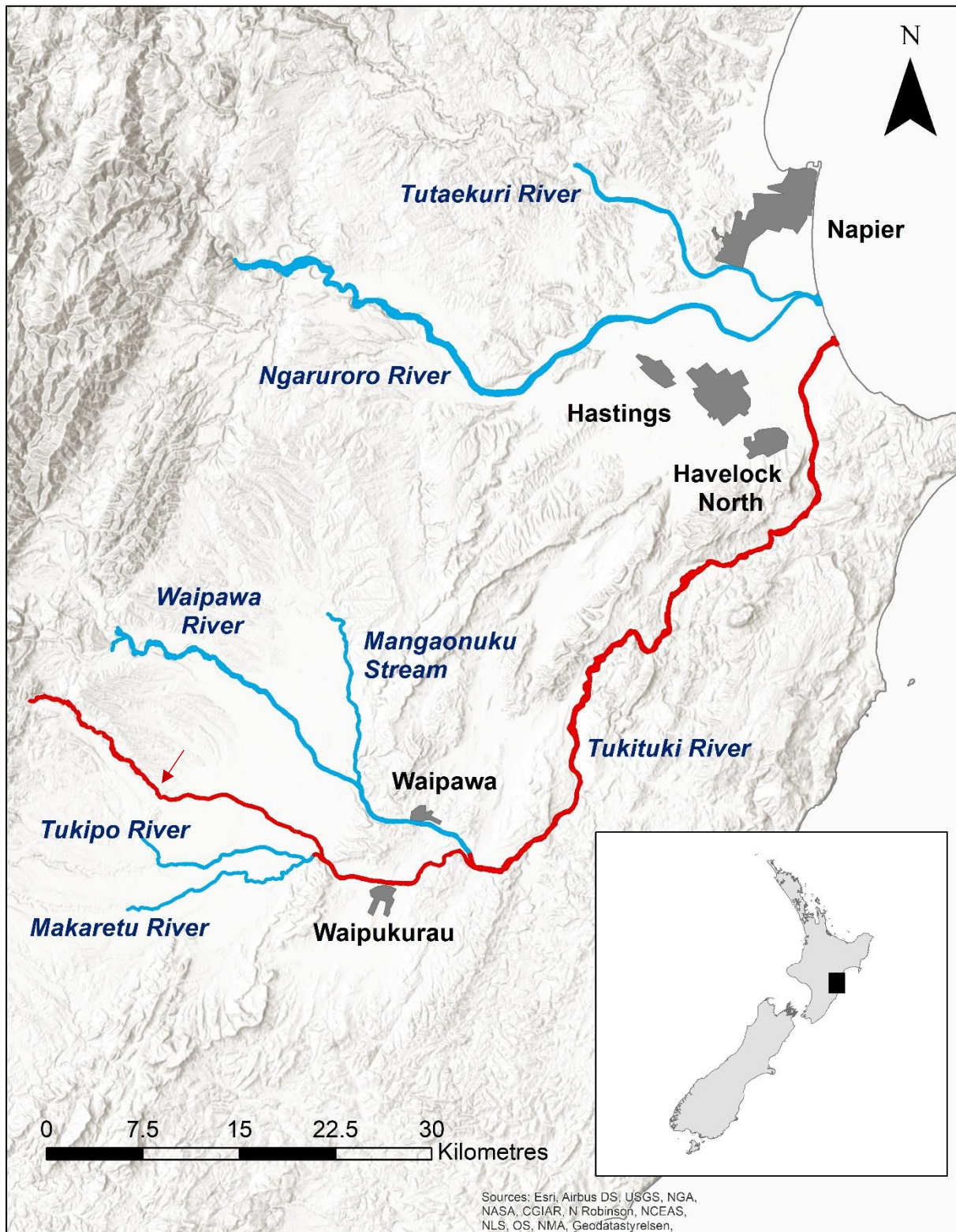
Although the primary aim of this shorebird survey was to provide HBRC with an updated understanding of shorebird abundance and distribution in order to inform flood mitigation and gravel extraction activities, the results of this survey also has important implication for DOC's banded dotterel management prescription on the Tukituki River. This November 2019 shorebird survey is the first shorebird survey to be carried out within DOC's Tukituki River banded dotterel management prescription area since 2014 (HBRC, unpublished data; Figure 4.3.1). This management prescription includes a commitment to survey the Tukituki River from Khyber Pass to the Tukituki Estuary every three years, to monitor population size and trends, and to identify high density breeding sites. Furthermore, should any survey detect that the Tukituki River banded dotterel population has fallen below a threshold of 75 breeding pairs (150 adult birds), DOC will implement a management response aimed at reducing or eliminating the threats likely to be driving this observed decline (Denise Fastier, personal communication, 13th August 2019).

A total of 888 adult banded dotterels were counted during this survey between the SH50 road bridge on the upper Tukituki River and the Tukituki Estuary, suggesting that the river currently supports up to 444 breeding pairs, well above DOC's management threshold of 75 breeding pairs. Furthermore, this population appears to have been relatively stable since 1962 (Table 3.2.2). Based on this result, no DOC management response is currently required. However, given that these results demonstrate that the Tukituki River and its tributaries currently supports the second-largest single-river population of banded dotterels in New Zealand (O'Donnell & Monks, *in press*), and supports 6% of the global banded dotterel population (Hansen et al, 2016), we recommend that DOC's current management threshold of 75 breeding pairs be urgently reviewed. The reason for this is that should the Tukituki River banded dotterel population decline from its present size to less than 75 breeding pairs before a management threshold is triggered, the population would have declined by over 80% before a management response has been implemented. We consider this to be an unusually low threshold for management, given the national and international significance of this population.

This survey has identified three discrete reaches of the Tukituki River that support particularly high numbers and high densities of banded dotterels. These three reaches are the lower Tukituki River, from the Tukituki Estuary to 3km downstream from Red Bridge (XS00 to XS26); the mid Tukituki River, from MacKenzie Road to 1km upstream of Patangata Bridge (XS20 to XS46) and the mid-upper Tukituki River from 1 km upstream of Patangata Bridge to 1.5 km upstream of the Taumumu Bridge ((TTM) XS42 to (TTU) XS03) (Table 4.1.1; Figure 4.1.1). The high numbers and high densities of banded dotterels counted within these reaches indicate that they provide relatively large areas of high-quality breeding habitat for these species, so should be considered high priority reaches for any management activities aimed at reducing or eliminating threats to banded dotterels on the Tukituki River, such as integrated multi-species predator control, weed control and reducing levels of nest disturbance (McArthur & Bell, 2016).

It should be noted that this November 2019 survey did not cover the entire DOC Tukituki River banded dotterel management prescription area. DOC's prescription area includes the entire main stem of the Tukituki River from Khyber Pass to the Tukituki Estuary, whereas the upstream limit of our survey was the SH50 road bridge (Figure 4.3.1). To rectify this discrepancy, we recommend that the river reach

from Khyber Pass to SH50 be added to this survey programme, so that complete coverage of DOC's Tukituki River banded dotterel management prescription is achieved during future surveys.



Map of Hawke's Bay showing the spatial extent of the DOC Tukituki River banded dotterel management prescription (maroon). Rivers surveyed for this shorebird survey include those marked in blue, as well as the Tukituki River upstream to SH50 (marked by red arrow). The upper Tukituki River from SH50 upstream to Khyber Pass was not covered by this survey.