

**BEFORE THE INDEPENDENT HEARINGS PANEL**

In the matter of

**The Proposed Regional Plan for Northland**

and

**Mangawhai Harbour Restoration Society Inc.**

(Submitter)

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**STATEMENT OF EVIDENCE OF GRAHAM DON**

**ON BEHALF OF THE MANGAWHAI HARBOUR RESTORATION SOCIETY INC.**

Dated 10 August 2018

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## PROPOSED REGIONAL PLAN FOR NORTHLAND

### Written Statement of Evidence – Graham Don

On behalf of the Mangawhai Harbour Restoration Society Inc.

#### 1. INTRODUCTION

- 1.1 My name is Graham Don. I am the Senior Ecology Consultant at Bioreserches Group (a subsidiary of Babbage Consultants Limited) which was established in 1972 and specialises in ecological consultancy services. I have a Bachelor of Science degree with majors in both Botany and Zoology, and a Master of Science degree with Honours in Zoology from the University of Auckland (1975).
- 1.2 I have been in private practice for 43 years. During that time, I have undertaken ecological assessments in a wide range of habitats throughout New Zealand (Karikari Peninsula in the Far North to Tiwai near Bluff) and on Chatham Island in a variety of habitat types (intertidal areas to South Island beech forest). For the past 20 years or so, my principal area of responsibility regarding field assessments has been the wildlife aspect of various proposals, especially the avifauna, with a particular interest in coastal birds. That also draws on my core discipline of marine ecology. For example, in the 1980's and early 1990's, I was involved with the assessment of about 12 marinas (both existing and proposed). That included consideration and analysis of the effects on marine organisms, water quality, sediment quality, contamination and sedimentation.
- 1.3 Examples of coastal bird surveys and subsequent habitat and effects assessments that I have completed over the years are listed in Appendix 1.
- 1.4 I have conducted and managed numerous ecological investigations for regional councils, district councils, private entities, preservation societies and others. Since 2013, I have managed the terrestrial ecological baseline surveys for the Ara Tūhono Project - Pūhoi to Warkworth Road of National Significance, undertook part of the field survey (estuarine birds), presented evidence to the Board of Inquiry, and was the sole Alliance ecologist involved in the construction bid evaluation. I am currently on the Technical Advisory Group for the project.
- 1.5 I have also undertaken various surveys of coastal birds in the Mangawhai Harbour on behalf of the Mangawhai Harbour Restoration Society Inc. (MHRS). To date, I have completed the following avifaunal surveys at Mangawhai:
  - 1.5.1 Pre-mangrove clearance: 2011-12
    - Banded rail surveys at Lincoln Street, Insley Street causeway and Black Swamp Road, Back Bay, Molesworth Drive to Moirs' Point and Riverside to Tern Point (November – December 2011)
    - Coastal bird surveys in the Sand Island to Riverside area of intertidal habitat; 18 hourly counts & habitat use records (February & March 2012)
  - 1.5.2 Post-mangrove clearance: 2016
    - Banded rail surveys at Lincoln Street, Back Bay & Insley Street (post mangrove removal) and Molesworth Drive (where there was no mangrove removal) – March & July 2016.

- Coastal bird surveys in the Molesworth Drive to Riverside area (18 hourly counts & habitat use records), Lincoln Street and Insley Street – February & March 2016.

#### 1.5.3 Post-mangrove clearance: 2017

- Banded rail surveys above the Insley Street and Molesworth Drive causeways (where there was no mangrove removal) – July 2017
- Coastal bird surveys at Insley Street (above & below the causeway) and Tara Creek (above Molesworth Drive causeway) - February & March 2017.

#### 1.5.4 Post-mangrove clearance: 2018

- Coastal bird surveys at Insley Street (above and below the causeway) and the Molesworth Drive to Riverside area - February & March 2018.

1.6 I have also managed and completed surveys of banded rail and other coastal birds at Pahurehure Inlet prior to and three years after a major mangrove removal exercise. Coastal birds were surveyed four times each in the summer, autumn and winter of 2015, providing a total of 72 hourly counts in the Inlet.

1.7 Although this is a council hearing, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. I have complied with that Code when preparing this Statement of Evidence and I agree to comply with it. I also confirm that I have not omitted to consider material facts known to me that might alter or detract from the opinion expressed in my evidence.

## 2. SCOPE OF EVIDENCE

2.1 I have been requested to:

- Discuss my observations, surveys and investigations of avifauna in the Mangawhai Harbour and other locations in Northland; and
- Provide my assessment of the effects of mangroves (including mangrove removal) on avifaunal life.

2.2 In my evidence, I discuss the following:

- The results of my investigations of avifauna (in the Mangawhai Harbour and in other locations), including the relationship between the mangroves and avifauna;
- The ecological impact and benefits of mangrove removal on various native, at-risk and threatened bird species;
- The importance of the Mangawhai sand spit for the fairy tern;
- Typical bird breeding periods;
- Locations used by birdlife around Mangawhai Harbour; and
- Misconceptions about mangroves and avifauna.

## 3. EXECUTIVE SUMMARY

3.1 Coastal bird surveys undertaken in mangrove-removal areas at Mangawhai, especially Sand Island, and Pahurehure Inlet have indicated that mangrove clearance has provided increased habitat that is utilised by avifauna for feeding and resting. In particular:

- The use of the Sand Island mangrove removal area by eastern bar-tailed godwit and New Zealand dotterel is in my view significant, with the recorded maxima of New Zealand dotterel on Sand Island triggering a Ramsar Convention criterion for an internationally important habitat;

- Data from two post-mangrove clearance surveys in the Molesworth Drive to Riverside area in Mangawhai also indicate a significant increase in the average number of coastal birds in that area following mangrove removal i. A similar increase has also been documented at Pahurehure Inlet; and
  - Banded rail has persisted in the mangrove removal areas at Back Bay, Lincoln Street and Pahurehure Inlet, with breeding recorded at the two latter sites.
- 3.2 In my view, the ecological benefits of mangrove removal to and effects on both coastal birds and banded rail are site specific. However, data collected to date has shown that the effects of mangrove removal on coastal birds at the Sand Island and Pahurehure Inlet mangrove removal areas to be both beneficial and unequivocal.
- 3.3 The fairy tern breeding data available also show that the total number of eggs laid and number of chicks fledged has been the same pre- and post-mangrove clearance. Breeding success has not been significantly lower post-mangrove clearance, suggesting that the NZ fairy tern breeding has not been adversely affected by the mangrove clearance.
- 3.4 The Regional Plan's Rules concerning bird breeding seasons should correctly reflect the bird breeding period accepted by the Environment Court (Decision Number: NZEnvC 232 and NZEnvC 245).
- 3.5 The classification of the entire Mangawhai Harbour as a Significant Bird and Seabird Area is not justified based on the existing database.
- 3.6 My detailed evidence follows.

#### **4. INVESTIGATIONS OF MANGROVES AND AVIFAUNA**

- 4.1 I discuss below:
- Key findings from the avifaunal investigations I have completed to date (as listed in paragraphs 1.5 and 1.6 above) which concern relatively major exercises in both Mangawhai Harbour and Pahurehure Inlet; and
  - My view on the ecological impact and benefits of mangrove removal on avifauna.

##### **Coastal Bird Surveys in Mangawhai Harbour**

- 4.2 The most recent post-mangrove removal surveys at Mangawhai were conducted in February-March 2018 in areas highlighted in Figure 2 ; Appendix 2.
- 4.3 While surveys to date have been conducted above and below the causeways, I consider the findings from Sand Island to be key when discussing mangroves and avifauna because of the robust database available from that area, its position in the Harbour, its size, and its proximity to a wide nearby area of feeding and resting bird habitat.
- 4.4 The total diversity of bird species using the post-mangrove removal areas in the Sand Island Sector was 16 bird species, whereas 18 bird species were recorded in the sandflat habitat adjacent to Sand Island where no mangrove clearance was required (chi-squared = 0.1; no significant difference).
- 4.5 A total of 4 threatened bird species and 6 at-risk bird species were recorded using the mangrove-cleared area. These were fairy tern, banded dotterel, caspian tern, lesser knot, eastern bar-tailed godwit, red-billed gull, royal spoonbill, South Island pied oystercatcher, New Zealand dotterel and variable oystercatcher.
- 4.6 The surveys demonstrate that removal of mangroves at Sand Island has provided increased feeding and resting habitat for species of conservation concern. While some of those species use areas containing mangrove pneumatophores (aerial roots) at

times, none of those species would typically venture under the mangrove canopy i.e. past the canopy drip line. Clearly, birds will use areas containing post-mangrove clearance debris.

- 4.7 I consider two species in particular that now regularly utilise the Sand Island mangrove removal area for feeding and resting to be of particular note in an international context.

#### **Eastern bar-tailed godwit**

- 4.8 Eastern bar-tailed godwit is currently rated as “at risk, declining” in New Zealand with a qualifier of “threatened overseas”. It is rated as “vulnerable” in Australia. Eastern bar-tailed godwit is identified in the Conservation of Migratory species of Wild Animals (the Bonn Convention), an international convention to which New Zealand has been a party since 2000. New Zealand is also a partner in the East Asian Australasian Flyway (EAAF) Partnership that focuses on the migration ecology and behaviour between the Southern and Northern Hemispheres.
- 4.9 In New Zealand, the availability of feeding habitat, especially pre-migration to Alaska (with stop overs; commencing about March-April), is a key factor in the migratory cycle. The New Zealand summer population of godwit decreased by about 18% between 1993 and 2003 (Southey, 2009)<sup>1</sup>. That trend has continued (Robertson et al 2017)<sup>2</sup> and is reflected by a similar trend in Australia (Studds et al, 2016)<sup>3</sup>. Degradation of foraging habitat is one of a number of factors that are threats to the eastern bar-tailed godwit, and that includes the invasion of mudflats and saltmarsh habitats by the spread of mangroves (Saintilan and Williams, 1999<sup>4</sup>; Straw and Saintilan, 2006<sup>5</sup>; Woodley, 2009<sup>6</sup>; Huang et al, 2012<sup>7</sup>; Threatened Species Scientific Committee, 2016<sup>8</sup>).
- 4.10 Maximum numbers of eastern bar-tailed godwit in the mangrove removal area at Sand Island were 68 in 2016 and 69 in 2018. The maxima represented 35.6% and 62.7% of the maxima respectively recorded for the entire “inlet” i.e. Molesworth Drive to Riverside.

#### **New Zealand dotterel**

- 4.11 The maximum numbers of New Zealand dotterel (currently rated as “at risk, recovering”) in the Sand Island mangrove removal area were 21 in 2016 and 41 in 2018. The totals for the entire Molesworth Drive to Riverside survey area were 52 and 112 respectively. The mangrove removal area maxima alone are high enough to represent 1.01% and 1.98% of the total New Zealand and world population of 2075 individuals (Dowding, 2017)<sup>9</sup> and therefore trigger a Ramsar Convention (of Wetlands

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<sup>1</sup> Southey, I (2009) Numbers of Waders in New Zealand 1994-2003. Dept of Conservation R & D Series 308. 70pp.

<sup>2</sup> Robertson, HA; Baird, K; Dowding, JE; Elliott, GP; Hitchmough, RA; Miskelly, CM; McArthur, N; O'Donnell, CFJ; Sagar, PM; Schofield, RP; Taylor, GA (2017) Conservation status of New Zealand birds, 2016. NZ Threat Classification Series 19; Department of Conservation 23pp.

<sup>3</sup> Studds, CE; Kendell, BE; Murray, NJ; Wilson, HB; Rogers, DI; Clemens, RS; Gosbell, K; Hassel, CJ; Jessop, R; Melville, DS; Milton, DA; Minton, CDT; Possingham, HP; Riegen, AC; Straw, P; Woehler, EJ. & Fuller, RA. (2017) Rapid population decline in migratory shorebirds relying on Yellow Sea tidal mudflats as stopover sites. Nature Communications/ 8.14895/DOI 10.1038/ncomms 14895.

<sup>4</sup> Saintilan, N & Williams, RJ (1999) Mangrove transgression into saltmarsh environments in south-east Australia. Global Ecol. & Biology. 8 :117-124pp

<sup>5</sup> Straw, P & Saintilan, N (2006) Loss of shorebird habitat as a result of mangrove incursion due to sea-level rise and urbanisation. In: Boere, G; Galbraith, C; Stroud, D (eds) Waterbirds around the world. The Stationary Office, Edinburgh UK, 717-720pp.

<sup>6</sup> Woodley, K (2009) Godwits: long-haul champions. Penguin Group Ltd, N.Z.

<sup>7</sup> Huang, S.C; Shih, SS; Ho, YS; Chen, CP; Hsieh, HL (2012) Restoration of Shorebird Roosting Mudflats by Partial Removal of Estuarine Mangroves in Northern Taiwan. Restoration Ecology 20(1), 76-84pp.

<sup>8</sup> Threatened Species Scientific Committee (2016) Conservation Advice- *Limosa lapponica baueri* (retrieved from: [www.environment.gov.au/biodiversity/threatened/species/pubs/86380-conservation-advice-05052016.pdf](http://www.environment.gov.au/biodiversity/threatened/species/pubs/86380-conservation-advice-05052016.pdf).)

<sup>9</sup> Dowding, J (2017) New Zealand dotterel. (retrieved from [www.birdsonline.org.nz](http://www.birdsonline.org.nz)).

of International Importance) criterion i.e. an area that supports >1% of the individuals in a population of one species or subspecies of waterbird is considered to be of international importance. Therefore, according to the Ramsar Convention, the mangrove-cleared area of Sand Island is now of international importance. That was not the case when it was covered with mangroves.

4.12 The comparative data for the Sand Island Sector post-mangrove clearance are shown in Table 1 below (note: the Sand Island Sector was mostly covered by mangroves in 2012 and any open areas were obscured by the mangrove trees).

<b>Table 1 SAND ISLAND MANGROVE REMOVAL AREA – AVERAGE &amp; MAXIMUM NUMBERS POST CLEARANCE</b>					
	n	mean number	SE	95% limits	maximum number
2016	18	66.6	10.8	43.8 - 89.4	169
2018	18	55.5	11.3	35.8 - 75.2	183

The average numbers using the mangrove-cleared area were consistent between 2016 and 2018, indicating regular use.

4.13 Table 2 below shows the average results for the Sandflat Sectors between Molesworth Drive & Riverside where no mangrove clearance occurred / was needed.

<b>Table 2 COMPARISON OF CENTRE SECTOR &amp; EAST SECTOR-AVERAGE BIRD NUMBERS OVER ALL SURVEYS</b>						
	Centre			East		
	2012	2016	2018	2012	2016	2018
n	18	18	18	18	18	18
mean	116.3	101.2	84.9	29.5	26.3	33.9
SE	22.4	22.7	19.8	7.6	9.2	8.3
95% limits	69.0 – 163.6	53.3 – 149.1	50.4 – 119.4	13.5 – 45.5	6.9 – 45.7	19.5 – 48.3

A comparison of the Centre Sandflat Sector data indicates a decrease in 2018 (chi-squared = 4.90;  $p < 0.05$ ) whereas the average numbers in the East Sandflat Sector have been constant (chi-squared = 0.98; not significant).

4.14 As a comparison, the average number of birds in the entire Sand Island Sector (i.e. mangrove-cleared area plus open sandflat) is shown in Table 3 below.

<b>Table 3 COMPARISON OF SAND ISLAND SECTOR – AVERAGE BIRD NUMBERS POST MANGROVE CLEARANCE</b>		
<b>SAND ISLAND (ENTIRE SECTOR)</b>		
	<b>2016</b>	<b>2018</b>
n	18	18
mean	106.0	120.7
SE	14.8	20.4
95% limits	74.8 – 137.2	85.2 – 156.2

The average percentages of birds in that Sector that were recorded in the mangrove-cleared area were 62.8% in 2016 and 45.9% in 2018. For equivalent post-clearance years, the average numbers recorded in the Sand Island (113.4) and Centre Sandflat Sectors (93.1) were similar (chi-squared = 1.98; not significant). These results indicate that the Sand Island habitat is at least as attractive to coastal birds as the Centre Sandflat Sector that was not subject to mangrove clearance, and presents a “control” area. In addition, within the Sand Island Sector, the mangrove-cleared area is used by a similar proportion of birds (overall 54.4%) to the Sandflat Sector where no mangrove clearance was required.

#### **General Bird Population in Mangawhai Harbour Post Mangrove Removal**

- 4.15 To assess whether any overall change has occurred in the average number of birds using the Molesworth Drive to Riverside area since mangrove removal, the three surveys undertaken at Sand Island were compared using a standardised survey period of High Water + 3 hours to Low Water + 2 hours inclusive (12 data sets per survey). Results are shown in Table 4 below.

<b>Table 4 MOLESWORTH DRIVE TO RIVERSIDE – AVERAGE NUMBER OF BIRDS OVER THREE SURVEYS: 2012 (PRE-CLEARANCE); 2016 &amp; 2018</b>			
	<b>2012</b>	<b>2016</b>	<b>2018</b>
n	12	12	12
mean no.	204.5	280.6	274.2
SE	32.7	41.6	43.8

- 4.16 The results show a significant increase in average bird numbers in 2016 and 2018 (chi-squared = 14.0;  $p < 0.001$ ) compared with the pre-mangrove clearance situation, with the consistency between 2016 and 2018 tending to verify that situation.
- 4.17 Habitat use data collected at the Sand Island mangrove removal area in 2016 and 2018 indicate that the overall averages show 81.75% of the records are of feeding birds and 18.25% of resting birds. Therefore, it is clear that removing the mangroves at Sand Island has increased the area of feeding habitat of coastal birds.

#### **Banded rail**

- 4.18 I have read Northland Regional Council's Section 32 Report on the Proposed Northland Regional Plan relating to mangroves (section 8.11).

- 4.19 I note that on page 353, Council has recorded that “...*Mangroves can however provide an important contribution to natural character and ecological values including habitat for threatened species such as banded rail*” (emphasis added).
- 4.20 The banded rail is not a threatened species, and I do not regard mangroves as vital habitat for the banded rail.
- 4.21 Banded rail is relatively common in Mangawhai Harbour and in various other Northland locations. It is also classified as an “at risk” (rather than “threatened”) species in the Declining A (1/1) category i.e. moderate to large population and low ongoing or predicted decline; 5000-20000 mature individuals, predicted decline 10-30%, with the qualifiers of “data poor” and “range restricted”.<sup>10</sup>
- 4.22 Banded rail is not an obligate mangrove-dweller. This is evidenced by their presence in Nelson-Marlborough, where mangroves are absent, and their known utilisation of “*mangrove forests, salt marshes and rush-covered (not raupo-covered) freshwater wetlands in Northland (including the Three Kings and Poor Knights Islands), around Auckland, Great Barrier Island, Coromandel Peninsula and Bay of Plenty.*”<sup>11</sup>
- 4.23 In Mangawhai Harbour, banded rail have been recorded throughout the Harbour in both mangrove and rush marsh habitats, above and below the causeways. The only location where banded rail was not recorded was the formerly pure-mangrove habitat of Sand Island (now cleared).
- 4.24 Mangrove-cleared areas where banded rail have been recorded post-clearance are at Lincoln Street, where breeding also occurred (pers. obs.), and Back Bay. Similarly, banded rail have also remained and have been observed feeding in mangrove-cleared areas in Pahurehure Inlet, with breeding also recorded (pers. obs.) (see **attached** Plates in Appendix 3).
- 4.25 In my view, because banded rail utilise a range of recorded habitats, they will continue to utilise mangrove-cleared habitats provided that habitat is adjacent to rushmarsh habitat or mangrove habitat remains contiguous. I note that banded rail persistence, through successful breeding, relies on the presence of rushmarsh or riparian scrub for nest location rather than mangrove vegetation that is utilised as part of their roosting and feeding range only.
- 4.26 The ecological effects of mangrove clearance on banded rail are (in my view) site-specific. For example:
- The clearance of mangroves at Sand Island is unlikely to have had any adverse effect whatsoever as there is no indication of banded rail use pre-mangrove clearance;
  - Lincoln Street and Back Bay clearance areas are in close proximity to either rushmarsh or remaining mangrove habitat, and the likely effects of mangrove clearance on banded rail in these areas are minimal; and
  - There are extensive mosaics of rushmarsh-mangrove habitat in the upper reaches of the Harbour and in Molesworth Drive in particular. The presence and proportions of those habitats should be considered in the assessment of effects on banded rail when considering future mangrove management.
- 4.27 Numerous photographs have also been taken by Mangawhai residents of banded rail at the Lincoln Street Reserve since mangroves were removed from that area. I **attach** various photographs (see Appendix 4) which shows and discusses the location of

<sup>10</sup> Robertson HA; Baird K; Dowding; Elliott, GP; Hitchmough RA; Miskelly, CM; McArthur, N; O'Donnell, CFJ; Sagar, PM; Scofield; RP; Taylor, GA. 2017 Conservation Status of New Zealand birds, (2016) Dept of Conservation 23pp.

<sup>11</sup> Heather, B and Robertson, H (2015) The Field Guide to Birds of New Zealand. 464pp. Penguin Book.

banded rail around the mangrove-free Reserve. The latest of these photographs were taken on 30 July 2018. As an example, I note that Photograph 4 shows a pair of banded rails with two juveniles.

- 4.28 It is also my view that predator control is an appropriate mitigation measure for banded rail management, and I include photographs of predation from Hobson Bay, Auckland (see **attached** Plates in Appendix 3).

### **Fairy Tern**

- 4.29 I understand that some submissions made on the Proposed Regional Plan have (incorrectly, in my view) claimed the demonstrated importance of mangroves for the fairy tern. I discuss the monitored presence and behaviour of fairy tern, including the species' relationship to mangroves, further below.
- 4.30 There are no records of NZ fairy tern feeding within mangrove habitats (e.g. the interior of Sand Island) and there is no evidence that there is any sort of obligate association between NZ fairy tern and mangroves.
- 4.31 Figure 1 (Appendix 1) shows the distribution of the Australian subspecies of fairy tern and the distribution of mangroves. No general association is apparent from this Figure either.
- 4.32 Causes of fairy tern breeding failure have in the past been attributed to egg predation, human damage, egg failure, nest abandonment and chick death. NZ fairy tern is considered to have a high proportion of infertile eggs (about 33%)<sup>12</sup> and inherent inbreeding depression (i.e. lack of genetic variation) may also be a significant factor for the population in the long term<sup>13</sup>.
- 4.33 NZ fairy terns feed on small fish that are caught from shallow waters by diving along the coast, in Mangawhai Harbour and the Spit lagoons. In Mangawhai, they have been recorded feeding along the low tide channel and beside the mangrove fringes from the Insley Street and Hotel area west around to Back Bay and then east to Moir Point. NZ fairy tern has also been recorded in open areas of the lower Harbour between Moir Point and the mouth, as well as in the Spit lagoon, where mangroves are not common.
- 4.34 In an analysis of birdlife in mangroves, Morrisey et al (2010) also concluded that “New Zealand does not appear to have any mangrove-dependent species<sup>14</sup>”

*“... As small fish are the main dietary component of fairy tern, it is appropriate to consider the relationship between fish and mangroves to determine whether removal of mangroves could adversely affect food abundance for fairy tern. There does not appear to be any evidence of mangrove-dependency for any New Zealand species of fish. “The general conclusion from these temperate mangrove studies is that, although mangrove habitats do provide habitat for fishes, many of the species involved are small bodied, of little or no commercial value, and often equally abundant in alternative habitats”.*

### **Fairy Tern Breeding Data from the Department of Conservation**

- 4.35 I have also reviewed and analysed the fairy tern breeding data from the 2006/07 season through to the 2017/18 season (inclusive) recently supplied by the Department of Conservation and provide my comments on these data below.
- 4.36 The data I was supplied regarding the numbers of fairy tern eggs laid and the numbers of fledged chicks are summarised in Table 5 below, with 8 datasets applying to pre-

<sup>12</sup> Hansen, K. New Zealand fairy tern (*Sterna nereis davisae*) recovery plan, 2005-15. 2006. Department of Conservation. 32pp.

<sup>13</sup> Ferreira, S.M; Hansen, K.M; Parrish, G.R; Pierce, R.J; Pulham, G.A. & Taylor, S. 2005. Conservation of the endangered New Zealand fairy tern. Biol. Cons. 125 : 345-354.

mangrove clearance areas (2006-2014 inclusive) and four to post-mangrove clearance areas (2014-2018 inclusive). The pre-clearance data has been split into two sets of four for statistical equality of sample sizes.

<b>TABLE 5 MANGAWHAI HARBOUR FAIRY TERN BREEDING DATA</b>		
<b>5A NUMBER OF EGGS LAID</b>		
PRE-CLEARANCE	n	total no. eggs
2006-2010	4	37
2010-2014	4	39
<b>POST CLEARANCE</b>		
2014-2018	4	37
<b>5B NUMBER OF CHICKS FLEDGED</b>		
PRE-CLEARANCE	n	total no. chicks
2006-2010	4	16
2010-2014	4	12
<b>POST CLEARANCE</b>		
2014-2018	4	13

4.37 The chi-squared tests I ran on this data indicate that there has been no significant difference between the total numbers of eggs laid or chicks fledged when pre- and post-mangrove clearance data are compared (chi-squared = 0.64 and 0.06 respectively).

4.38 Based on the Department of Conservation's data, there has been no change in the productivity of fairy tern since mangrove clearance. This would suggest that changes in habitat (including removal of mangroves) have not been detrimental to fairy tern breeding success.

#### **Importance of the Mangawhai Spit for Fairy Tern**

4.39 Since 2005, a total of 77 chicks have fledged at Mangawhai, Pakiri Papakanui and Waipu combined. The Mangawhai Spit fairy tern breeding habitat has produced 44 (57.1%) of those chicks, illustrating the importance of that area.

4.40 The fairy tern data supplied by the Department of Conservation for that area do not indicate any significant post-mangrove clearance decrease in productivity.

4.41 Aside from the Spit providing suitable habitat for fairy tern, the breeding success is likely to reflect predator control and continuous management during the breeding season.

#### **Coastal Bird Surveys at Pahurehure Inlet**

4.42 The mangrove removal undertaken in Pahurehure Inlet No. 2 (alongside the Southern Motorway in Auckland) was extensive. It involved clearance of its central area and three of four major arms (compared to the smaller mangrove removal exercise undertaken from Molesworth Drive to Riverside in the Mangawhai Harbour). The entire mangrove-removal area at Pahurehure Inlet was upstream from a motorway causeway.

- 4.43 The mangrove clearance at Pahurehure Inlet No. 2 resulted in a significant increase in the Inlet's use by coastal birds especially during summer when Harbour diversity and numbers are highest.
- 4.44 In that location, additional wading bird species recorded post-mangrove clearance were the eastern bar-tailed godwit, little egret and royal spoonbill<sup>15</sup>.
- 4.45 The summarised data from summer and winter surveys undertaken following that mangrove removal exercise are shown in the **attached** Figures 3 and 4 in Appendix 2 (total of 72 counts). The post-mangrove clearance increase in the average number of coastal birds in summer was 3.4 times (c.341%) the number recorded pre-mangrove clearance; and the increase in winter was 1.6 times (c.159%).

### Conclusion

- 4.46 The monitoring of post-mangrove removal areas to date indicates that the effect of mangrove removal is beneficial to coastal bird feeding and resting.
- 4.47 The data collected has also indicated aspects that require consideration. Firstly, banded rail will not be displaced if there is established rush marsh adjacent to the removal area. Secondly, the difference between wading bird use of the Sand Island and Insley Street habitats suggests the relative benefit of mangrove removal to coastal birds is site specific, and based on the current database, cannot be validly generalised. Thirdly, I consider the benefit of mangrove clearance to coastal birds at both Sand Island and Pahurehure Inlet to be unequivocal.

## 5. BIRD BREEDING, ROOSTING AND NESTING PERIODS

### Rule C.1.4.1

- 5.1 In Rule C.1.4.1, the Proposed Regional Plan records the breeding, roosting and nesting periods for birds as *"1 August [to] 31 March (inclusive)"*.
- 5.2 In my view, the Proposed Regional Plan overstates the bird breeding, roosting and nesting season. The main bird breeding season is 1 September to 28 February, and for the most part occurs from 1 September to 31 December but is variable.
- 5.3 In an Environment Court decision involving the MHRS (Decision Number NZEnvC 245), the Court established (based on expert evidence from several parties, including the NRC) that removal of mangroves could begin as early as February if qualified experts determined the fairy tern had fledged:
- *"[27] The evidence of the experts, and indeed the clear and straightforward agreement amongst avifaunal experts, was that the season during which Fairy Terns were nesting and fledging (during which mangrove clearance and control work is to be banned) should be 1 September to 28 February (unless there was an expert indication that fledging had been completed prior to the latter date). The respondent, supported by other s274 parties, is now proposing that the off-limits period be extended to 31 March."*
  - *"[28] **We can see no need to extend the period of prohibition beyond that expressly agreed by the experts.** The opposing parties appear to raise other issues such as disturbance to wading birds, but the Court has already analysed that threat and made its findings, and it is not appropriate to re-litigate it."*  
**(emphasis added)**
- 5.4 The Plan should provide for a bird breeding period (at least for Mangawhai) that is consistent with the Environment Court's decision i.e. 1 September to 28 February, especially if one of the key concerns is the fairy tern.

<sup>15</sup> Bioresearches (2015) 2015 Coastal Bird Survey of Pahurehure Inlet No. 2, Papakura. 108 pp. For Auckland Council.

5.5 In my view, the bird breeding period established by the Environment Court (1 September to 28 February) would also be protective of other bird species, such as New Zealand dotterel and variable oystercatcher.

#### **Rule C.8.4.1**

5.6 I have also been asked to comment on Rule C.8.4.1 of the Proposed Regional Plan. I understand this Rule relates to permitted vegetation clearance and coastal dune restoration, and states that such activities are permitted, provided (amongst other matters) that *“there is no disturbance of indigenous or migratory bird nesting sites”* (Condition 4).

5.7 I understand that:

- The MHRS requested this condition be amended to read: “there is no disturbance of indigenous or migratory bird nesting sites between 1 September and 28 February (inclusive) to avoid disturbance of birds during breeding, roosting and nesting periods” (proposed addition underlined), their reasoning being that disturbance of indigenous or migratory bird nesting sites should only be prohibited during bird breeding, roosting and nesting periods; and
- The Council Officer has not adopted the MHRS’ requested amendment in his s42A report, his reason being – *“I do not support the requested relief to amend condition 4, as it infers that people could disturb bird nesting sites outside of 01 September to 28 February. The existing wording is a standard condition, used in many permitted rules within the Proposed Plan and I am not convinced that it should be amended.”*

5.8 In my view, I cannot see any harm in adopting the amendments to Rule C.8.4.1 requested by the MHRS. I do not envisage any adverse effects to potential bird nesting sites if those sites are “disturbed” outside of the 1 September to 28 February bird breeding season discussed above.

## **6. LOCATIONS OF BIRDLIFE AROUND MANGAWHAI HARBOUR**

6.1 I note that the Proposed Regional Plan’s Maps have classified the entire Mangawhai Estuary as a Significant Bird Area and a Significant Seabird Area.

6.2 I have read Council’s reasoning for these classifications, set out in its:

- Significant Bird Area Assessment Sheet; and
- Significant Ecological Marine Area (Marine Mammal and Seabird) Assessment Sheet.

6.3 I do not consider these classifications to be correct. The registration of the entire Mangawhai Harbour as a Significant Bird and Seabird Area is not justified based on the existing database.

### **Significant Seabird Area**

6.4 In terms of Council’s “Significant Seabird Area” designation for Mangawhai, I note that:

- Council’s Ecological Marine Area Assessment Sheet notes that the site’s value is triggered by five species of “seabirds” – fairy tern, black-billed gull, NZ dotterel, wrybill and Australasian bittern.
- However, black-billed gull has only nested at Te Arai , while wrybill is not an important component of the Mangawhai Harbour’s avifauna, nor is it noted in the “guiding reference”<sup>16</sup> used in Council’s Assessment Sheet. Neither species is

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<sup>16</sup> Forest and Bird (2016) Important areas for New Zealand Seabirds – Sites on land-rivers, estuaries, coastal lagoons and harbours. NZ010 Mangawhai

particularly relevant in triggering the “value” of this site.

- While I accept the importance placed on the New Zealand dotterel and fairy tern, the “Significant Seabird” designation should be removed from above (i.e. landward of) both causeways in Mangawhai, where neither the New Zealand dotterel nor the fairy tern have been recorded on a regular basis. The “Significant Seabird” designation should also be removed from remaining areas of mangrove below the causeways on the basis that no obligate association has been demonstrated.
- Furthermore, while data available on fairy tern and New Zealand dotterel are robust, I am not aware of similar data for Australasian bittern. The reference for Australasian bittern used in Council’s Assessment Sheet is a large scale presence/absence summary in which the most recent data are from 2004. Particularly, the quality and quantity of information from above both causeways in Mangawhai (relied on by Council in designating these areas as “Significant Seabird Areas”) is poor. The Australasian bittern’s typical habitat is *“tall, dense beds of raupo and reeds in freshwater wetlands, wet habitats with a mixture of water purslane and willow weed, and damp pasture infested with large clumps of rush or introduced tall fescue”*<sup>17</sup>, and it is not a typical harbour-wide “coastal” species.

6.5 Clearly, Council’s Assessment Sheet regarding Seabirds (at least for Mangawhai) is not an assessment restricted to “seabirds” and in my view, the database is not of sufficient quality to enable a “Significant Seabird” designation to be placed on the entire Mangawhai Estuary.

6.6 In my view a blanket “Significant Seabird” designation for Mangawhai has not been justified based on the existing database, and the incorrect designations of various areas in Mangawhai as a “Significant Seabird Area” (for example, in the Upper Harbour areas landward of the two main causeways) should be removed.

#### **Council Officer’s Section 42A Report**

6.7 It has been brought to my attention that Council Officer’s S42A report has recommended that the “Significant Seabird Area” designation for the entire Mangawhai Estuary remain unchanged, because *“...For several avian species, these channels and mangrove edges are also important feeding areas, notably the tern species for example.”*

6.8 This statement (along with other statements made in Council’s “Significant Bird Area” Assessment Sheet – discussed below) appears to rely on a paper published by Dr Ismar and her colleagues in 2014<sup>18</sup>.

6.9 I note that this paper contains virtually the same information and material presented by Dr Ismar in a previous 2012 Environment Court Hearing involving the MHRS. The Environment Court, in its 2012 decision (NZEnv232) found that Dr Ismar’s 2010/11 research *“did not establish that there was a causal relationship between mangroves and fairy tern foraging habitats”* and that *“We find that the presence of mangroves is not essential to the physical habitat requirements and successful foraging of the fairy tern”*.

6.10 There are various issues arising from Dr Ismar’s paper, including:

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<sup>17</sup> Heather, B and Robertson, H (2015) The Field Guide to Birds of New Zealand. 464pp. Penguin Book.

<sup>18</sup> Ismar, SMH; Trnski, T; Beauchamp, T; Bury SJ; Wilson, D; Kannemeyer, R; Bellingham M & Baird K (2014) Foraging ecology and choice of feeding habitat in the New Zealand Fairy Tern *Sterna nereis davisiae*. *Birdlife Conservation International* 24: 72-87.

- The surveys undertaken by Dr Ismar attempt to draw a cause-and-effect link between mangrove presence and fairy tern survival. In my view, that cannot be achieved based on the study design and I question whether this was even an aim at the outset. In the 2012 Environment Court hearing, Dr Ismar conceded during cross-examination that her 2010/11 research on Fairy Tern at Mangawhai “*was an observational study and as such it did not establish that there was a causal relationship between mangroves and fairy tern foraging habitats*” (para [64], NZEnv232)
- The paper does not present any data to show that fairy tern were foraging over the mangrove canopy or within the pneumatophore zone. It is clear that the assessment of foraging habitat use spanned “two hours either side of low tide” and prey (fish) sampling occurred “within three hours of low tide” (i.e. half tide falling to half tide rising). Therefore, both the fairy tern foraging and fish sampling survey locations were beyond the mangrove habitat. In addition, fish were sampled with a dragged seine net which would not have been an appropriate sampling device within a pneumatophore zone.
- The paper also presents a distribution figure of foraging dives which clearly shows that feeding was biased towards the northern part of the Harbour (i.e. north of Moir Point) where mangroves were (then) either relatively sparse or absent entirely. That is further illustrated by a kernel density distribution of foraging by fairy tern generated by the objective ArcGIS 10 Spatial Analyst Tool set to display 90% of spatial use. The key foraging area was the Harbour from Riverside North to the Harbour entrance (including the Spit lagoon) and biased towards the eastern side. Aside from a small area at Lincoln Street, there were no mangroves in the key foraging area. A subsidiary area was the channel from Moir Point to off Moir Street where the nearest mangroves were on Sand Island and on the Riverside shoreline.
- Table 1 of Dr Ismar’s paper also records the number of foraging dives and reflects the kernel density distribution with 34.1% of the dives occurring between Riverside and Sand Island and 65.9% north of the end of the Riverside mangrove fringe. The least utilised area is further defined as “*at least one shoreline vegetated by mangroves*”. In my view, that statement should have been balanced by defining the most utilised foraging area as being virtually devoid of mangroves. The lack of general association of Australian fairy tern with mangroves is shown in Figure 1.

6.11 In my view, the Ismar et al 2014 paper (and the investigations it discusses) should not be considered to demonstrate a cause-and-effect link between mangrove presence and fairy tern foraging and breeding success. In an analysis of birdlife in mangroves, Morrissey et al 2010 concluded “*that New Zealand does not appear to have any mangrove-dependant species*”<sup>19</sup>.

6.12 Additionally, there does not appear to be any evidence of mangrove-dependency for any New Zealand species of fish<sup>20</sup>.

6.13 A comparative study between mangrove habitat (*Avicennia marina* as it is in New Zealand) and mudflat habitat in South Australia showed that yellow-eyed mullet was strongly associated with mangroves. While the assemblage structure of fish in mangroves differed from assemblages 500m away, neither total abundance nor species richness differed significantly between mangrove mudflats. The conclusion

<sup>19</sup> Morrissey, DJ; Swales, A; Dittmann, S; Morrison, M; Lovelock, CE & Beard, CM (2010) The ecology & management of temperate mangroves. *Oceano & Mar. Biol: An Annual Review* 48: 43-160. (Note: based on 556 references).

<sup>20</sup> Morrissey, D; Beard, C; Morrison, M; Craggs, R & Lowe, M (2007) The New Zealand mangrove: review of the current state of knowledge. Auckland Regional Council Tech. Publ. No. 325; 156 pp (NIWA Report: HAM2007-052).

was that “mangrove habitats in temperate Australia support no greater abundance or diversity of fish than adjacent mudflat habitats and that mangrove proximity does not influence fish distribution at a habitat scale”<sup>21</sup>.

6.14 The general conclusion from these temperate mangrove studies is that, although mangrove habitats do provide habitat for fishes, many of the species involved are small bodied, of little or no commercial value, and often equally abundant in alternative habitats<sup>22</sup>.

6.15 Given the number of issues with Dr Ismar’s 2014 paper, it should not be used by Council to inform its mapping of “Significant Seabird (or Bird) Areas” in Mangawhai.

### **Significant Bird Area**

6.16 Council’s reasoning for classifying the entire Mangawhai Estuary as a “Significant Bird Area is detailed in Council’s “Significant Bird Area” Assessment Sheet as follows:

*“Mangawhai Estuary is a small estuary, but it contains a wide variety and representative succession of habitats spanning dunes, tidal flats, channels, mangroves, saltmarsh and freshwater wetlands and adjacent shrubland. It is the single most important breeding ground for the Nationally Critical NZ fairy tern which breeds on the sandspit, and individuals forage in the estuary or just offshore for much of the year. The estuary is also important for breeding of a number of other threatened or at risk birds, notably northern NZ dotterel, Caspian tern, pied shag, reef heron, white-fronted tern and variable oystercatcher, with several migrant species visiting at different times of the year. The saltmarshes and mangroves support Australasian bittern, banded rails, fernbirds and others. The estuary has nationally important significance on the basis of being the primary breeding ground for a NZ-endemic and critical taxon, the NZ fairy tern. In a recent study, researchers have documented the use of the various habitats within the estuary by the birds and notably identified habitats that are believed to be critical foraging areas during the breeding season. These habitats are essentially all the shallow channel edges, the open coast shallow habitats and significantly the shallow ‘edge’ of mangrove forest areas.”*

6.17 There are various incorrect and unsubstantiated statements made in Council’s assessment used to justify a Harbour-wide “Significant Bird” classification at Mangawhai. I highlight a few key errors below:

6.18 Council has (incorrectly) asserted that:

- *“The estuary has nationally important significance on the basis of being the primary breeding ground for a NZ-endemic and critical taxon, the NZ fairy tern”.*

As discussed in my evidence above, it is only the Mangawhai Spit that is the primary breeding ground for fairy tern, not the entire Estuary.

- *“The saltmarshes and mangroves support Australasian bittern, banded rails, fernbirds and others.”*

This statement appears to incorrectly conflate the benefits of saltmarshes to avifauna with mangroves (a very different habitat). Additionally (as discussed above), the existing data do not support Australasian bittern being reliant on mangroves.

- *“In a recent study, researchers have documented the use of the various habitats within the estuary by the birds and notably identified habitats that are believed to*

<sup>21</sup> Payne, NL & Gillanders, BM (2009) Assemblages of fish along a mangrove-mudflat gradient in temperate Australia. Mar & FW Res. 60: 1-13.

<sup>22</sup> Morrisey, DJ; Swales, A; Dittmann, S; Morrison, M; Lovelock, CE & Beard, CM (2010) The ecology & management of temperate mangroves. Oceano & Mar. Biol: An Annual Review 48: 43-160. (Note: based on 556 references).

*be critical foraging areas during the breeding season. These habitats are essentially all the shallow channel edges, the open coast shallow habitats and significantly the shallow 'edge' of mangrove forest areas."*

This statement references the 2014 paper published by Dr Ismar and her colleagues<sup>23</sup>, the issues with which I have already discussed above.

- *"The estuary is an internationally important site recognised by the Important Bird Area programme triggered by the following species: NZ Fairy Tern; Black-billed Gull; NZ Dotterel; Wrybill and Australasian Bittern."*

I have discussed the various errors with this statement under the "Significant Seabird Area" heading above.

- With respect to breeding by "*a number of other threatened or at risk birds*" – this statement is not supported by any referenced information and in my view has not been demonstrated. Further, NZ dotterel, caspian tern, white-fronted tern and variable oystercatcher would mainly utilise the spit for any nesting, not the entire Estuary. Pied shag and reef heron would nest at a few discrete locations around the Estuary edge.

6.19 Based on the data and evidence currently available regarding the exact locations used by birdlife in the Mangawhai Harbour, I consider that the "Significant Bird Area" designation should be removed from the Upper Harbour areas in Mangawhai landward of the two main causeways (apart from areas of rush marsh and salt marsh), and remaining areas of mangrove below (seaward of) the causeways again because no obligate relationship has been demonstrated.

6.20 In my view the justification for this classification over the entire Estuary has not been demonstrated.

## **7. MISCONCEPTIONS ABOUT MANGROVES AND AVIFAUNA**

7.1 As an aside, I have also noted that a common assumption in mangrove management assessments (usually expressed by mangrove-advocates) is that there are already vast existing feeding areas for coastal birds, so there will be no benefit from adding more (by removing mangroves).

7.2 This assumption ignores any consideration of carrying capacity, which (in my view) should not be ignored. For example, various scientific studies have noted that:

- *"A particularly unfortunate tendency is for some authors to imply that habitat loss will only affect population size if the carrying capacity of the area has already been reached. It is this dangerous misunderstanding in particular which makes it timely once again to discuss the definition of the concept, how capacity might be measured and the implication of its use for managing wetland birds."*, and
- *"...habitat loss can reduce local birds' numbers even before the capacity of the area has been reached"*<sup>24</sup>.

7.3 In my view consideration of carrying capacity should not be ignored.<sup>25, 26, 27, 28</sup>

<sup>23</sup> Ismar, SMH; Trnski, T; Beauchamp, T; Bury SJ; Wilson, D; Kannemeyer, R; Bellingham M & Baird K (2014) Foraging ecology and choice of feeding habitat in the New Zealand Fairy Tern *Sternula nereis davisae*. *Birdlife Conservation International* 24: 72-87.

<sup>24</sup> Goss-Custard, JD & West, AD (1997) The Concept of Carrying Capacity and Shorebirds. In: Goss-Custard, J.D.; Ruffino, R.; Luis, A. (eds) *Effect of habitat loss and change on waterbirds*. 144pp. The Stationary Office, London.

<sup>25</sup> Goss-Custard, JD; Stillman, RA; West AD; Caldow, RDG; McGorty, S (2002) Carrying capacity in overwintering migratory birds. *Biol. Cons.* 105(1): 27-41.

<sup>26</sup> Zhenning, GE; Zhou, X; Shi, W; Wang, T (2008) Carrying capacity for shorebirds using migratory seasons at the Jiuduansha Wetland, Yangtze River Estuary, China. *Front. Biol. China* 3(4): 536-542.

Date: 10 August 2018



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Graham L Don

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<sup>27</sup> GE, Z-M; Zhou, X; Wang T-H; Wang K-Y; Pei, E; Yuan, X (2009) Effects of Vegetative Cover Changes on the Carrying Capacity of Migratory Shorebirds in a Newly Farmed Wetland, Yangtze River Estuary, China. 2001. *Studies* 48(6): 769-779.

<sup>28</sup> Fanseca, J; Basso, E; Serrano, D; Navedo, JG (2017) Effects of tidal cycles on shorebird distribution and foraging behaviour in a coastal tropical wetland; Insights for carrying capacity assessment. *Estuarine, Coastal & Shelf Science* 198(A): 279-287.

## APPENDIX 1

### GRAHAM DON (MSc. HONS)

#### RECENT FIELD EXPERIENCE WITH COASTAL BIRD SURVEYS

1. **Marsden Bay, Marsden Point, Northland (canal housing and marina development) (Marsden Cove Ltd)**
  - 40 ha of intertidal habitat divided into 3 main sectors;
  - 2000: May/June 20 counts and habitat use;
  - 2003: Feb/Mar 36 counts and habitat use;
  - 2005: Feb/Mar 36 counts and habitat use; habitat disturbance survey;
  - 2007: Feb/Mar 36 counts and habitat use;
  - 2008: Feb/Mar 36 counts and habitat use;
  - 2009: Feb/Mar/Apr 36 counts and habitat use;
  - 2011: 13 Feb/Mar 18 counts and habitat use;
  - 2015: Feb/Mar 18 counts and habitat use.
  
2. **Hobson Bay, Waitemata Harbour (coastal walkway) (Auckland City)**
  - 21 ha of mangrove/intertidal habitat;
  - 5 surveys; 36 counts and habitat use;
  - 2003: February/March.
  
3. **Wairoa River, Clevedon (waterway housing) (Wairoa River Canal Partnership)**
  - 5.5 km of estuarine channel plus river mouth and approaches surveyed via kayak; 11 surveys of 11 sectors; total of 60.5 survey kilometres plus habitat use; plus banded rail surveys;
  - 2003: November to March.
  
4. **Tamaki River (stormwater discharge option) (Landco Ltd)**
  - 2004: February/March 600 m coastline; 40 hourly counts plus habitat use in 3 sectors;
  - 2009: Feb/Mar 36 counts and habitat use over an 800 m section of coastline.
  
5. **Panmure Basin (stormwater discharge option) (Landco Ltd)**
  - 2005: February/March;
  - 4 surveys x 10 hourly counts each and habitat use of entire Basin.
  
6. **Half Moon Bay (marine terminal) (New Zealand Transport Authority)**
  - 2005: March;
  - 450 m section of Tamaki River coastline;
  - 4 surveys; 40 counts and habitat use;
  - locally significant variable oystercatcher feeding area.
  
7. **Waipu: Ocean Beach (wastewater treatment site) (Whangarei District Council)**
  - 2007: February – March;
  - 1 km coastline;
  - 4 surveys; 24 counts and habitat use;
  - variable oystercatcher frequent.

8. **Waipu: Ocean Beach and River Mouth (wastewater treatment site) (Whangarei District Council)**
  - 2007: May – June;
  - 1 km coastline and 900 m river mouth;
  - 3 surveys; 18 counts and habitat use;
  - locally significant habitat for NZ dotterel and variable oystercatcher.
  
9. **Pikes Point, Manukau Harbour (proposed heliport) (Ports of Auckland Ltd)**
  - 2007: April – May;
  - 14 ha; 4 sectors;
  - 4 surveys; 36 counts and habitat use;
  - significant wrybill feeding area.
  
10. **Auckland International Airport Ltd (Auckland Airport)**
  - 2007-09 bird hazard assessment and management investigations;
  - all coastal bird groups plus waterfowl (ducks, black swan);
  - 2016-17 bird hazard assessment – second runway;
  - 2017-18 flight paths; habitat use; roosting habitat quality.
  
11. **Whangamata Harbour (Whangamata Marina Society)**
  - 2007-08 marina pre-construction surveys (numbers, diversity and habitat use);
  - Sept, Dec, Feb, Apr;
  - 109 counts in each of ten lower Harbour sectors;
  - 2008-11 marina construction and post-construction surveys (numbers, diversity and habitat use);
  - Oct, Nov-Dec, Feb, Jun-Jul;
  - 144 counts in each of ten lower Harbour sectors.
  
12. **Pahurehure Inlet, Manukau Harbour (pre and post mangrove removal) (Papakura District and Auckland Council)**
  - 2008: Jan, Feb, Mar, Jul; 2015; summer and winter;
  - 72 counts and habitat use of entire Inlet.
  
13. **Hobsonville (marine terminal) (Hobsonville Land Co.)**
  - July 2009 and February 2010;
  - total of 32 counts and habitat use; 2.2 km of coastline;
  - banded rail survey.
  
14. **Hatea (Harbour Bridge) Whangarei Harbour (Whangarei District Council)**
  - November and December 2009;
  - 13 hourly counts and habitat use at proposed harbour bridge crossing.
  
15. **Mangere Inlet (launching ramp) (Manukau City Council)**
  - Kiwi Esplanade; 9 counts and habitat use; 1.5 km of coastline; January 2010.
  
16. **Panmure Basin (pylon removal) (Transpower Ltd)**
  - January 2010;
  - 8 counts and habitat use of western area.

17. **Hobson Bay Coastal Walkway (Auckland Council)**
  - general coastal bird habitat appraisal – June 2012;
  - banded rail survey – November 2012.
18. **Motions Creek, Weona Coastal Walkway (Auckland Council)**
  - February/March 2013;
  - 28 hourly counts and habitat use; 5 days;
  - banded rail survey management.
19. **Maraetai Beach – Waiheke Island Cable (Chorus Ltd)**
  - February 2013;
  - 8 counts and habitat use.
20. **Tamaki River, Highbrook Aquatic Centre (Projenz Ltd)**
  - April 2013;
  - 7 counts and habitat use.
21. **Waterview Connection/SH 16 (Causeway Alliance)**
  - April 2013 - April 2014;
  - monthly monitoring of high tide wader roost.
22. **Monterey Park (Summerset Retirement Village)**
  - February-March 2014 to 2018; ongoing monitoring;
  - 18 hourly counts and habitat use survey annually;
  - banded rail survey;
  - Herald Island staging area surveys.
23. **Bomb Point, Hobsonville (recreation reserve)**
  - February – March 2015;
  - 1500 m coastline plus banded rail
  - 16 hourly counts and habitat use survey
24. **Marsden Point (Refining NZ: capital dredging)**
  - February – March 2015
  - 5 coastal sectors
  - 54 hourly counts and habitat use survey
  - February – March 2016
  - 8 coastal sectors
  - 70 hourly counts and habitat use survey
25. **Marsden Point (Refining NZ: capital dredging)**
  - November 2015
  - Outer Whangarei Harbour breeding survey
  - Mair Road to Northport
  - Darch Point to Home Point
26. **Marsden Point (Refining NZ: capital dredging)**
  - November – December 2016
  - little penguin surveys

- 27. Orion Point, Hobsonville**
- February – March 2017
  - hourly counts and habitat use
  - 450m coastline
- 28. Mangawhai Harbour Restoration Society (pre and post mangrove removal)**
- February-March 2012; February – July 2016; February-March 2017-2018
  - hourly counts and habitat use surveys;
  - banded rail surveys.
- 29. Wairoa River, Clevedon (subdivision)**
- February, April 2017
  - re-survey part of 2003 investigation
  - 16 counts + habitat use
- 30. Okura – Karepiro Bay**
- March 2017
  - 18 hourly counts and habitat use
  - high tide roost surveys

## APPENDIX 2

### FIGURES

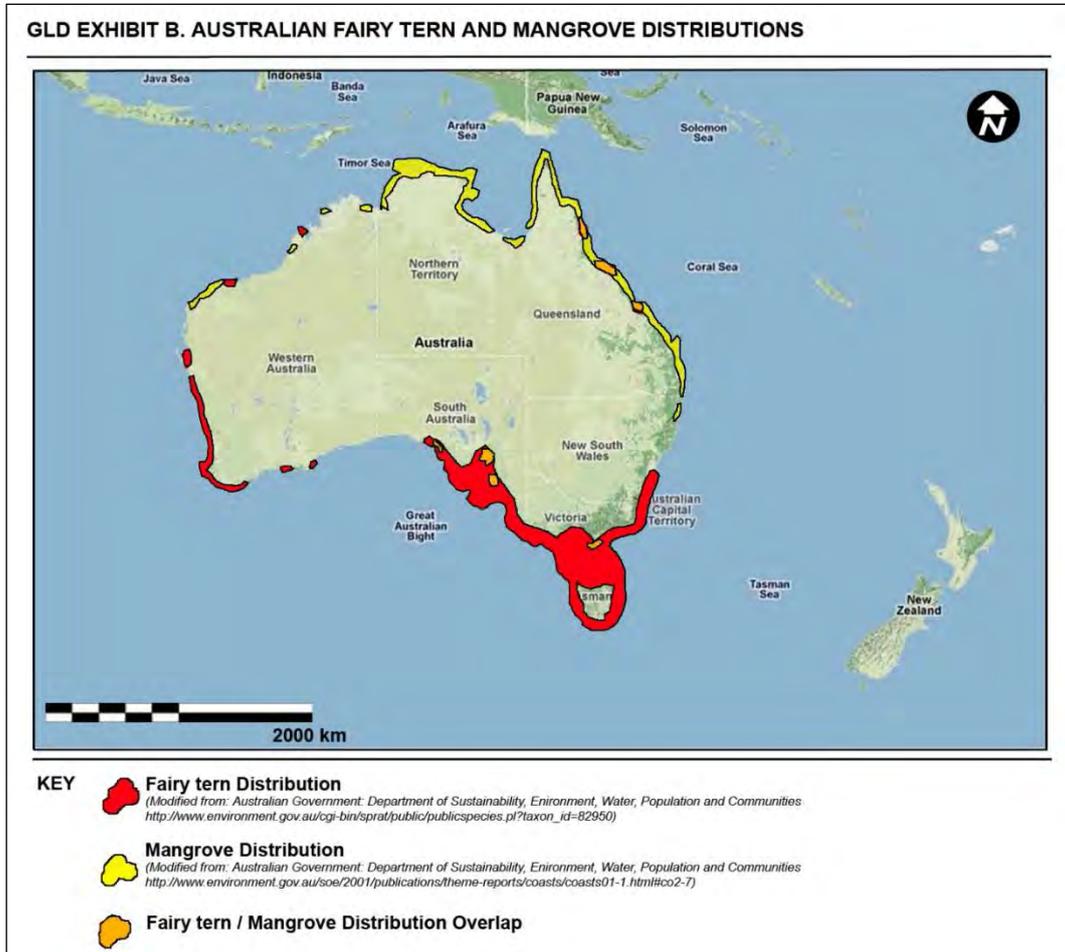


Figure 1. Fairy tern and mangroves.



Figure 2. Mangawhai survey area.

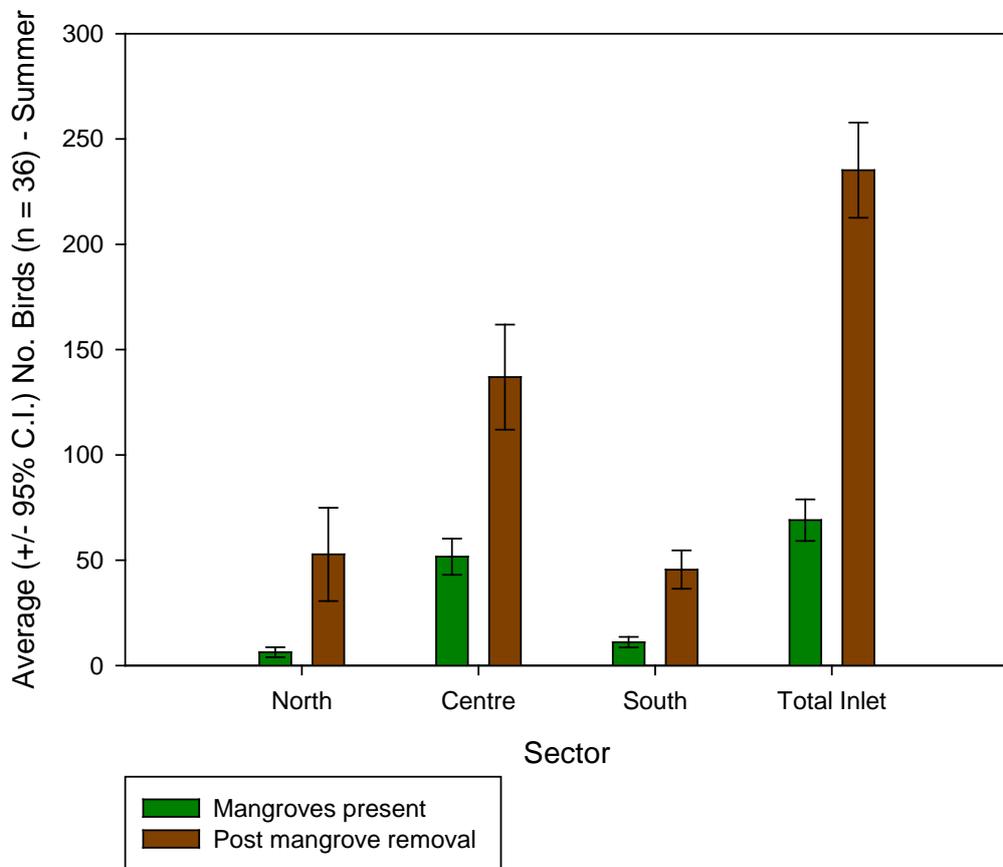


Figure 3. Pahurehure Inlet average hourly bird counts for each sector- summer survey comparison.

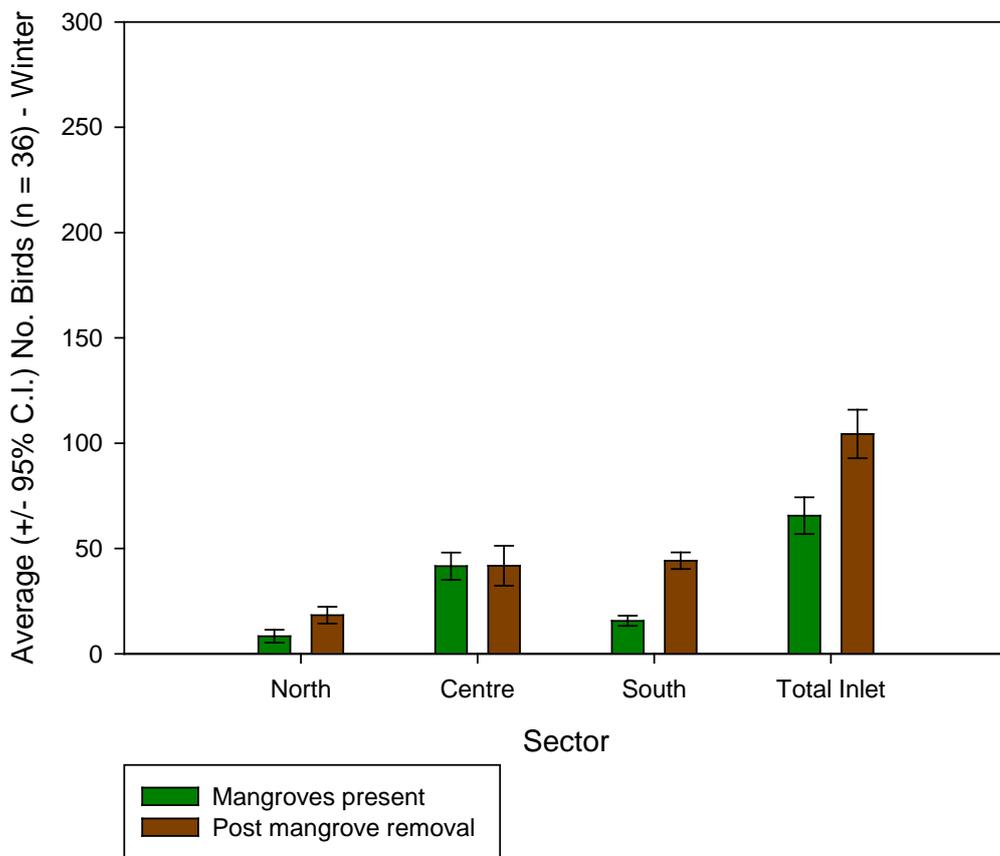


Figure 4. Pahurehure Inlet average hourly bird counts for each sector - winter survey comparison.

## APPENDIX 3

### PLATES



*Plate 1. Shore Road rush-salt marsh from the eastern side showing the banded rail nest (with eggs) location; Shore Road to the left (Bioresearches, 2013).*



Plate 2. Rush-salt marsh edge viewed towards Shore Road (Bioresearches, 2013).



Plate 3. Banded rail nest (with eggs) location and predated (probably) banded rail (Bioresearches, 2013).



Plate 4. *Banded rail nest with eggs (Bioresearches, 2013).*

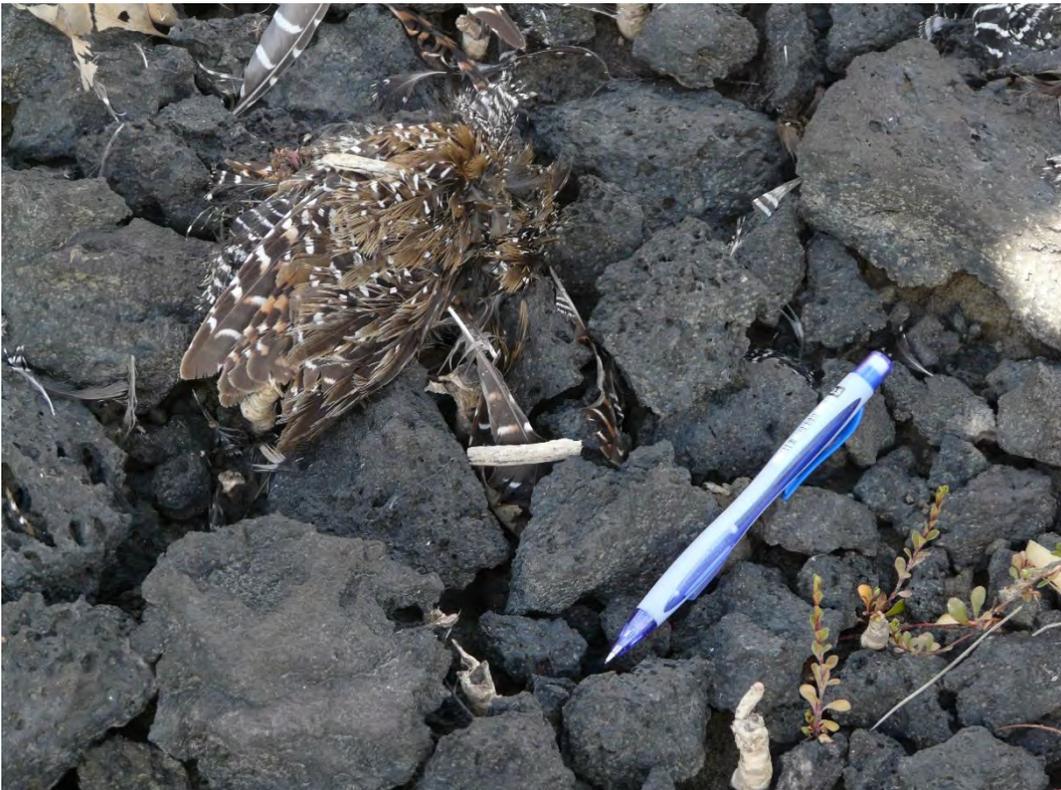


Plate 5. *Predated (probably) banded rail (Bioresearches, 2013).*



*Plate 6. A second (abandoned?) nest elsewhere in the rush marsh (Bioresearches, 2013)<sup>29</sup>.*

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<sup>29</sup> Bioresearches (2013) Proposed Orakei Boardwalk: Ecological Aspects. 23 pp. For Auckland Council.



*Plate 7. Banded rail adult and chicks at Pahurehure Inlet (Don, 2012).*



*Plate 8. Banded rail chick at Pahurehure Inlet (Don, 2012).*



*Plate 9. Banded rail adult and chicks at Pahurehure Inlet (Don, 2012).*



*Plate 10. Banded rail adult and chicks at Pahurehure Inlet (Don, 2012).*



Plate 11. Pahurehure Inlet (Don, 2012)<sup>30</sup>.

<sup>30</sup> Don, G. (2012) Brief of rebuttal evidence of Graham Lloyd Don. In the Environment Court at Auckland (ENV 2011-AKL-000110) in the matter of an appeal under section 120 of the Resource Management Act between Mangawhai Harbour Restoration Society Incorporated and Northland Regional Council.



*Plate 12. Banded rail feeding – South Sector of Pahurehure Inlet (Biosearches, 2015).*



Plate 13. Banded rail pair – South Sector of Pahurehure Inlet (Bioresearches, 2015)<sup>31</sup>.

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<sup>31</sup> Bioresearches (2015). 2015 Coastal Bird Survey of Pahurehure Inlet No. 2. 109 pp. For Auckland Council.

## APPENDIX 4

### PHOTOGRAPHS OF BANDED RAIL AT THE LINCOLN STREET RESERVE (MANGAWHAI)



*Photograph 1 - Banded Rail; Lincoln Street; 8 January 2017; 9.36am (Pers. comm. Ray & Alison Welson).*



*Photograph 2 - Banded Rails on the beach at Lincoln Street Reserve heading for the sale marsh; 28 January 2017; 1.21pm (Pers. comm. Ray & Alison Welson).*



*Photograph 3 - Banded Rail; Lincoln Street Reserve; 12 May 2017; 11.20am (Pers. comm. Peter Lynch).*

**NB: Map reference showing location of this Banded Rail's location is attached below.**



Google Maps view of Mangawhai / Lincoln Street Reserve, showing location of banded rail (re Photograph 3)



Photograph 4 – Banded rail pair and juveniles; Lincoln Street Reserve; 16 February 2018; around 11.30am (Pers. comm. Peter Lynch).

**NB: Map reference showing location of these banded rails is attached below.**



*Google Maps view of Mangawhai / Lincoln Street Reserve, showing location of banded rail (re Photograph 4)*



*Photograph 5 – Banded rail pair and juveniles; Lincoln Street Reserve; 16 February 2018; around 11.30am (Pers. comm. Peter Lynch).*



*Photograph 6 – Banded rail pair and juveniles; Lincoln Street Reserve; 16 February 2018; around 11.30am (Pers. comm. Peter Lynch).*



*Photograph 7 - Banded Rail; Lincoln Street Reserve; 8 June 2018; 12.30pm (Pers. comm. Peter Lynch).*

**NB: Map reference showing location of this banded rail is attached below.**



Google Maps view of Mangawhai / Lincoln Street Reserve, showing location of banded rail (re Photograph 7)



Photograph 8- Banded Rail; Lincoln Street Reserve; 9 June 2018; 1.40pm (Pers. comm. Peter Lynch).

**NB: Taken at same location as Photograph 7**



*Photograph 9 - Banded Rail; Lincoln Street Reserve; 6 February 2018; between 5pm and 6pm (Pers. comm. Peter Lynch).*



*Photograph 10 – Group of Banded Rail; Lincoln Street Reserve; 6 February 2018; between 5pm and 6pm (Pers. comm. Peter Lynch).*



*Photograph 11 – Group of Banded Rail; Lincoln Street Reserve; 6 February 2018; between 5pm and 6pm (Pers. comm. Peter Lynch).*



*Google Maps view of Mangawhai / Lincoln Street Reserve – Green dots show tracked location of group of banded rail recorded in Photographs 9, 10 and 11 above. Yellow dots show usual area in which banded rail is spotted.*



*Photograph 12 – Banded Rail; Lincoln Street Reserve; 20 January 2018 (Pers. comm. Peter Lynch).*



*Photograph 13 – Banded Rail; Lincoln Street Reserve; 20 January 2018 (Pers. comm. Peter Lynch).*



*Photograph 14 – Banded Rail; Lincoln Street Reserve; 20 January 2018 (Pers. comm. Peter Lynch).*



*Photograph 15 – Banded Rail; Lincoln Street Mangrove-Removal Site; 30 July 2018; 10-11am (Pers. comm. Peter Lynch).*



*Photograph 16 – Banded Rail; Lincoln Street Mangrove-Removal Site; 30 July 2018; 10-11am (Pers. comm. Peter Lynch).*



*Google Maps view of Lincoln Street Mangrove-Removal Site (Mangawhai), showing location of banded rail in Photographs 15 and 16*