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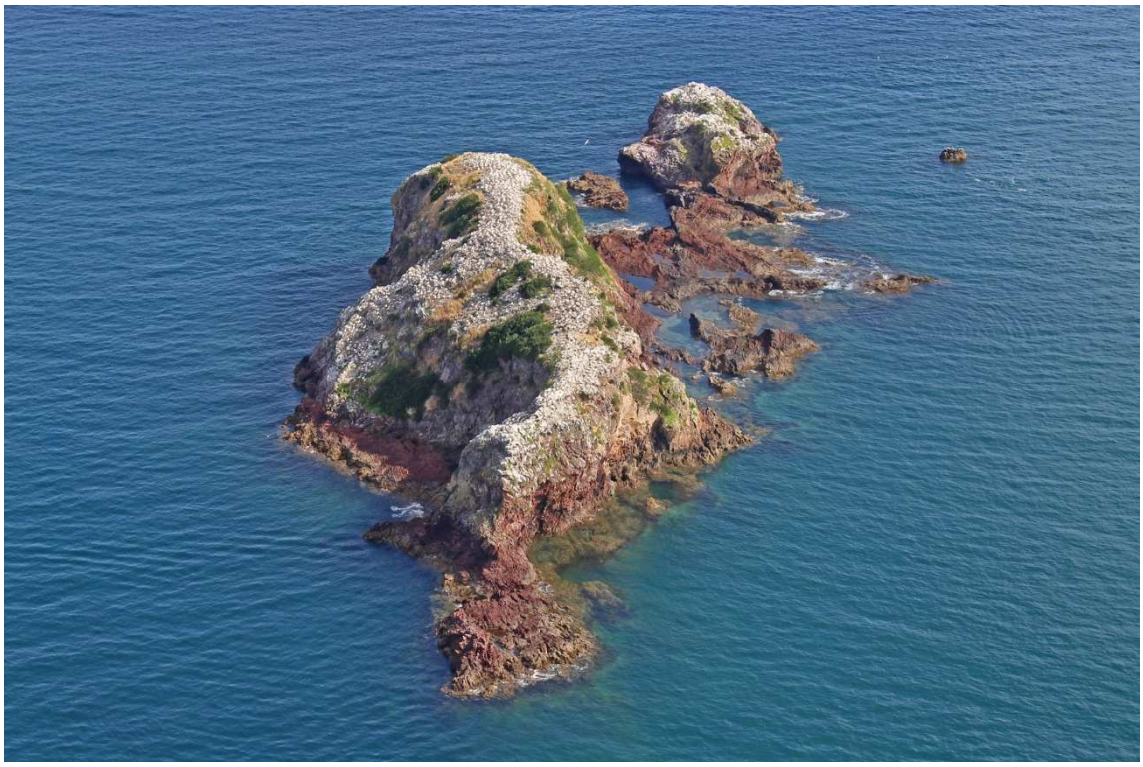

Horuhoru Rock, off Whaiheke Island, showing the gannet colony on complex terrain (photo: P.G.H. Frost)

National Red-billed Gull Survey (2014-2017)
Final Report on an Aerial Survey of Red-billed Gulls and Australasian Gannets, November 2017

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Background

Members of Birds New Zealand, the Department of Conservation and the public contributed to a national survey of breeding red-billed gulls between June 2014 and March 2016. A paper reporting the results of this survey will be published in the March 2018 issue of *Notornis*.[1] At the end of that survey, there was $5,744.17 unspent from the original grant ($15,510). A supplementary application was made to Birds New Zealand to use this money to resurvey the red-billed gull colonies on the Three Kings Islands, formerly the site of the reputed largest aggregation of breeding red-billed gulls in New Zealand.[2]

Analysis of aerial photographs taken of nesting gulls on these islands in 2014 and 2015 produced counts of 1,106 and 1,763 pairs respectively, in contrast to the many thousands reported prior to 1960 (Gurr & Kinsky 1965). Unfortunately, the lack of information on the airplane flight paths around the islands during the 2014 and 2015 surveys meant that the exact location of many of the groups of nesting gulls was not known. It also left open questions about whether the low numbers of nesting gulls recorded, relatively to those reported previously, was due to inter-annual variation in breeding, with 2014 and 2015 being poor breeding years, or if they reflected a real decline in the importance of these islands as a refuge for breeding gulls. Accordingly, a supplementary application was made to resurvey these islands in 2016, and that was granted. Difficulties in obtaining a suitable airplane and pilot at short notice and in planning a flight meant that the 2016 survey was postponed to 2017.

In the meantime, two things happened that modified the plan for 2017. First, I had analysed photographs taken by Les Feasey in 2014 of the Australasian gannet colonies on the Three Kings Islands. It turned out that among the more than 390 photographs taken, a full set could be constructed covering the five gannet colonies on the Three Kings Islands (from east to west: South-west Island, Arbutus, Tutanekai, Archway Rock and Hinemoa Rock). The total count of 6,402 apparently occupied nests (= nesting pairs) contrasted with the 9,855 pairs counted from aerial photographs taken in 1980-81,[3] an apparent 35% reduction of over the past 34 years. Likewise, an analysis of photographs taken of the gannet colonies on White Island by Julian Fitter during the red-billed gull survey showed a 20% decline. Did these changes represent real declines in the size of these breeding colonies, or were they simply reflections of substantial inter-annual variation in the number of pairs breeding each year, depending on current environmental conditions, particularly food availability? Given that the last national survey of Australasian gannets in New Zealand was in 1980-81, it seemed opportune to resurvey several them, especially in the northern North Island, where most colonies are situated.

Second, and partly stimulated by a point raised during the 2014–16 national red-billed gull survey, the Conservation Services Programme of the Department of Conservation initiated a pilot study into the possible indirect effects of commercial fishing on those seabirds that are regularly attracted to 'boil ups' created by predatory fish that force their prey—small fish and krill—close to the sea surface, where they become available to surface- and near surface-feeding seabirds. Most of these bird species seem to depend on boil-ups to obtain much of the high-quality food needed to rear their chicks successfully. There is concern that the frequency, size and duration of these events may be declining, for whatever reason, and that this could reduce the birds' overall foraging efficiency and compromise their breeding success.

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[1] Frost, P.G.H.; Taylor, G.A. 2018. The status of the red-billed gull (*Larus novaehollandiae scopulinus*) in New Zealand, 2014-2016. *Notornis 65*, 1–13.

[2] Gurr, L.; Kinsky F. 1965. The distribution of breeding colonies and status of the red-billed gull in New Zealand and its outlying islands. *Notornis 12*, 223–240.

[3] Wodzicki, K., Robertson, C.J.R., Thompson, H.R. & Alderton, C.J.T. 1984. The distribution and number of gannets (*Sula serrator*) in New Zealand. *Notornis, 31*, 232-261.

Part of that study was to collate past and present information on the location and size of breeding colonies of the main non-procellariform seabirds attracted to these boil ups: Australasian gannet (*Morus serrator*), spotted shag (*Stictocarbo punctatus*), red-billed gull (*Larus novaehollandiae*), white-fronted tern (*Sterna striata*), and grey noddy (*Procelsterna albivitta*[4]). Information was collated from numerous sources, principally the Classified Summarised Notes (CSN) of the Ornithological Society of New Zealand (OSNZ), published annually from 1939 to 1962, then as annual summaries up to 2002; New Zealand eBird checklists; OSNZ gull and tern survey, 1965-1968; Birds New Zealand red-billed gull survey database; species accounts published in various scientific journals; and individual records provided by knowledgeable observers. Common problems encountered with all data sets included: inconsistency in survey methods; lack of clarity as to what the reported numbers denote—birds, pairs, or active nests; exact location of colonies often unclear; a potential bias in only reporting large colonies; and no regular monitoring.[5]

The lack of regular monitoring, and the need to identify the most cost-effective way of instituting a monitoring programme, prompted a revised objective to the original proposal to Birds New Zealand to include Australasian gannet in an extended aerial survey of islands with known surface-nesting seabird colonies from the inner Hauraki Gulf, up the east coast of the North Island to the Three Kings Islands, then down the west coast to Karewa (Gannet Island) off Kawhia Harbour in the Waikato. In addition to photographing the colonies for later detailed analysis, this flight would also provide first-hand experience from which lessons could be learned that could be applied to improve later surveys.

The objectives of the requested extension to the original survey were therefore:

a) to survey several past-known red-billed gull colonies that were not surveyed in the original Birds New Zealand study, particularly on offshore islands from the Hauraki Gulf northwards, using aerial photography;

b) to resolve the exact locations and sizes of the gull colonies on the Three Kings Is; and

c) to take the opportunity to survey previously identified Australasian gannet colonies along the way, and to check some apparently new ones.

In addition to myself as navigator, the personnel involved in the survey were:

- Richard Robinson (Depth, Underwater Photography, https://www.depth.co.nz/about)
- Neil Fitzgerald (Landcare Research, https://www.neilfitzgeraldphoto.co.nz/profile.html)
- Olivia Hamilton (Institute of Marine Science, The University of Auckland, studying the spatial ecology of marine mammals and birds at sea)

Richard and Neil served as photographers, while Olivia kept track of the flight in real time. Chris Gaskin Northern New Zealand Seabird Trust), who was originally due to join us on the flight, was not able to, but assisted greatly with the planning, including contracting Richard, Neil and Olivia.

[4] Referred to as *P. cerulea albivitta* by Gill *et al.* (2010) but now widely accepted to be a separate species.

[5] Frost, P.G.H. 2017. Population status and trends of selected seabirds in northern New Zealand. Report to Conservation Services Programme, Department of Conservation, Wellington (URL: http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/int2016-04-status-and-trends-seabirds-peter.pdf).

Approach

The survey was organised in conjunction with the Northern New Zealand Seabird Trust (NNZST). The Trust had been contracted by the Conservation Services Programme (CSP) of the Department of Conservation (DOC) to undertake further study of the indirect impacts of changes in fish populations on seabirds in the north-east North Island region (project POP2017-06). This project built on 2016 pilot study to which I had contributed, so it seemed logical to link the two initiatives and be able to call on some additional resources. Effective aerial surveys of surface-nesting seabirds depend on getting high-quality photographs at a range of scales. This in turn usually requires the services of experienced photographers using top-quality equipment. Such persons are usually professionals and require some compensation for their time. The NNZST had built this provision into their proposal to DOC-CSP, so a collaborative effort had reciprocal benefits, with the Birds New Zealand grant covering some of the flight and land-transport costs, and the grant to the NNZST covering the balance of the flight costs and professional time, with an agreement to share the photographs and results of the survey.

The flight was organised through FlyStark Airlines Ltd (www.flystark.com), a company based in Whitianga but also flying out of Ardmore airport, Auckland. That company flies Gippsland GA8s, single-engine, high-wing aircraft equipped to fly over sea, having large windows suitable for aerial photography, and with properly qualified pilots. The Gippsland GA8 is used for sky-diving, among other things, and has a large rear door that can be opened in flight by suitably qualified personnel, but we were unable to get permission to do this.

A detailed 18-page flight plan was drawn up, containing the geographic locations of 35 islands or island groups, descriptions of each island (elevation, vegetation) and, if known, the positions or suspected positions of red-billed gull and Australasian gannet colonies on these islands. The flight plan also included a map showing the proposed route. The purpose of the flight plan was to give both the pilot and the photographers forewarning of what to expect at each location, as well as the target species there. A set of guidelines for the aerial survey of seabird colonies, covering aims, sources of error in counting, and suggested optimal approach to planning, preparation and performance of a survey, was also circulated. Copies of both documents are appended separately.

To ensure that the flight path around each survey location was documented, three GPS units (2 Garmin GPSMap 62s, 1 Garmin GPSMap 64s) were used. One Garmin GPSMap 62s was under the control of the navigator (myself), while the other was monitored by Olivia Hamilton, who tracked the flight on computer in real time and made notes of any significant events during the flight, including any sightings of marine mammals and fish bait balls ('boil ups). Neil Fitzgerald also kept track of the flight on his Garmin GPSMap 64s. The navigator's unit was placed on the aircraft dashboard throughout and had the clearest view of the sky, and so gave the most accurate information on the track, at least when judged against written notes and memory of the flight paths around the islands. All cameras and watches were synchronised to the nearest second with the time shown on the GPS units.

The flight took place on 23 November 2017, departing from Ardmore airport at 08h46 and ending eventually, 9.4 hr and 1,465 km later at 18h09. Weather conditions were ideal with an almost cloudless sky and windless conditions up and down both coasts. Total time in the air was 8.2 hr, somewhat longer than had been anticipated because insufficient allowance made for the time taken to circle and photograph each location. This came to 86 min overall, an average of just under 3 min at each point. Track data were imported from the GPS *.gpx files to OziExplorer® and from there to Excel, where the time was corrected from UTC to local time. The data were then exported to both Google Earth (as *.kml files) and QGIS (as shape files). The flight path of the survey is shown in Fig. 1 and operational details of the flights around each island given in Table 1.

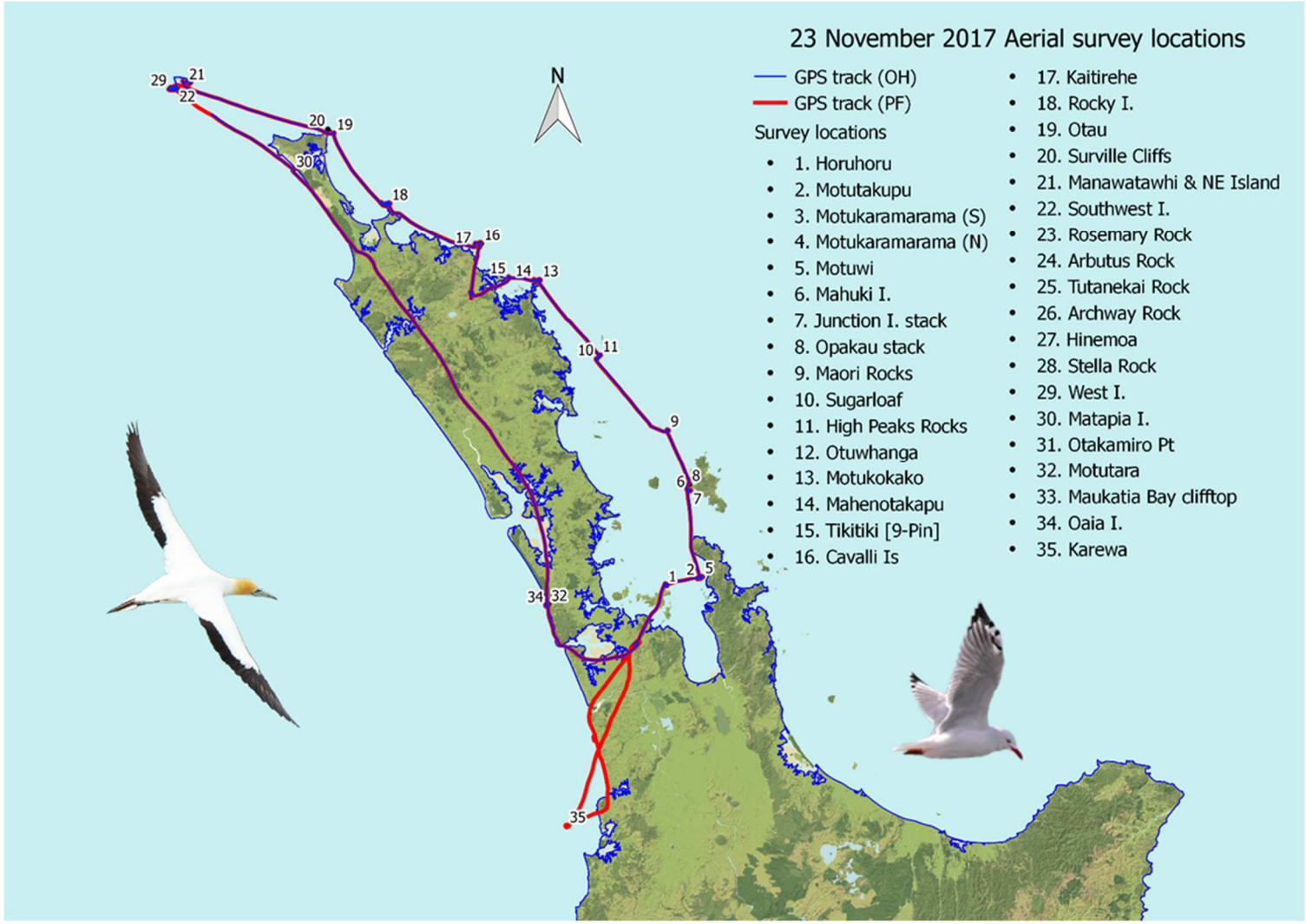

Figure 1. Flight path and location of sites surveyed on 23 November 2017.

Table 1. Operational details of the aerial photographic survey carried out on 23 November 2017 from the inner Hauraki Gulf to the Three Kings Islands (A), around the Three Kings Islands (B), and from the Three Kings Islands south to Karewa Island (C).

A. North Island East Coast Sites

Locality surveyed	Survey type (number of circuits)	Start time	End time	Duration (min)	Distance (km)	Ave. speed (kph)	Min. altitude (m)	Max. altitude (m)
Horuhoru	Circle (3)	8:58:30	9:04:13	5:42	13.25	139.1	137	208
Motutakupu	Circle (3)	9:10:04	9:13:30	3:25	7.86	137.3	140	205
Motukaramarama	Circle (3)	9:14:03	9:18:06	4:03	9.37	138.7	144	266
Islet W of Motuwi	Circle (1)	9:18:11	9:19:29	1:18	3.00	138.3	146	204
Mahuki Island (& Junction I. stack)	Circle (2)	9:35:11	9:39:40	4:28	10.24	137.0	142	219
Stack east of Opakau I.	Flypast	9:40:51	9:41:15	0:24	0.94	141.1	164	189
Maori Rocks, Mokohinau Is	Circle (2)	9:51:58	9:54:32	2:33	5.85	136.8	132	165
Sugarloaf, Poor Knights Is	Circle (2.5)	10:13:11	10:15:25	2:13	5.07	136.2	212	235
High Peaks Rocks, Poor Knights Is	Circle (2)	10:16:26	10:18:57	2:31	5.82	138.6	177	254
Otuwhanga/Cape Brett/Motukokako	Circle (1)	10:35:10	10:36:55	1:45	5.92	203.1	300	350
Mahenotakapu (Bird Rock)	Circle (2)	10:37:32	10:39:52	2:20	5.37	138.0	160	217
9 Pin Rock (Tikitiki Rock)	Circle (3)	10:44:23	10:47:48	3:24	7.8	137.0	148	222
Islet off Te Anaputa Island	Circle (1)	11:39:09	11:40:15	1:06	2.64	144.0	161	194
Motutakupu & outer Cavalli Is	Circle (1) & flypast	11:40:56	11:43:12	2:16	5.63	149.1	131	180
Kaitirehe Rock	Flypast	11:44:16	11:44:39	0:22	0.96	149.9	150	167
Rocky Island	Circle (3)	12:00:32	12:04:28	3:56	9.12	139.1	114	221
Karikari Stacks	Circle (1) & flypast	12:05:05	12:10:14	5:09	12.62	147.0	121	197
North Cape (Otou, Murimotu)	Circle (1)	12:24:05	12:25:17	1:11	2.78	138.9	137	208

B. Three Kings Islands

Locality surveyed	Survey type (number of circuits)	Start time	End time	Duration (min)	Distance (km)	Ave. speed (kph)	Min. altitude (m)	Max. altitude (m)
Manawatāwhi/Great I. (part NW-NE)	Flypast	12:49:34	12:53:16	3:42	8.58	139.2	175	249
North-east Island	Flypast	12:53:41	12:55:32	1:50	4.5	146.1	129	180
Farmer Rocks	Circle (1)	12:56:12	12:57:40	1:27	3.48	142.4	156	175
Manawatāwhi/Great I. (part SE-SW)	Flypast	12:57:40	12:59:25	1:45	4.58	157.0	139	174
South-west Island	Circle (1.5)	13:01:32	13:06:12	4:40	10.87	139.7	155	215
Rosemary Rock Arbutus Rock Tutanekai Rock Archway Rock Hinemoa Rock Stella Rock West I.	Circle (3-4)	13:06:46	13:19:18	12:31	29.80	142.7	139	293

C. North Island West Coast sites

Locality surveyed	Survey type (number of circuits)	Start time	End time	Duration (min)	Distance (km)	Ave. speed (kph)	Min. altitude (m)	Max. altitude (m)
Matapia I.	Flypast	13:46:30	13:46:57	0:25	1.07	153.4	181	253
Oaia Island, Muriwai	Circle (1)	15:46:58	15:48:33	1:34	3.57	135.4	153	200
Otakamiro Point, Muriwai Muriwai stack (Motutara), Muriwai Maukatia Bay clifftop, Muriwai	Flypast (2)	15:49:18	15:51:03	1:45	1.89	64.9	164	184
Karewa (Gannet I.)	Circle (3)	17:21:48	17:27:50	6:01	13.67	136.0	128	176
Ngatutura Point (Waikato Coast)	Circle (1)	17:46:43	17:49:07	2:24	8.4	209.9	193	235

A total of 1740 photographs were taken with three different cameras: Canon EOS 5DS R with EF24-70mm f/2.8L II USM lens at shutter speed 1/1000 s and aperture F5.6 at focal lengths varying from 38-70 mm (700 images); Canon EOS-1D X Mark II with an EF300mm f/2.8L IS USM lens, at shutter speed 1/2500 s, aperture F5.0 (215 images); and a Canon EOS-1D Mark IV with an EF70-200mm f/4L USM lens at 1/1000 to 1/8000 (817 images). The Exif data for each image (camera make and model, date and time of each image, shutter speed, ISO rating and lens focal length) were bulk extracted using Picture Information Extractor 6.99.10.61, Picmeta Systems (http://www.picmeta.com).

It will take some time to process, analyse and count nesting birds on these images. Using procedures developed during the 2014-16 red-billed gull survey, photographs will be processed in Photoshop Elements 14, with lighting, contrast, hue and saturation adjusted to highlight the birds as best as possible. To be useful for counting birds, an image must have a sufficiently discrete area that can be demarcated from neighbouring areas along a common boundary that is mappable in both images. This extends in some cases to images that overlap above and below to cover the whole colony. The adjoining images in turn must have their own distinct areas that can be distinguished from the next image in the sequence, and so on until all areas in which there are nesting birds have been covered without overlap or gaps (Fig. 2).

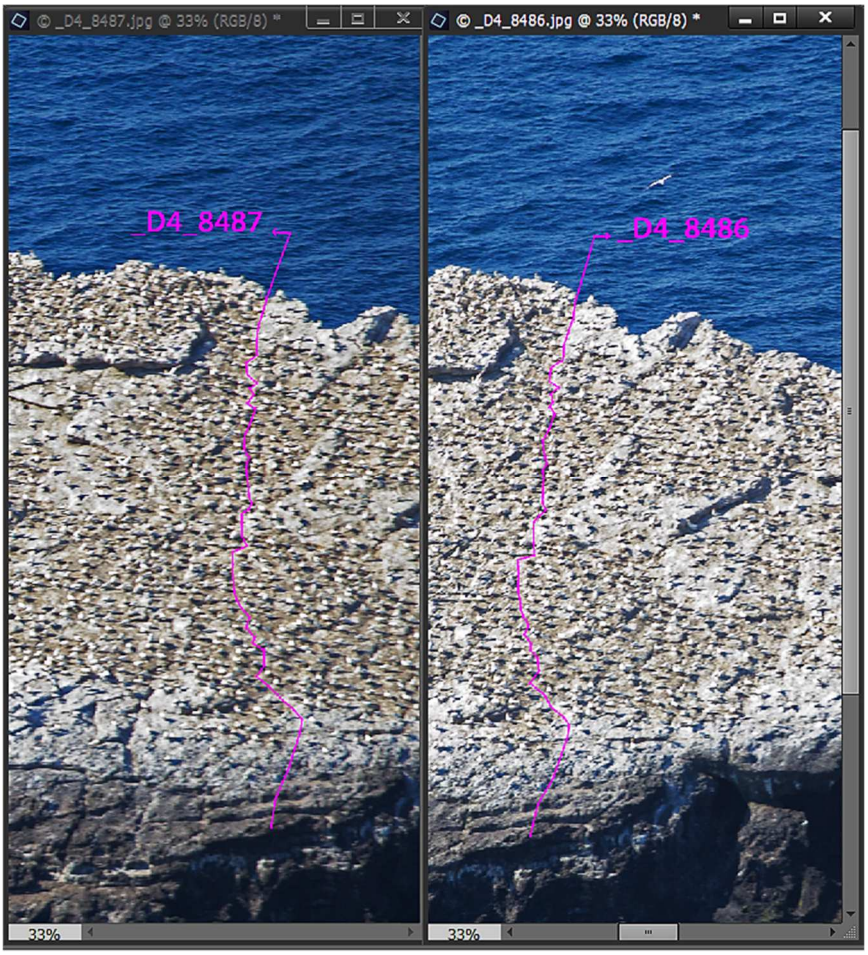

Figure 2. Illustration of the delineation of discrete areas on adjacent images to ensure that there are no gaps or overlapping areas in which birds are being counted (gannets on Karewa Island). Nesting birds will be counted to the left on image 8487 and right on 8486 up to the next demarcation lines to the left and right respectively where these overlap with the next images.

One set of images has already been analysed. A small population of Buller's mollymawk (*Thalassarche bulleri*) was discovered nesting on Rosemary Rock in the Three Kings Islands in December 1983,[6] and surveyed more completely the next season (1984/85), when 18 birds and 15 nests (13 occupied) were noted.[7] Since then, despite intermittent visits by scientists and birders, there has been no subsequent survey, so the present status of this population was unknown. The Department of Conservation had asked that this locality be surveyed. We flew past the islet four times at 156–250 m a.s.l. altitude (average 204 m) and 130–340 m distance (average 230 m). Although no mollymawks were seen on the rock or in the air at the time, later analysis of the photographs taken revealed 38 birds occupying 35 sites (34 with nesting birds). One vacant site was also identified. A short note on this has been submitted to *Notornis* and is currently in review.[8] The note fully acknowledges the financial support of Birds New Zealand.

All gannet colonies were successfully photographed and one small new satellite colony to that on Motukaramarama was discovered on an islet off Motuwi. No large red-billed gull colonies were noted, but several previously unsurveyed ones were photographed and will in turn be analysed. Various large aggregations of white-fronted terns were also seen and photographed, some of which include nesting birds. Given the extent of the survey, and the numbers of colonies and birds of all species involved, these analyses will take some time.

The mainland gannet colony at Muriwai was photographed completely on 22 November 2017, the day before the aerial survey. These photographs also incorporated nesting white-fronted terns and a few red-billed gulls. Analysis of these photographs will provide ground-truthing for the analysis of the aerial photographs. A total of 1,572 nesting gannets were counted on photographs of the Otakamiro colony and adjacent Motutara (Pillar Rock) taken by Oliver Nicholson for me in October 2016,[9] so a count from the November 2017 photographs will also provide some measure of inter-annual variation in colony size. With appropriate organisation by Birds New Zealand, this colony is one that could be surveyed annually to monitor changes in gannet numbers over time.

Grant and expenditure

The budget granted by Birds NZ for the revised application was $7,293.12. Including the initial grant of $15,510 for the 2014–16 National Red-billed Gull Survey, the total project cost therefore amounted to $17,058.95. Of this, $14,819.74 (86.9%) was spent on funding aerial surveys, $953.86 (5.6%) on other transport, and $733.48 (4.3%) on administration, leaving $551.87 (3.2%) unspent.

[6] Wright, A.E. 1984. Buller's Mollymawk breeding at the Three Kings Islands. *Notornis 31*, 203–207.

[7] McCallum, J., Brook, F. & Francis, M. 1985. Buller's Mollymawks on Rosemary Rock, Three Kings Islands, in 1985. *Notornis 32*, 257–259.

[8] Frost, P.G.H.; Fitzgerald, N.; Robinson, R.; Hamilton, O. (submitted) Buller's mollymawk on Rosemary Rock, Three Kings Islands. (In review in *Notornis*.)

[9] Frost, P.G.H. 2017. Population status and trends of selected seabirds in northern New Zealand. Report to Conservation Services Programme, Department of Conservation, Wellington (URL: http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/int2016-04-status-and-trends-seabirds-peter.pdf).

Lessons learned

In addition to successfully completing the survey as planned, several useful lessons about doing aerial surveys from small airplanes were learnt.

1. The ideal survey airplane must be one in which it is possible either to photograph through open windows, door or a specially designed photographic port. The photographers, both professionals, commented that the acrylic windows, although thoroughly cleaned beforehand, still marred the clarity of the images, something that is obvious when the images are examined at high resolution (but this does not render the images unusable, only more difficult to work with). The problems of being able to open the rear door of the Gippsland—the need for a wind deflector to be fitted; having someone on board who is suitably qualified to open and close a door in flight (Richard Robinson had experience but this was not accepted by the airline charter company); additional drag and therefore increased fuel consumption; and, most importantly, whether the company was certified by the CAA to open the door in flight—all became apparent too late in the negotiations to be resolved.
2. The importance of on-board communication needs stressing. The photographers must be able to communicate directly with the pilot (or at least with the person sitting next to the pilot) so that requests to fly around again, or to fly higher/lower/closer in/further out, can be easily communicated. This was poor feature of this flight in that, whereas the pilot and navigator could communicate through the main intercom, those sitting in the passenger seats could not speak to the pilot directly via intercom, though they could speak among themselves, up to a point. Moreover, the four-point safety harnesses worn by the pilot and navigator do not allow much lateral movement, such as turning around. The three-point, automotive-style harnesses worn by the passengers allowed more freedom of movement, but still did not make it easy someone in the passenger seats to lean forward and communicate with the pilot. If an airplane does not have an auxiliary intercom system through which to communicate with the pilot/navigator, then a small A4-sized whiteboard could be used to pass messages between the photographers and pilot.
3. One does not appreciate just how fast the airplane flies past these colonies, especially when only a few hundred metres or less from an island. This does not leave much time for decision-making. It also emphasises the need for an initial look-see circuit, to plan how best to approach the definitive flypasts, so that everything that needs to be is photographed and documented.
4. Points 2 and 3 above bring out the point that more time needs to be set aside for flying around the survey locations. This has implications not only for total flying time (and therefore cost) but also for fuel consumption, given that the airplane is frequently banking, which requires additional power to maintain altitude under reduced lift. Increased fuel consumption can compromise flight range. As it was, we had to land three times to refuel (partly also because of the number of people on-board also increased fuel consumption).
5. Aerial survey is the only cost-effective way of censusing surface-nesting seabirds on remote islands, but this need not necessarily mean surveys from airplanes. Consideration should be given to developing the use of unmanned aerial vehicles (UAVs or drones). This is a rapidly advancing technology, including uses in the field of seabird monitoring, and it needs to be tested locally (there are professional drone operators who could be involved.

Acknowledgements

I am grateful to Birds New Zealand and Fruzio for so generously supporting these surveys, and to the Conservation Services Programme of the Department of Conservation for both direct and indirect support. I am also grateful to Richard Robinson and Neil Fitzgerald for taking and making available their excellent photographs and putting up with a string of requests and possibly needless suggestions; to Olivia Hamilton for providing back-up on keeping track of the flight; and to Chris Gaskin (Northern New Zealand Seabird Trust), for encouragement and many suggestions, and for securing the additional funding needed for this survey to get off the ground finally. Finally, my thanks to Ingrid Hutzler, not only for keeping me on track with the budget but also for trying to explain to me the intricacies of how GST works in relation to grants. I am still not sure that I fully understand it.