

Indirect effects on seabirds in northern North Island

POP2017-06

Summary of activities carried out to collect population estimates of priority seabirds in 2017-2018 (Milestone 4)

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Cover photos: Australasian gannet colony on Mahuki Island; Buller's shearwater burrows on Tawhiti Rahi, Poor Knights Islands; Buller's shearwater and Pacific gecko, Aorangi island; and red-billed gull, Burgess Island. Photos (respectively): Neil Fitzgerald, Karen Baird, NNZST and Abe Borker.

Figure 1 (above). Huge raft of fluttering shearwaters with Buller's shearwaters and red-billed gulls, Northwest Reef, Hauraki Gulf, 6 October 2017. Photo: Edin Whitehead.

Introduction

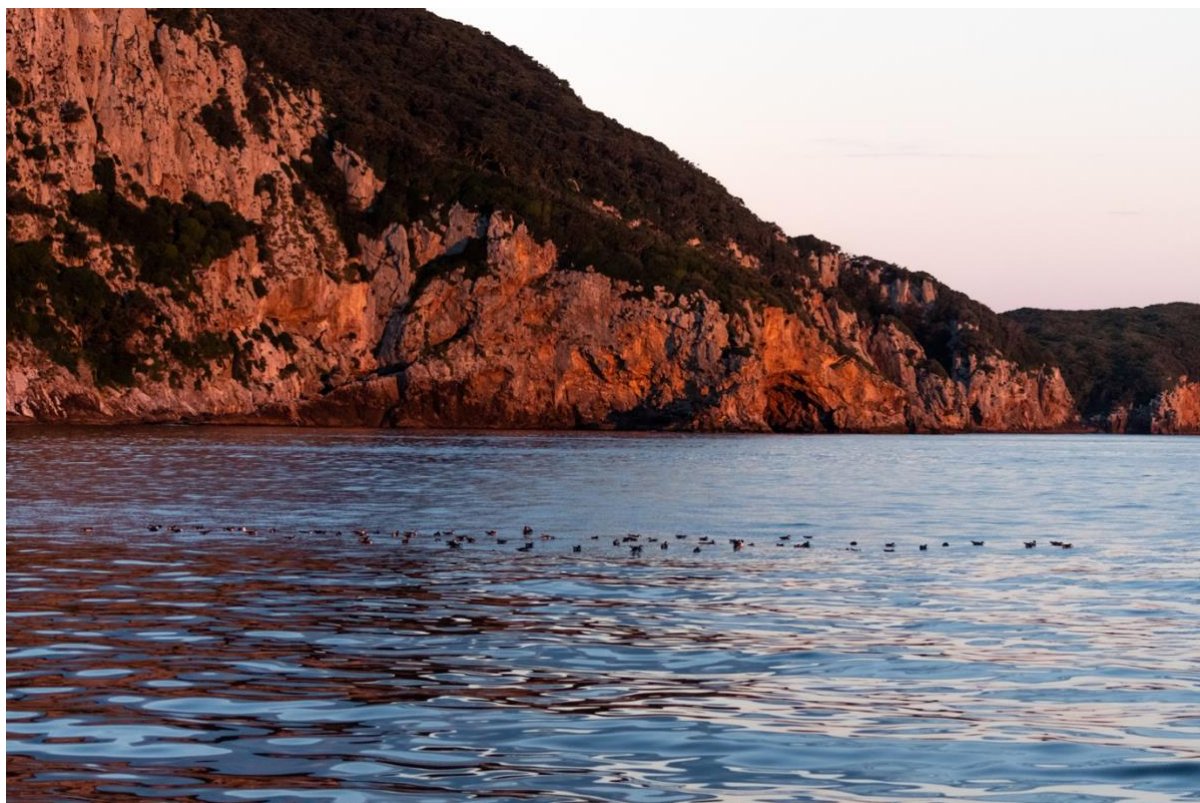
This project (**POP2017-06**) builds on the findings of **INT2016-04** (Indirect effects of commercial fishing on Buller's shearwater and red-billed gulls). A range of commercial fisheries target aggregations of surface shoaling fish. Purse seining is commonly used to capture these fish schools. The dense fish schools create a phenomenon known as fish work-ups. These fish drive up prey items to the sea surface and observations suggest that this forms an important food source for a range of seabird species. There is currently poor knowledge of both the diet of surface-foraging seabirds and what prey items are being made available to seabirds from fish work-ups. This is currently limiting our understanding of the mechanisms through which changes in the distribution and/or abundance of fish work-ups may be driving seabird population changes (population status and annual breeding success). Recent population abundance data are also incomplete or unknown for many seabird species that interact with surface feeding fish shoals and limits our assessment of population trends over time.

Objective 4 for POP2017-06 requires the following:

- Collect baseline population data on surface nesting seabirds (Australasian gannet, red-billed gull and white-fronted tern).
- Collect population data on a sample of burrowing petrel species if part of collaborative projects (Buller's and fluttering shearwaters, fairy prion).

The scope of work to achieve includes: Carrying out aerial population censuses of Australasian gannets, red-billed gulls and white-fronted terns around northern New Zealand; carrying out ground-based population surveys on islands for Buller's and fluttering shearwaters and fairy prions; and producing population reports. This Milestone 4 report summarises activities carried out in 2017-2018 to collect population estimates of priority seabirds.

Figure 2. Buller's shearwaters rafting at sunset close to Tawhiti Rahi, Poor Knights Islands, 1 May 2018.
Photo: Edin Whitehead

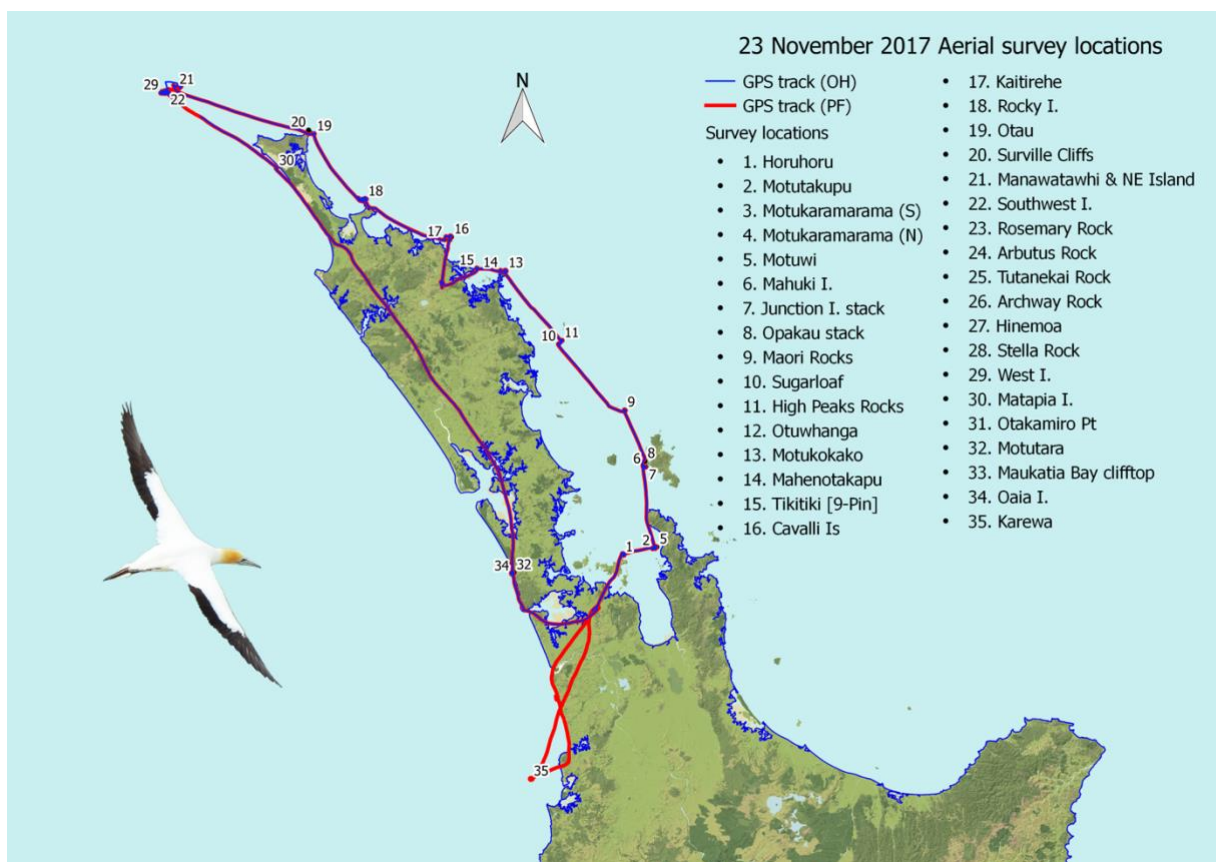


Australasian gannet

Determining the number of breeding pairs of Australasian gannets at the survey sites, provides a baseline against which the results from future surveys can be assessed. If these are carried out at regular intervals across a range of sites, and provided both the survey and assessment methods are comparable through time, such surveys help determine both site-specific and region-wide trends in a species' status.

Aerial photographs of Australasian gannet and red-billed gull colonies on selected islands in the north-east of the North Island were from a Gippsland GA8 Airvan on 23 November 2017 (Fig 3). Fourteen gannet colonies were identified between the southern Hauraki Gulf and the Three Kings Islands, with a further five colonies along the west coast between Muriwai and Karewa Island.

Figure 3. Australasian gannet and red-billed gull aerial survey locations, 23 November 2017. Map: Peter Frost and Olivia Hamilton.



At each colony being censused, three complementary sets of photographs were taken:

- wide-angle images (35-50 mm focal length) of the area in general, showing key features that can be used to locate and orientate the fields of view of closer-focused photographs;
- medium-scale images (85-135 mm focal length) showing nesting and other birds clearly enough that they can be identified and counted; and
- close-up photographs (200-300 mm focal length) of groups of individual birds in sufficient detail that their status can be accurately determined (e.g. incubating adult, chick, adult on nest but not incubating, non-breeder).

Because medium-scale photographs usually cover only some of a colony, they were taken so that they overlap to cover the whole area. By finding and marking common points in adjacent images a mosaic of discrete adjoining zones covering the whole colony will be created, each containing a unique subset of birds present. Suitable control points include conspicuous or

distinctive rocks or fissures, well-demarcated bare or eroded areas, notable patches of vegetation, or any other prominent feature. Panoramas, in which adjacent images are stitched together digitally, were generally not be used because of periodic omission and sometimes duplication of individuals in the merged zone, a consequence of photographs being taken from a moving platform.

The birds present in each zone were then counted. To reduce the risk of either double counting or overlooking nesting individuals, the areas were gridded. Each grid was then searched systematically, identifying and marking apparently occupied nests depending on the what was present at the site (e.g. for gannets: an ‘apparently occupied site’ was one that contained a bird incubating an egg or brooding a chick, or a chick alone in a nest, or two birds together at a nest site). Birds standing around were not counted as nesting.

Figure 4. Hinemoa Rock, Princes Islands, Manawatawhi Three Kings Islands. Figure 5. Detail from colony in Motukawao Group. Photos: Neil Fitzgerald, Richard Robinson, taken during aerial survey 23 November 2017.



To date (20 June 2018) counts of gannets (and some red-billed gulls) have been completed at the following sites: Horuhoru Rock, Motutakapu, Motukaramarama, Motiwi islet, Mahuki, Māori Rocks, Tikitiki Rock, Oaia Island, Motutara, Three Kings Islands, Muriwai and Karewa (table 1). The large colonies on Sugarloaf and High Peaks Rocks (Poor Knights Islands) remain to be counted.

Table 1. Interim results on the population status of the Australasian Gannet *Morus serrator* in northern New Zealand, based on analysis of aerial photographs of the colonies taken on 23 November 2017

Location	1946 ¹	1969 ²	1980 ²	2014-16 ³	2017 ⁴
Arbutus Rock, Three Kings Group	1000	2175	2652	1651	2687
Tutanekai Rock, Three Kings Group	300	406	402	686	654
Archway Rock, Three Kings Group	490	618	1530	774	1362
Hinemoa Rock, Three Kings Group	1520	3232	4136	2245	3402
South-west Island, Three Kings Group	824	804	1135	1046	1267
Nine Pin Rock (= Tikitiki Rock)	0	0	0	76	107
High Peaks Rocks, Poor Knights Islands	100	528	1153	-	TBD
Sugarloaf, Poor Knights Islands	1410	2462	2617	-	TBD
Maori Rocks, Mokohinau Islands	12	49	344	-	383
Mahuki Island, Aotea/Great Barrier Group	325	1869	2681	-	6160
Motuwi, Coromandel	5	50	96	-	130
Motukaramarama, Coromandel	1513	2834	3530	-	1956
Motutakapu, Coromandel	288	777	925	-	464
Horuhoru Rock, Waiheke Group	1228	2526	2647	-	988
Muriwai mainland	0	0	8	1285	1931
Motutara, Muriwai	0	0	298	187	209
Oaia Island, Muriwai	338	892	761	32	25
Karewa (Gannet Island)	3715	6132	8003	-	5713

¹Fleming & Wodzicki 1952; ²Wodzicki, Robertson, Thompson & Alderton 1984; ³Frost 2017; ⁴This study

A full analysis, including comparisons with previous surveys, remains to be done. Nevertheless, some marked changes are indicated. On the Three Kings Islands, the total number of breeding pairs (9372) is 46% higher than that recorded in a similar aerial survey carried out in December 2014 (6402). The reason for the difference is unclear. It could be a genuine increase, with 2014 being a poor year for breeding, or it could reflect undercounting of birds visible in the 2014 photographs (the quality of the 2017 photographs was substantially better than in 2014). Conversely, the number recorded in November 2017 is only 5% less than that reported from an aerial survey in 1980. This illustrates the difficulty of interpreting population change solely from intermittent surveys carried out at long intervals.

Elsewhere, marked regional changes are also suggested. The number of breeding pairs recorded in 2017 on the Coromandel islands and Horuhoru Rock is about 51% less than that recorded in 1980, while Mahuki has increased by 130%. On the West Coast, the combined numbers nesting at Muriwai and offshore (Motutara and Oaia Island) have increased by 102% since 1980 (the Muriwai colony itself barely existed then), while the number on Karewa seems to have decreased by just under 29%. This may reflect spatial redistribution of the gannet population rather than any large-scale population change, much as has been found for the Cape gannet in Namibia and South Africa (Crawford et al 2007), but counting of the Sugarloaf and High Peak Rocks colonies needs to be completed before this can be confirmed.

Red-billed gull

Although still abundant, the red-billed gull is classed as At Risk - Declining in New Zealand because of an apparent decline in numbers nationally, especially at some of the largest colonies, and despite some reported regional increases, such as in Otago. A synthesis of known breeding colonies from the late- 1800s to the mid-1960s, published in 1965, estimated a national breeding population then of around 40,000 pairs. To update this figure, Birds New Zealand, in conjunction with the Department of Conservation, carried out a national survey during 2014-2016 to establish the current size of the red-billed gull breeding population (Frost & Taylor 2016). The authors suggested, together with Birds New Zealand, DOC and others, that there is the need to identify several representative colonies around the country, for future monitoring over many years using comparable and consistent methods.

A census of North Island red-billed gull colonies (Three Kings to East Cape) is required for this contract POP2017-06 and the aerial survey conducted 23 November 2017 was able to include a number of sites, including the Three Kings Islands colonies. These counts (i.e. from photographs taken during aerial survey) have yet to be made (June 2018).

Figure 6. Red-billed gull activity around shoaling fish and roost on reef just south of Rocky Island, Moturoa Group, Northland. Photo: Richard Robinson, taken during aerial survey 23 November 2017.



White-fronted tern

Frost (2017) reported that white-fronted terns are still widely distributed in northern New Zealand, with more smaller colonies evident. Frost also suggested that relocations of colonies between years obscures changes in colony size unless vacant sites are also surveyed and reported. The aerial survey conducted on 23 November 2017 as part of this study also included a number of known sites for this species. The birds' small size makes it difficult to both locate and count them in the images obtained during the aerial survey, but this will be attempted when the gannet and gull counts have been completed.

Figure 7. White-fronted terns roosting on an outcrop on Tatapihi (Groper Rock), Mokohinau Group. 26 September 2010. *Photo: Karen Baird.* Figure 8 Terns roosting on the wharf at Motuihe, 28 March 2015. *Photo: Chris Gaskin*



Buller's shearwater

For the past two seasons (December to April 2016-2017 and 2017-2018), teams have conducted the first-ever comprehensive survey of Buller's shearwater on Tawhiti Rahi and Aorangi, Poor Knights Islands. In 2016-2017 field visits were made to Tawhiti Rahi - ten days in December, four days in February, and ten days in March/April. In 2017-2018 field visits were made to Aorangi - ten days in December, four days in February, and five days in March/April. We also spent five days in April on Tawhiti Rahi, for the purposes of comparing breeding success between the two islands. The aim of these trips was to collect data on burrow occupancy and density throughout both islands; record audio of nocturnally active seabird species to provide insight into the density and distribution of Buller's shearwaters and other species; and investigate the incubation periods, provisioning shifts and breeding success of Buller's shearwater.

Methods- Field

Reproductive behavior and chick success

Permanent plots were created to track the breeding success of Buller's shearwaters in a range of habitats across the two islands. Three permanent plots were set up at 25 x 25m. Every burrow within the plot was grubbed and identified if it was active (Dec. trip) and if chicks were successful (March/April) trip. Each plot had 2 acoustic recorders placed at the center point of the plot to ground-truth the acoustic activity in a plot of known burrow activity. Two active burrows at each plot were followed with automated camera traps to identify when birds were entering and leaving burrows. Permanent plots will continue to show trends of chick success and development of Buller's shearwaters on the Poor Knights Islands.

NB: In addition to the new permanent plots, several permanent plots established by Graeme Taylor on Aorangi in 2013 were also surveyed. Many Buller's shearwaters were banded by Graeme Taylor and others in 2011 (n=233) and 2013 (n=181) in the vicinity of the camp. A total of 39 Buller's shearwaters were recaptured in December 2017 and 19 in February 2018 (of the latter 4 were second recaptures from December). A geolocator fitted to a Buller's shearwater on the 19th December 2011 was recovered on 14th February 2018.

Burrow occupancy

To test for burrow occupancy randomly across Aorangi and Tawhiti Rahi, we set up transects coming off the ridgeline on each of the islands. On each transect, data were collected at 3 points 50 m apart. At each point, the two burrows nearest to the point were investigated for burrow occupancy. In addition to burrow occupancy, data were also collected on physical characteristics at each point, including: distance to nearest two burrows, aspect, canopy height, three prominent plant species, elevation, substrate depth, % canopy, slope, topo units (ridge, plateau, mid slope, gully), burrow height and width. Acoustic recorders were also deployed at each point in December and picked up in March/ April to encompass the main vocal activity of Buller's shearwater during breeding.

Island burrow density

To identify how densely burrows are distributed across Tawhiti Rahi and Aorangi, we surveyed random circular plots of 6 m in diameter, across the islands (except in areas where the researchers' safety was at risk). We surveyed 65 random plots on Tawhiti Rahi and 42 random plots on Aorangi. Plots were located by entering coordinates into GPS and navigating to the plot center. Once plot perimeter was established, all Buller's shearwater burrows within the plot were counted. In addition to the number of burrows, we also collected data on: aspect, three main vegetation species, % canopy, topo units, canopy height, other seabird burrows present (as determined by size of burrow opening).

Additional Avian Monitoring

The burrow density random plots were also used as locations for 5-minute bird counts to assess the diversity of all diurnal avian species on the Poor Knights islands. This data has already been submitted for publication showing the first records of avian diversity in the PK for decades.

Methods- Population modeling

The methods we are using for predicting a population estimate for Buller's shearwater are based on the methods outlined in Rayner et al (2007). They used a predictive habitat model to establish a population estimate for Cook's petrels on Te Hauturu-o-Toi Little Barrier island. The field components of the data collection were primarily two-fold to establish: (i) burrow-density, and (ii) the rate of burrow occupancy. Our next steps will be to model the relationship between the density of burrows and habitat selection predictors (we collected data on all these habitat types while in the field – Rayner et al (2007) uses GIS data as well - we are still working on this component). Our field methods for the population estimate data:

1. Burrow Density

- a. Visited pre-determined random GPS coordinates. Center point was as close to coordinates as you can get using GPS. Used 3m rope to create a 6m diameter circle.
- b. Data collection at random points included: the number of burrows in the circle, aspect, 3 main vegetation species, % canopy, topo units, canopy height

2. Burrow Occupancy

- a. Burrow occupancy was done during incubation time when burrows would most likely be occupied
- b. 150 m transects were run from the top of the ridgeline (this would likely vary depending on your study site)
- c. Data was collected 50 m apart along the transect
- d. At each point, the two burrows closest to the point were checked for occupancy
- e. Data collected every 50 m along transect included: distance to nearest 2 burrows, occupancy of those 2 burrows, aspect, canopy height, 3 prominent plant species, elevation, substrate depth, % canopy, slope, topo units (ridge, plateau, mid slope, gully), burrow height and width, and recorders deployed at each stop
- f. In addition to data from the transect points, we are also using the data from 6 permanent plots to add to the burrow occupancy points

Results – preliminary population estimate

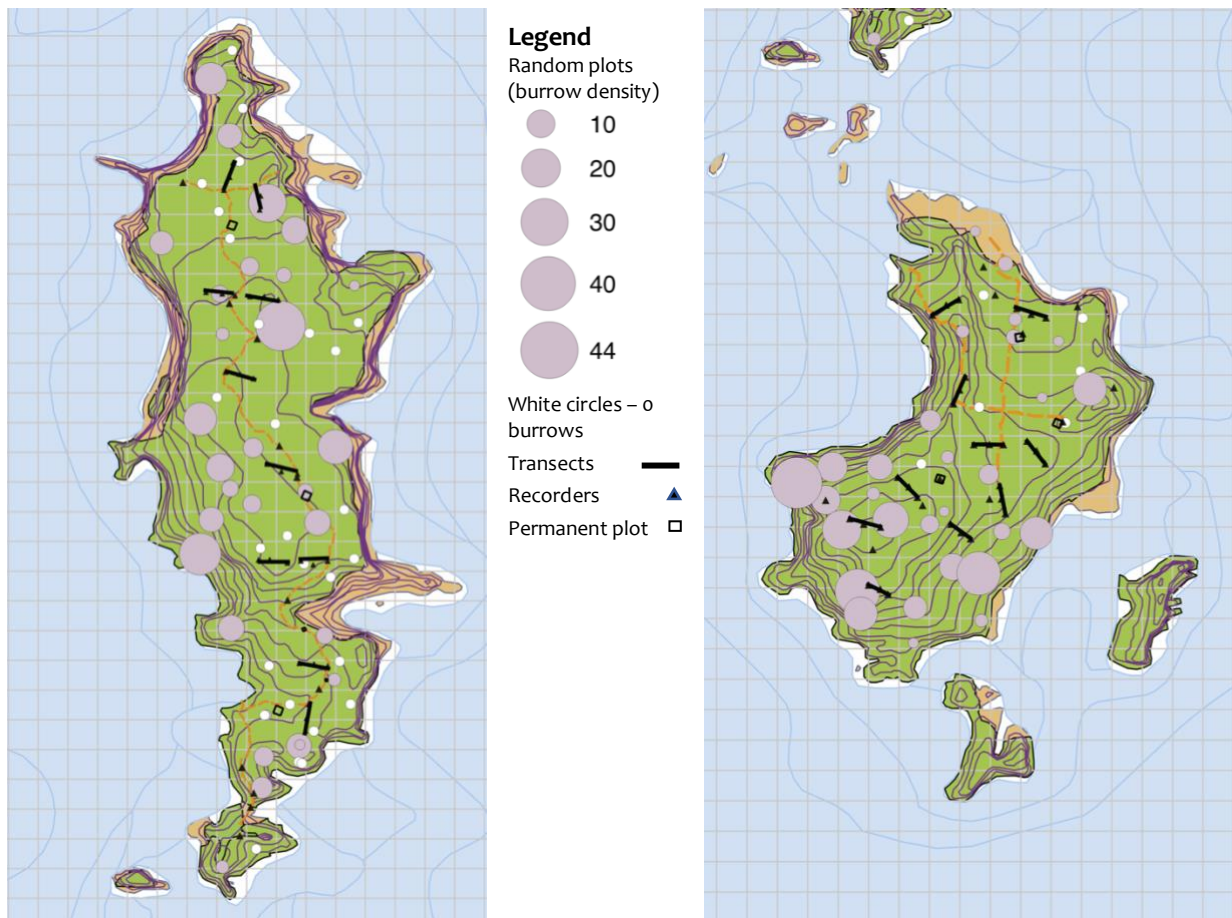
Buller's shearwater population thought to be 2.5 million birds in the 1980s. Rapid surveys on Aorangi in 2012-2013 suggested less than half that estimate (Taylor 2013).

Burrow occupancy

- Tawhiti Rahi (2016-2017) – 51.7% occupied
- Aorangi (2017-2018) – 42% occupied

Preliminary estimate of ~271,007 breeding pairs is based on individual island area, burrow occupancy and density. However, further modelling incorporating other data collected is required.

Figure 8. Buller's shearwater surveys for Tawhiti Rahi (left) and Aorangi (right)



This survey over two seasons, to complete a quantitative population estimate for Buller's shearwaters, is crucial to understanding the status of this species and will provide a baseline estimate from which this species' population can be monitored in the future. In addition to the core aspects of the project, habitat surveys and five-minute bird counts were conducted, and numerous incidental observations of wildlife made. Funding for the project was made available by the Birds New Zealand Research Fund.

Figure 9. Heavily burrowed area on Aorangi, 8 December 2017. Photo: Graeme Loh



Fluttering shearwater

This species breeds on many islands in the Hauraki Gulf and is seen at sea often in very large congregations. Although fluttering shearwaters have been recorded off the eastern coast of Australia post-breeding, the bulk of the northern population appears to remain in northern North Island waters throughout the year.

One of the mysteries, given the numbers seen at sea and a major gap in our knowledge of breeding species in the wider Hauraki Gulf, is the location of large colonies for this species. During the survey of Tawhiti Rahi in 2016-2017 there was no evidence of the large population recorded by McCallum (1981) of ‘many thousands of pairs making nest preparations’ (A. Tennyson pers. comm.). However, the different times of visits (i.e. September 1980 and December 2016) may account for their presence not being detected. McCallum et al. (1984) also noted that ‘several thousand fluttering shearwaters breed on the plateau of Muriwhenua Island’ (Northwest Chickens Islands). The high frequency of fluttering shearwater calls detected on acoustic recorders deployed by the author (CG) at five sites on Taranga Hen Island from 26 October to 26 November 2010 needs to be further investigated. All three islands together with other islands require detailed surveys to confirm these earlier observations, and to determine population estimates and establish study areas in order to monitor trends and breeding success (see **Recommendations 2018-2019** below).

Figure 10. Huge raft of fluttering shearwaters with Buller’s shearwaters and red-billed gulls, Northwest Reef, Hauraki Gulf, 6 October 2017. Photo: Edin Whitehead.



Figure 11. Raft of fluttering shearwaters, Kawau Bay, Hauraki Gulf, 4 April 2009. Photo: Karen Baird



Fairy prion

The Buller's shearwater surveys on the Poor Knights Islands (2016-2017, 2017-2018) together with previous acoustic surveys (Gaskin 2010-2012, Aorangi only) and spotlighting around the Poor Knights during searches for NZ storm petrel (Gaskin 2006, 2007) identified areas on all islands where significant numbers of fairy prions are breeding, and, where they are absent (i.e. areas dominated by Buller's shearwaters or completely free of all breeding Procellariiforms).

Recommendations for 2018-2019

In terms of next season's work, we are recommending the following fieldwork:

1. Searching out mid-winter foraging aggregations for red-billed gull and white-fronted tern; particularly in areas which have small breeding populations (e.g. Mokohinau Islands). This will be done in conjunction with other projects.
2. Visit to Tawhiti Rahi in September 2018 to locate fluttering shearwater breeding sites (as reported by McCallum (1981).
3. Visits to Taranga (Hen Island) in September and November to locate fluttering shearwater breeding sites; also, to locate any flesh-footed shearwater sites; acoustic recorders will be deployed.
4. Surveys of Northwest Chickens (Muriwhenua, Wareware, Pupuha Islands) and Bream Islands in October 2018; acoustic recorders will be deployed; repeat short visits in November.
5. Visits to Aorangi in November and December, Poor Knights for fairy prion census purposes and to locate suitable study sites for ongoing work with this species; the December trip would be in conjunction with Buller's shearwaters
6. Locate red-billed gull and white-fronted tern colonies for census purposes. Identify a number of these colonies for collection of regurgitation and faecal samples for Objective 2 of this contract. Approaches will be made to Birds NZ (OSNZ) regional representatives for support with surveys and counts.

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Figure 12. Shoaling fish near Moturoa Islands, taken during aerial survey 23 November 2017. Photo: Richard Robinson.

