Shorebird Diversity of the Northern Tauranga Harbour Kayak Surveys

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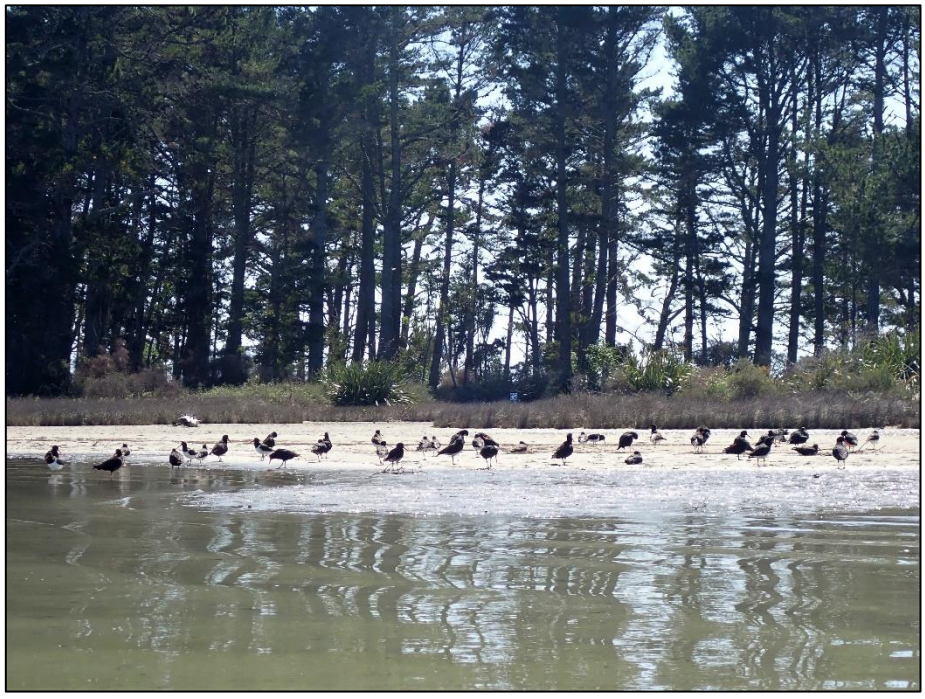

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Introduction

Project Parore is a community-led initiative advocating sustainable land use and management of the seven catchments draining into the Northern Tauranga Harbour. The project recognises intensive land use across the area has had detrimental effects on the land, waterways, and the harbour. One goal of the project is to mitigate the effects of land-use through management and restoration. Waterways are an important aspect of the project which aims to: reduce erosion, prevent sediments and pollutants entering streams, and support landowners to plant the stream- and harbour margins.

The Northern Tauranga Harbour – estuarine complex is the link between inland river systems and the Pacific Ocean. Coastal estuarine habitats receive the natural and anthropogenic materials resulting from land use. The minerals, soils and nutrients received by an estuary affect species diversity. Wetlands and their reliant species are threatened globally due to their sensitivity to development and land use. Effective wetland management requires an understanding of the interactions of species and micro-habitat (Ryeland *et al.* 2020). The diversity and abundance of bird species inhabiting a wetland are dependent on resource availability and predator abundance. The restoration efforts of Project Parore aims to improve water quality, increase habitat availability, and remove invasive species (both weeds and mammalian pests). As these efforts progress, bird diversity and abundance will respond, and we expect (more) native and endemic bird species to thrive. Surveying coastal birds is an efficient monitoring activitiy for documenting species response to restoration efforts across the catchments leading into the Northern Tauranga Harbour.

Bird monitoring in New Zealand is carried out using various approaches. Most ecological surveys of forest birds implement 5-minute point counts established by Dawson & Bull (Dawson & Bull, 1975). An alternative method is the slow walk transect (Bell, 2015). For a slow walk transect a path is determined, the observer walks slowly continuously recording count data of all species seen and heard (Envirologic Ltd., 2007,O'Donnell, 1996). The slow walk transect is preferred when the survey aims to ensure a high detection probability (Morgan *et al.* 2012, Sullivan, 2012). Monitoring coastal/ wetland birds using slow walk transects is advantageous as wetland birds can be clustered and associated with micro-habitats. Predetermining sites for 5-minute point counts may under-represent the diversity and abundance of species occupying wetlands and coastal areas. Another issue when surveying coastal birds, is finding transects that are accessible during all tidal cycles and seasons, while remaining conspicuous and yet not frightening the birds away. Continuous accessibility of coastal areas can be overcome by planning transects that can be completed using a kayak. For this report we carry out 'slow-kayak' transects that utilise the slow walk method along the coast. Birds roosting at high tide appear less easily disturbed by kayaks on the water than by foot traffic on land close to their roosts.

We trialled a monitoring strategy to gather base-line information on the bird species present in the Northern Tauranga Harbour. To establish a baseline of species-presence and abundance, we carried out ten paired coastal high tide transects by kayak. Our aim was to: document birds utilizing the harbour (diversity and relative abundance), identify important habitats, and identify bird species of major conservation concern.

Methods

Kayak survey

Study site

The study site is in the rohe of Ngai Tamawhariua.

The Northern Tauranga Harbour is separated from the Pacific Ocean by Matakana Island and partially separated from the Southern Tauranga Harbour by a sandbar (Figure 1). The estuarine habitat is approximately 6400 ha of inter-tidal sand and mud flats. At least 15 rivers and streams, which drain seven catchments, feed into the Northern Tauranga Harbour. There are significant areas of native forest at the head of at least four of the seven catchments. Land use in the seven catchments varies from small town settlements to production farming. Industry in the area includes dairy and dry-stock farms, avocado and kiwifruit orchards, other horticultural crops, production forestry and a sawmill. Settlements include the town of Katikati, batch towns, and lifestyle blocks.

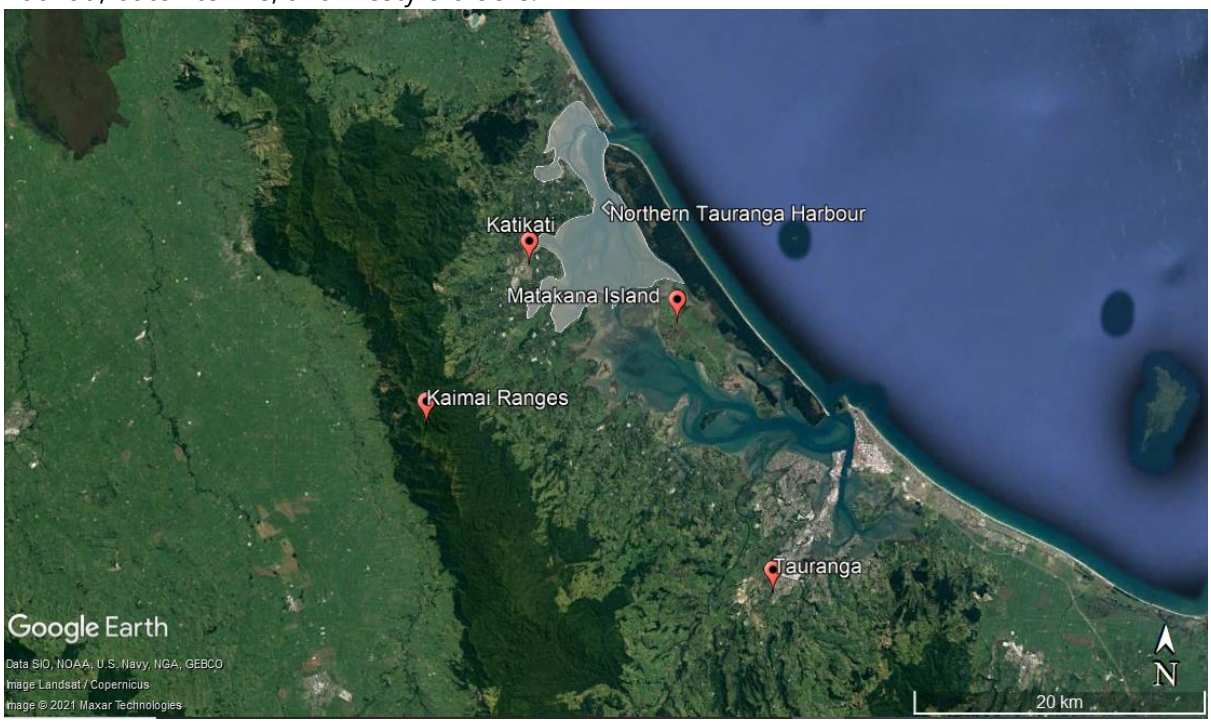

Figure 1 Map of the Northern Tauranga Harbour (opaque white) reproduced from Google Earth 11/2/2020.

Survey design and implementation

From the 2nd-6th of October we used tandem kayaks to record birds along 10 fixed transects across the Northern Tauranga Harbour (Figure 2). We identified five major river mouths along the harbour as starting points for the transects (Figure 2). Each survey occurred between the two hours either side of high tide. For each survey four people in two tandem kayaks entered the harbour from a major river mouth. Starting at the southern end of the harbour, at the Waione rivermouth, each pair surveyed in opposite directions (N-S) along the coast. The transects ended when the surveyors reached a previously identified pick up point. We recorded the kayak's route using a Garmin GPS. Transect distance depended on the availability of pick-up sites for the kayaks and the availability of water deep enough to

paddle. Transect lengths varied between 2.8 – 7.1 km (Appendix 1). Each day we started at a different river mouth, making our way north along the harbour; by the end of 5 days, we surveyed 41.7 km of coastline (Figure 2).

Figure 2 Map of the Northern Tauranga Harbour displaying transects (orange) carried out in pairs of tandem kayaks from the 2nd - 6th October 2020. Each Transect pair begins at the blue arrow and ends at the red arrows. The displayed transects are the kayak routes tracked using a Garmin GPS. This map is reproduced from Google Earth 10/2/2020.

To record birds along the transect we divided tasks and responsibilities. One person in each kayak (in the front seat) was responsible for recording the birds, and the person in the back seat was the navigator/ paddler. The recorder identified all birds seen and /or heard along the transect. They recorded the species, count, time, and behaviour (roosting, foraging, flying, preening, swimming, diving, perching, standing, call only). The recorder used binoculars to clearly identify birds. The navigator assisted with identification and counts where possible. For large flocks of birds, a count estimate was recorded.

Results

Kayak survey

A total of 3215 birds from 45 species were observed across the 10 kayak transects along the landward coastline of the Northern Tauranga Harbour. The bar-tailed godwit was the most

abundant species with 807 individuals observed (Table 1), of which 800 were counted as one group at the southern end of the Waione transect. Sixteen species were recorded in all five areas surveyed (Table 1). For the species distributed across all survey areas, black swans were the most abundant with 521 birds recorded, followed by the black-backed gull with 188 birds recorded (Table 1).

Of the five areas surveyed Waione had the greatest abundance of birds with 1304 birds recorded, while Uretara and Tuapiro shared the greatest diversity with 34 species recorded in each area (Table 1).

Table 1 Number of birds according to species surveyed across the Northern Tauranga Harbour October 2020. Endemic species are listed in bold, native in italics, and introduced in plain font.

Order	Species	Waiau	Tuapiro	Uretara	Te Mania	Waione	Total
Anseriformes	Black swan	37	89	225	58	112	521
	Canada goose	-	3	28	40	19	90
	Mallard	1	2	36	6	7	52
	Paradise duck	**-**	**1**	**-**	**2**	**1**	**4**
Suliformes	*Gannet*	*1*	-	-	-	-	*1*
Phalacroccoracidae	*Black shag*	*4*	-	*4*	*1*	-	*9*
	Little black shag	-	*10*	*2*	*1*	*2*	*15*
	Little shag	*3*	*4*	*21*	*2*	-	*30*
	Pied shag	*6*	*70*	*6*	*5*	*4*	*91*
	Shag sp	*1*	*4*	*11*	*2*	*2*	*20*
Ciconiiformes	*Spoonbill*	-	*11*	*41*	*39*	*4*	*95*
	White-faced heron	*1*	*31*	*55*	*6*	*12*	*105*
	Kotuku White heron	-	-	-	*1*	*1*	*2*
Charadriiformes	*Bar-tailed godwit*	-	-	*5*	-	*802*	*807*
	Pied oystercatcher	**-**	**8**	**5**	**-**	**209**	**222**
	Variable oystercatcher	**65**	**24**	**-**	**3**	**4**	**96**
	Pied stilt	-	*21*	*39*	-	*10*	*70*
	Spur-winged plover	*2*	*1*	*1*	*11*	*5*	*20*
	Black-backed gull	*50*	*38*	*89*	*9*	*2*	*188*
	Red billed gull	*19*	-	*2*	*3*	*2*	*26*
	White-fronted tern	*4*	*1*	*1*	*6*	-	*12*
	Caspian tern	*1*	*1*	*2*	*4*	*16*	*24*
Gruiformes	*Pūkeko*	*1*	*6*	*4*	*7*	*3*	*21*
Accipitriformes	*Australasian harrier*	-	*10*	*6*	*2*	*4*	*22*
Galliformes	California quail	-	4	-	-	-	4
	Pheasant	-	7	1	5	2	15
Psittaciformes	Eastern rosella	-	-	-	2	8	10
Columbiformes	Malay dove	-	-	-	3	2	5
Coraciiformes	*Kingfisher*	*17*	*32*	*20*	*38*	*21*	*128*
Passeriformes	**Grey warbler**	**7**	**4**	**3**	**3**	**1**	**18**
	Tui	**5**	**6**	**7**	**-**	**-**	**18**
	Fantail	**2**	**-**	**1**	**-**	**-**	**3**
	Fernbird	**-**	**1**	**-**	**-**	**-**	**1**
	Silvereye	*1*	-	-	-	-	*1*
	Shinning cuckoo	*1*	*4*	*2*	*1*	-	*8*
	Welcome swallow	*18*	*16*	*35*	*8*	*5*	*82*
	Australian magpie	2	3	2	1	2	10
	Skylark	6	1	1	4	2	14
	Blackbird	17	14	10	11	7	59
	Song thrush	-	3	-	-	3	6
	Starling	-	-	-	-	6	6
	Myna	15	10	9	26	5	65
	House Sparrow	122	1	12	1	18	154
	Finches unID	-	-	-	45	-	45
	Greenfinch	-	-	1	-	-	1
	Goldfinch	-	6	2	-	-	8
	Chaffinch	-	2	1	7	1	11
Abundance		409	449	690	363	1304	3215
Number of species		26	34	34	31	33	45

The diversity and relative abundance of waders, waterfowl, and land-birds varied between survey areas. The Waione area surveyed had the most waders recorded, including the highest relative abundance of godwits and pied oystercatchers (Figure 3). However, for Waione the relative abundance of remaining wader species was low (Figure 3). No little shags were recorded in the Waione survey. In the Waiau survey variable oystercatcher had a high relative abundance, while the relative abundance of the remaining wader species was very low (Figure 3). No spoonbill or pied stilt were recorded in the Waiau survey area. The Uretara area surveyed had the least variability in relative abundance of waders, seven of the eight most common wader species were recorded in the Uretara area (Figure 3).

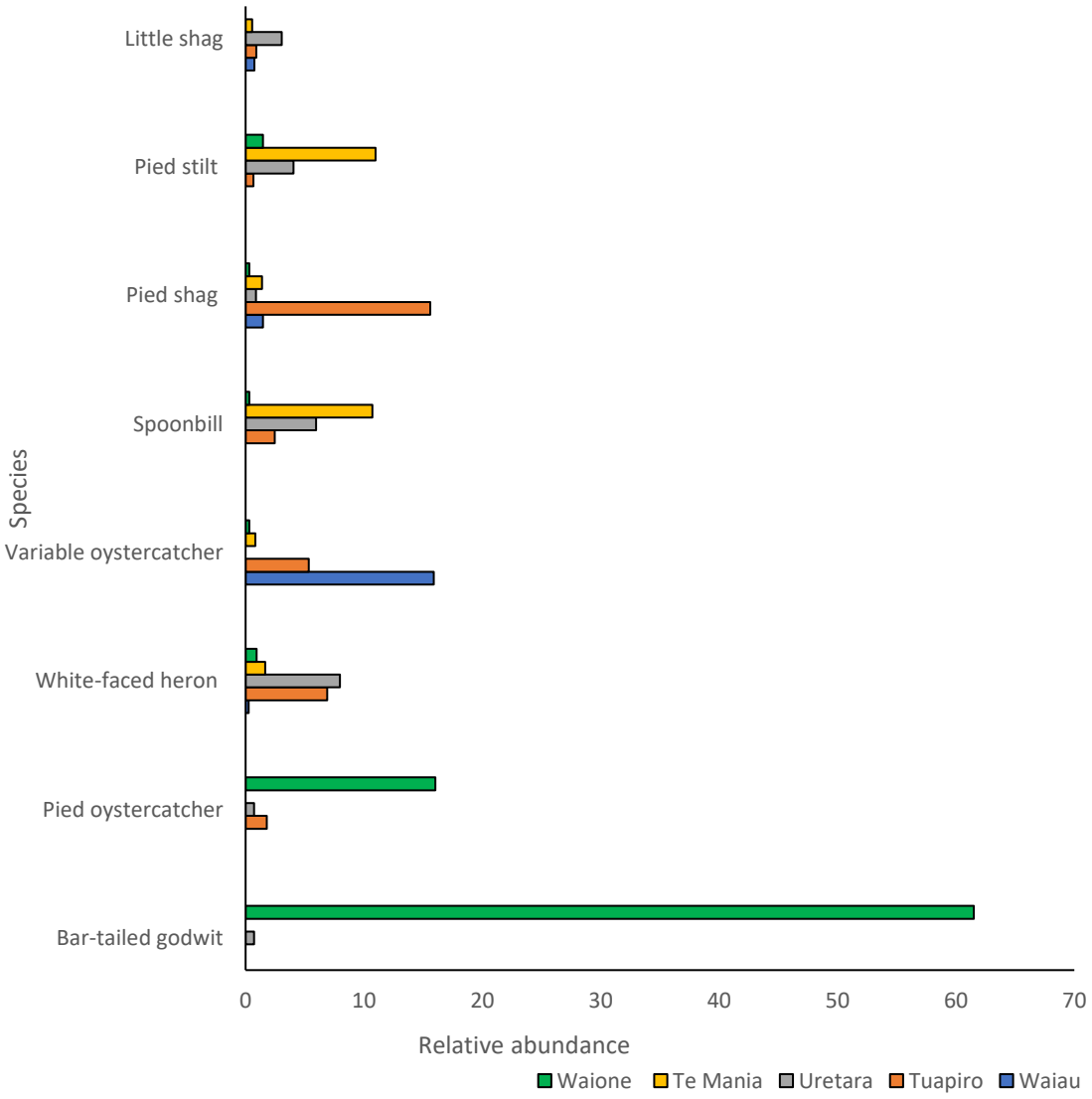

Figure 3 Relative abundance of the eight most common waders for each survey area across the Northern Tauranga Harbour. Relative abundance calculated as a percentage of their total density at each site.

Five of the six most common waterfowl were recorded in every survey area (Figure 4, Table 1). Only red-billed gulls were not recorded in the Tuapiro survey area. The most waterfowl were recorded in the Uretara survey area, this area had the greatest relative abundance of black swan, black back gull, mallard and the second greatest for Canada geese, following Tuapiro (Figure 4).

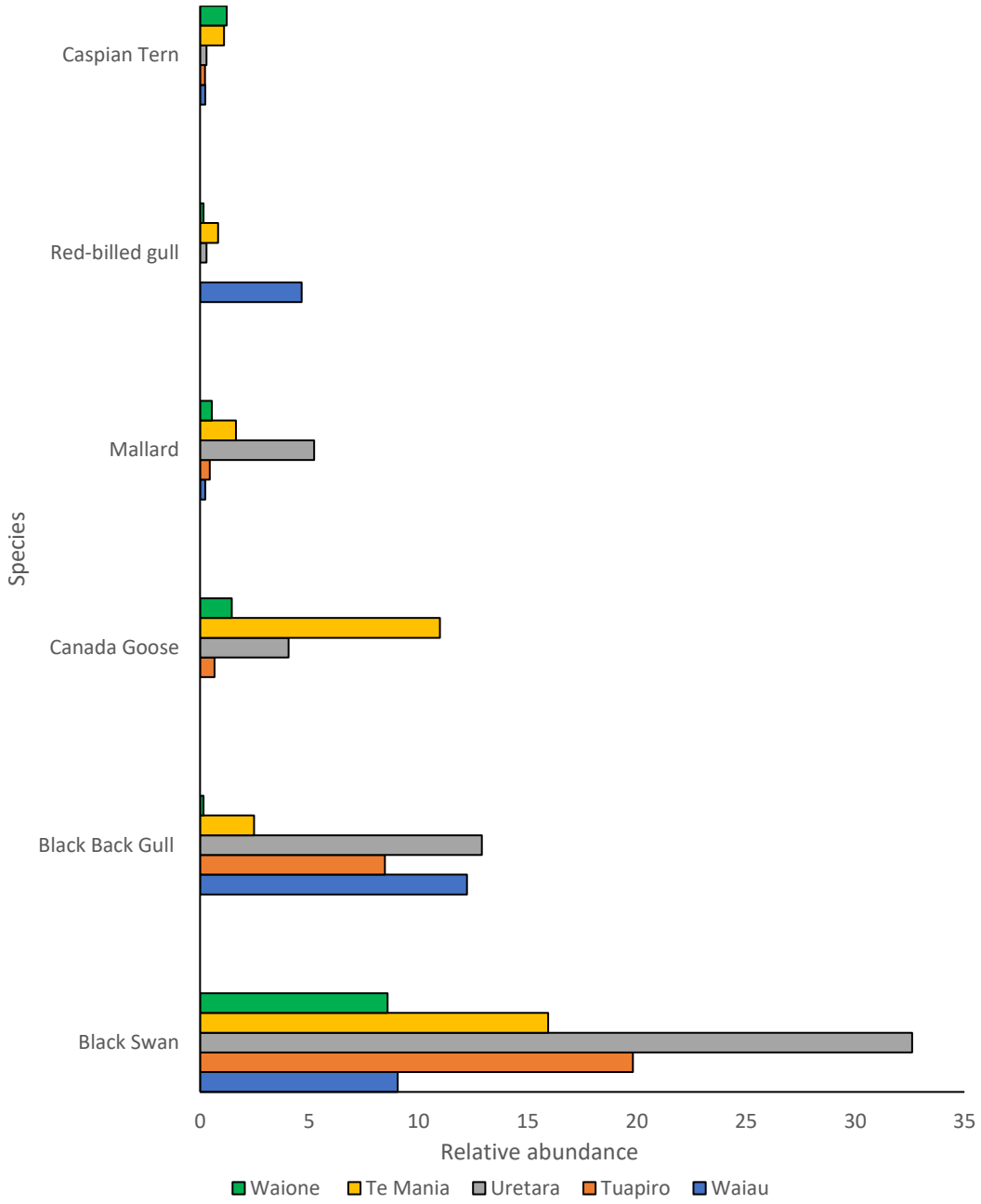

Figure 4 Relative abundance of the six most common waterfowl for each survey area across the Northern Tauranga Harbour. Relative abundance calculated as a percentage of their total density at each site.

Seven of the nine most common land-birds were recorded in all survey areas (Table 1). Australian harriers were recorded in all survey areas excluding Waiau, while tūi were only recorded in the three northern survey areas: Uretara, Tuapiro and Waiau (Table 1, Figure 5). The relative abundance of myna was seven times higher in the Te Mania survey than any other survey area, while the relative abundance of sparrows was 14 times higher in the Waiau survey area (Figure 5).

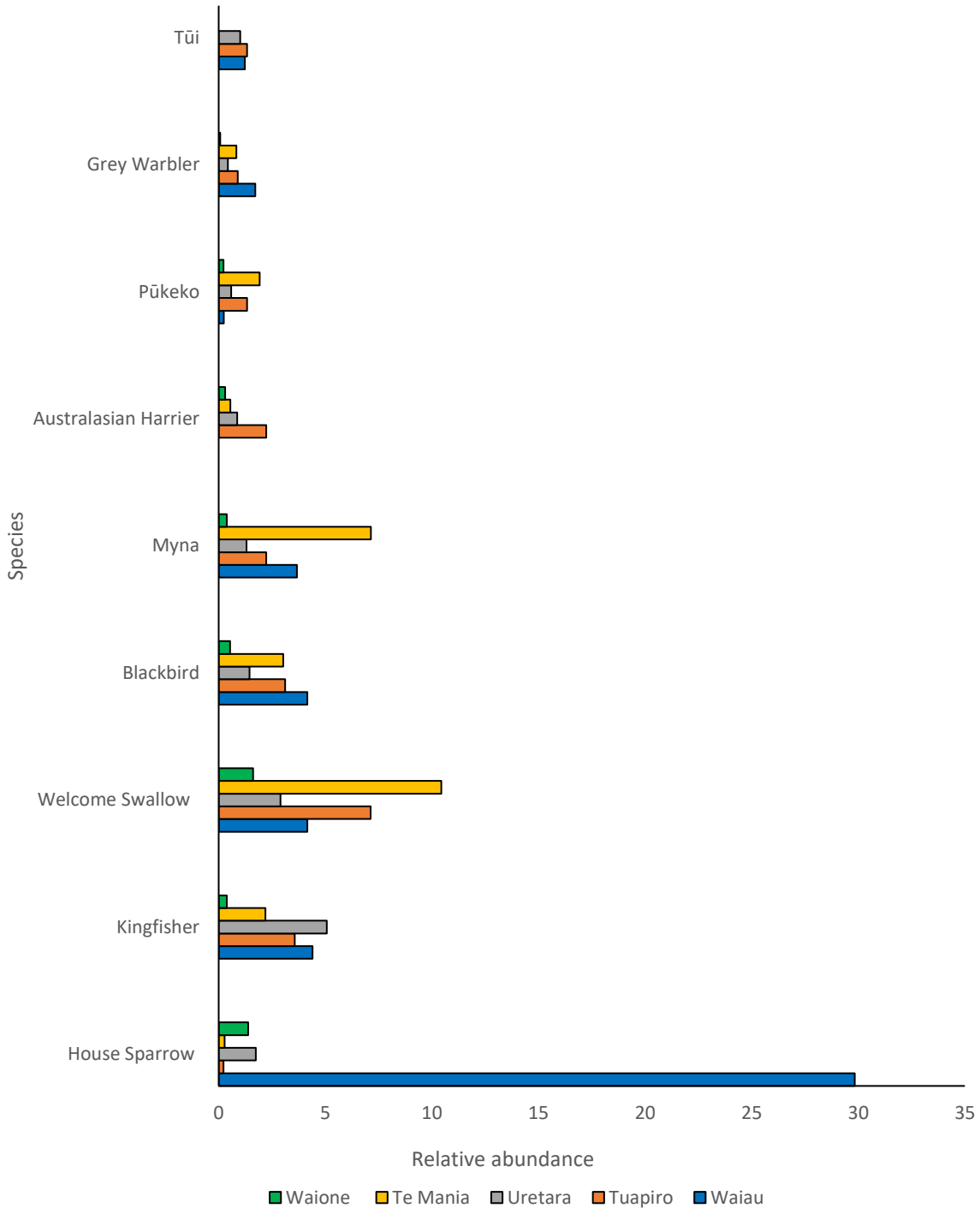

Figure 5 Relative abundance of the nine most common land-birds for each survey area across the Northern Tauranga Harbour. Relative abundance calculated as a percentage of their total density at each site.

Twenty-five native and endemic species were observed. Native species with the greatest relative abundance were bar-tailed godwit (12.4 ± 0.1), black-backed gull (7.2 ± 0.05) and kingfisher (5.2 ± 0.2) (Figures 3-5). The highest number of native and endemic species recorded in a survey area was 20 species, observed in the Uretara and Te Mania transects (Table 1, Figure 6). Waione transects had the highest total number of native birds recorded at 1109 individual birds (Table 1, Figure 7). There were more native and endemic species recorded for all survey areas (Figure 6). Overall, more native and endemic birds were recorded than introduced in the Northern Tauranga Harbour, although the proportions of introduced to native varied with each survey area. Native and endemic birds outnumbered introduced birds five-fold in the Waione survey area (Figure 7). There were 1.8 times as many native and endemic birds in the Tuapiro survey area (Figure 7). The proportion of native and introduced birds in the Uretara, Te Mania, and Waiau survey areas is even, with 19 more introduced birds than native recorded on the Waiau transects (Figure 7).

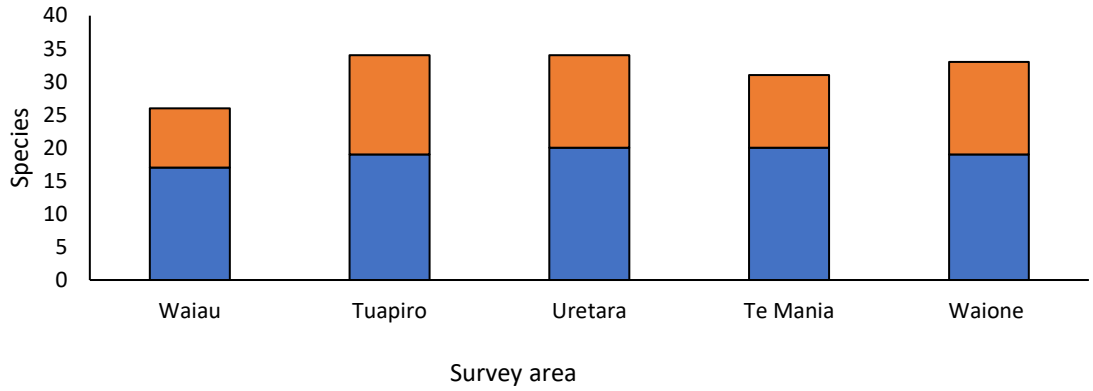

Figure 6 Number of native and endemic species (blue) and introduced species (orange) recorded in each survey area of the Northern Tauranga Catchment from the 1st of October to 6th October 2020.

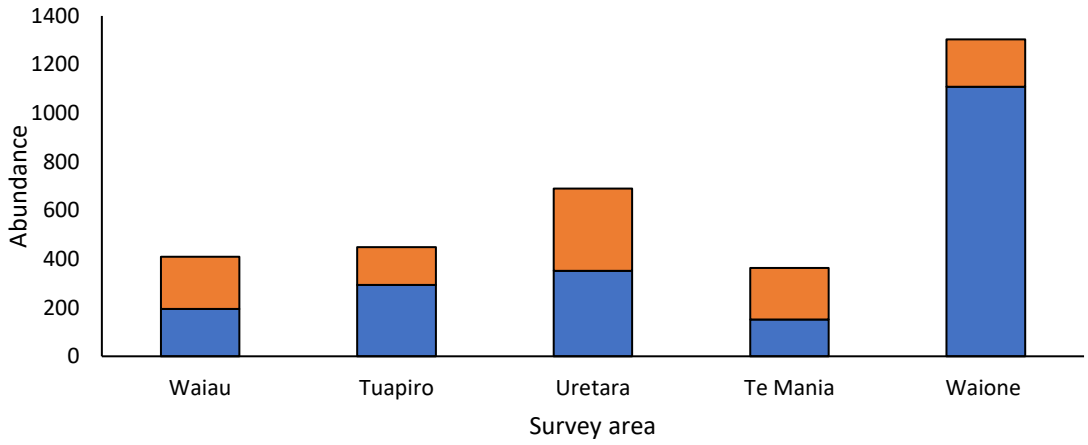

Figure 7 Number of native and endemic birds (blue) and introduced species (orange) recorded in each survey area of the Northern Tauranga Catchment from the 1st of October to 6th October 2020.

Discussion

Our surveys of the Northern Tauranga Harbour suggest the harbour is of high ecological significance, providing valuable habitat for a diversity of bird species. The diversity and relative abundance of bird species recorded in each survey area was unique. These differences between sites demonstrate the importance of considering restoration and protection of the Northern Tauranga Harbour as an entire system. The Project Parore restoration and sustainable land management plans are underway and will almost certainly yield positive outcomes for the estuarine habitat and communities. Continued monitoring of bird species diversity and relative abundance will track the progress of Project Parore, inform decisions on species-management, and highlight issues that need to be addressed. Our kayak survey method has been effective at providing a baseline of the species diversity present throughout the Northern Tauranga Harbour.

All the abundant birds recorded at the Northern Tauranga Harbour were species that utilise a range of habitats and benefit from wetlands. The Waiau survey area contained predominately seabirds and garden birds. A high relative abundance of house sparrow, black-back gull, red billed gull, welcome swallow, and grey warbler were recorded in the Waiau survey area. This survey was closest to the Pacific Ocean and Waihi Beach favouring seabirds. The survey transects passed many batch homes with native gardens providing habitat for passerines. The Waiau survey area were the only transects where gannet and silvereye were recorded.

Relative abundance of pied shag, white faced heron, variable oyster catcher, black-back gull, and welcome swallow at the Tuapiro survey area was high. This suggests the Tuapiro area has appropriate food availability for native species and necessary plant diversity. Pied shag and variable oystercatcher are listed as recovering species (IUCN red list). The Tuapiro area is the only area we surveyed where fernbird were recorded. Fernbird are of conservation concern as a declining endemic species reliant on wetland habitat, their presence is used to indicate high wetland quality (Anderson & Ogden, 2003). During the survey, a fernbird was recorded at 9:45am at the beginning of the northern transect (Appendix B). Another fernbird was observed observed at the Tuapiro Point Foreshore Reserve outside of the kayak survey. A fernbird was seen when a recording device was being collected. That recording device recorded fernbird duetting suggesting breeding pairs are located here.

There was a predominance of waterfowl recorded along the Uretara survey area. Uretara had a high relative abundance of black swan, Canada geese, mallard, and white face heron. Of the predominant birds the white-faced heron is the only native species. Although we recorded a diversity of species in the Uretara survey, this area has the second highest number of species recorded at 34 (equal with Tuapiro). More native species (20) were recorded and there were slightly more native birds (351) than introduced (339). The Uretara Estuary is a site that has been returned from grazing land to wetland, it is the surrounded by Katikati which is the most urbanised of all the survey areas. Our kayak survey focused on the coast, starting at the edge of the Uretara Estuary. This predominance of introduced waterfowl could be the combined influence of these birds benefiting from the urbanisation,

and native birds preferring the Uretata Estuary area inland of the coastal survey transect. Fernbird were not recorded during this coastal survey; however an additional survey was carried out at the Uretara Estuary to compare kayak and walking transects. Fernbird were recorded during the comparison survey in the estuary habitat upstream/ inland of the coastal kayak transect (Langton-Myers, 2021).

A range of birds were abundant in the Te mania survey area: welcome swallow, myna, black swan, Canada geese, spur-winged plover, spoonbill, and pied stilt. One kotuku white heron was recorded from both the southern and northern transects at 8:40am

Bar-tailed godwit were the predominant species of the Waione survey area. The southern kayak transect recorded a large flock of approximately 800 bar-tailed godwit towards the end of the survey (Appendix C). Owen (2013) noted that the average number of bar-tailed godwits recorded in the Tauranga harbour ranged from ~630 in winter to >5000 in summer. It is worth noting that 23 high-tide roosts were surveyed by the OSNZ, only three of which were in the upper Tauranga harbour, and only one of those three overlapped with the areas surveyed by our team. Bar-tailed godwit are the most abundant Palearctic wader to visit New Zealand, returning from Alaska around October (Veitch & Habraken, 1999). Their presence in the Waione area in October suggests good food availability for the returning birds. Bar-tailed godwit occur in harbours and estuary around the country.

Pūkorokoro-Miranda is considered as one of the largest sites for bar-tailed godwit, population studies documenting the Pūkorokoro Miranda population from 1960-1998 discovered a slight decline and suggested changes in habitat quality may be encouraging bar-tail godwit to drift to other locations (Veitch & Habraken, 1999). We recorded an abundance of pied oystercatcher a declining wader and Caspian tern in the Waione survey, both species are nationally vulnerable with increasing populations. An endemic kotuku white heron classified as nationally critical, was also recorded along the southern transect.

Waders do not always use the same roosts (day or season), flocks of birds of the same species are fluid, and mixed-species flocks are not always common. It is important to recognise also that this survey represents a snapshot in time: a high-tide survey with a focus on the landward coast of the Upper Tauranga harbour. However, the method used allows for extensive coverage in a relatively short time and includes areas that are not otherwise (easily) accessible on foot. The bird counts from the kayaks are non-intrusive, repeatable regardless of the height of the tide, and provide an excellent long-term monitoring tool. Having the ability to record bird species presence and abundance across 41.7km of coast in five days provides a through baseline of information representing the entire Northern Tauranga Harbour.

Land-birds of interest along the survey sites include kingfisher, tūi and eastern rosella. Kingfisher were recorded regularly across all transects. Clay banks and mature trees were available for kingfisher nesting sites along all of the transects. Mature trees in the southern Waione and Te Mania survey areas tended to be exotic conifers. While in the southern Waiau and Tuapiro transects, pōhutukawa was the predominant mature tree species. The mature tree composition reflects the land-use of each area. The northern surveys are surrounded by

batch towns and suburbs. The community at tanner's point have well maintained gardens including many native trees and plants. While the coastal land use of the Waiona and Te Mania survey areas includes a variety of orchards with shelter belts grown for wind protection. Tūi were abundant in the northern survey areas where there were plenty of native plants available. While eastern rosella were only found in the southern survey areas where the open exotic landscape is more suitable.

Recommendations

1. Reduce predation risk of current bird populations with predator control. The Tuapiro area should be prioritized for predator control. Ideally an annual pest control program should be carried out targeting feral cats, rodents, and mustelids. To assist the fernbird population at Tuapiro pest control should occur in September-October immediately prior to the fernbird breeding season (November-February).
2. Conduct bi-annual spring and autumn repeats of the shore-bird survey by kayak every two years. This survey has provided a solid baseline of bird species diversity and abundance from which meaningful comparisons can be made, if the survey is repeated.
   Ideally repeats will take place at the same time of year, while allowing for cooperation with the tides. Adding an additional season would be beneficial as shorebirds are migratory and their composition changes throughout the year. Is it important to be guided by the spring or neap tides (i.e. lunar cycle), and/or specifically when migratory waders are here.
3. Conduct a detailed habitat survey of the Northern Tauranga Harbour. A habitat survey will document the different micro-habitats available, identify areas dominated by exotic species and identify native species already occurring. The kayak survey focusing on birds noted the presence of different habitats such as mangrove habitat and eel grass beds but not to a sufficient level of detail. Ideally a habitat survey more detailed than landcover maps is conducted. Different habitats regularly respond to the same landcover class especially in wetland areas (Adamo *et al.* 2016). Including plant growth stage and water levels provides information on topology and zonation. This information uncovers the details of habitat availability. Recently the importance of microhabitats to wading birds was highlighted from a study observing the roosting patterns of nine shorebirds across the coastal areas of southern Victoria, where birds roosted on wet substrate to thermoregulate (Ryeland et al., 2020). They discovered that during the hottest periods birds would roost in water-logged wetland margins to benefit from heat dissipation through their uninsulated legs (Ryeland et al., 2020). Wetland management requires detailed understanding of microhabitats as species utilize microhabitats for feeding, breeding, roosting and thermoregulation. For the Northern Tauranga Harbour the current distribution of eel grass and salt marsh is of great interest.
4. Habitat restoration plans including planting should be planned in accordance of habitat use. This includes the maintenance of open area which are important to shore birds which rely on open spaces to detect and avoid predators. - open areas important to shorebirds.
5. This report is a baseline summary collating species abundance and diversity from the October 2021 surveys by kayak. There is still a great deal of data collected during the surveys that is so far un-used. Further analysis of the spatial and behavioural

information will begin to highlight important habitats. This information combined with habitat mapping will provide a detailed understanding of habitat use.

Conclusion

It is clear the Northern Tauranga Harbour already provides a diverse range of habitats to coastal bird species. Effective catchment management can support the coastal bird species relying on microhabitats for foraging, breeding and roosting to thrive. There is scope to enhance the environment further which will happen under the umbrella of Project Parore.

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Appendix

Appendix A

Details of the slow kayak transects carried out October 2020 in the Northern Tauranga Harbour.

Survey	Date	Start	End	Length	Cloud cover start	Cloud cover end	Rain	Wind
Waione SE	2/10/2020	7:45	9.04	4 km	1/8	3/8	0	0
Waione NE	2/10/2020	7:45	9:07	3.18km	1/8	1/8	0	0
Te Mania SE	3/10/2020	8:40		2.8km	0		0	0
Te Mania NE	3/10/2020	8:38	10:23	5.73km	0	1/8	0	0
Uretara 3 SE	4/10/2020	8:48	10:09	7.1km	1/8	5/8	0	0
Uretara 3 NE	4/10/2020	8:47	10:00	3.7km	2/8	7/8	0	0-1
Tuapiro NE	5/10/2020	9:40	11:40	4.4km	0	0	0	0
Tuapiro SE	5/10/2020	9:40	11:23	3 km	0	0	0	0
Waiau SE	6/10/2020	10:06	11:29	5 km	3/8	0	0	0-3
Waiau SW	6/10/2020	10:06	11:29	2.8km	0	0	0	2

Appendix B

The Tuapiro survey area displaying locations where fernbird was recorded. The first fernbird location (yellow circle) was sighted on the 2/10/2020 prior to the kayak survey as a remote recording device was being collected at the Tuapiro Point Foreshore Reserve. The second fernbird location (orange circle) at the river entrance to the harbour was observed during the kayak survey on the 5/10/2020. Fernbird duetting were recorded by the recording device (purple square) each day from the 22/9/2020-26/9/2020.

Appendix C

Photo showing part of the bar-tailed godwit flock observed during the southern Waione kayak survey of the Northern Tauranga Harbour. Photo by Chris Longson on the 2/10/2020.