A Census of Northern Royal Albatross Nesting on the Chatham Is, February 2022

Linked to project POP2021-03
Chatham Island albatross
research

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- Current estimated total breeding population ~6000 pairs, >99% of which nest on these three privately-owned islands (Fig. 1)
- NRA breeds biennially. Annual number breeding = ? birds that did not breed the previous year + some proportion of failed breeders from that year
- Ground surveys carried out in December 2016 (Motuhara) and December 2017 (Rangitatahi)
- Recent aerial surveys conducted in
  - November 2016 (adults on nests [AON]: Baker et al. 2017)
  - July 2017 (chicks: Frost 2017)
  - December 2017 (AON: Frost 2019)
  - August 2018 (chicks: Frost 2019)
  - September 2020 (chicks: Frost 2021a)
  - December 2020 (AON: Frost 2021b)
- No aerial survey possible in November/December 2021 (start of incubation); carried out instead on 2 February 2022 (eggs hatching) by Gemma Green and Levi Barton (DOC)
- Coincided with fieldwork by Mike Bell (counted toroa nesting in five 20 x 20 m quadrats, 29 January 2022: 158 current nests examined, 31% with eggs, 63% with chicks, 6% failed)

Objectives

- Analyse aerial photographs to estimate the number of apparently occupied Northern Royal Albatross|Toroa nests (AON) on the three islands in February 2022
- Put these numbers in context:
  (a) previously recorded numbers of apparently occupied nests during early incubation
  (b) numbers of chicks present immediately prior to, or at, fledging
- Compare the number of toroa apparently nesting in five 20 x 20 m quadrats on Motuhara, as assessed from both aerial photographs and drone imagery, with those counted on the ground 2-3 days earlier

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- Survey also the five 10 x 10 m Northern Buller's Mollymawk long-term monitoring quadrats on Motuhara and compare these counts with those made previously
- Compare recent ground counts of these quadrats with those made from aerial imagery (including drone images)
- Assess the merits and limitations of both aerial and drone surveys

Fig. 2. Image acquisition

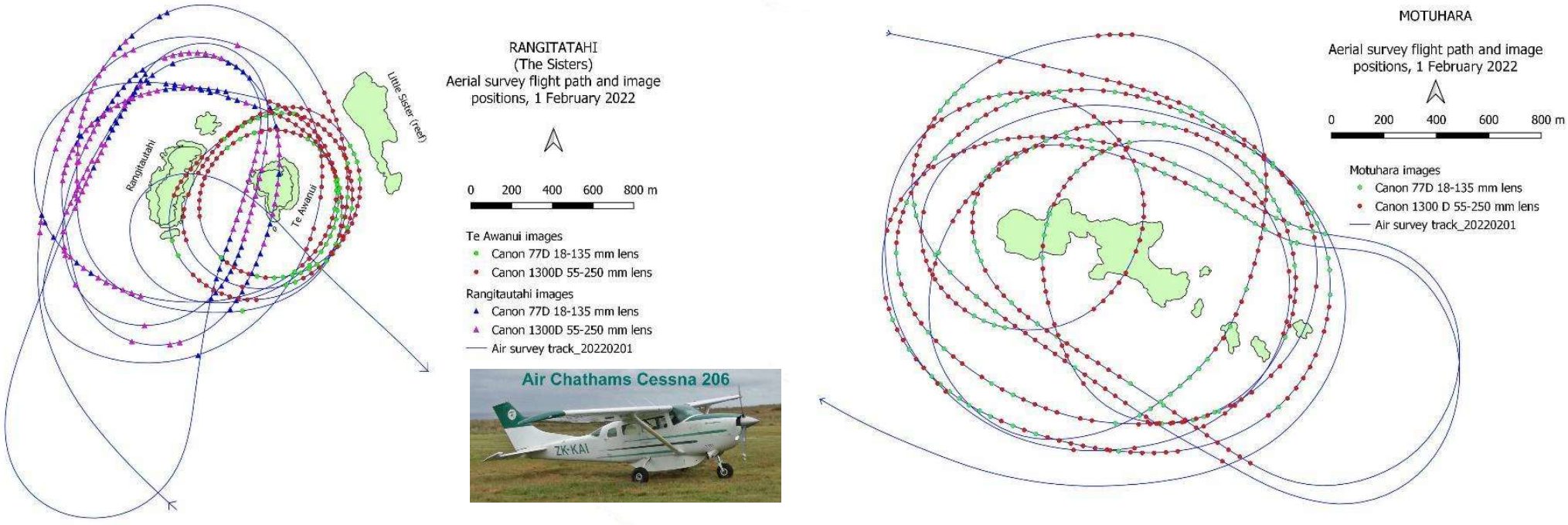
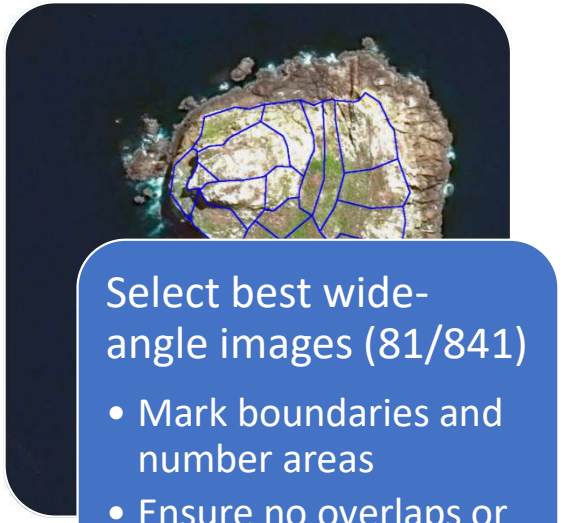


Table 1. Basic flight parameters

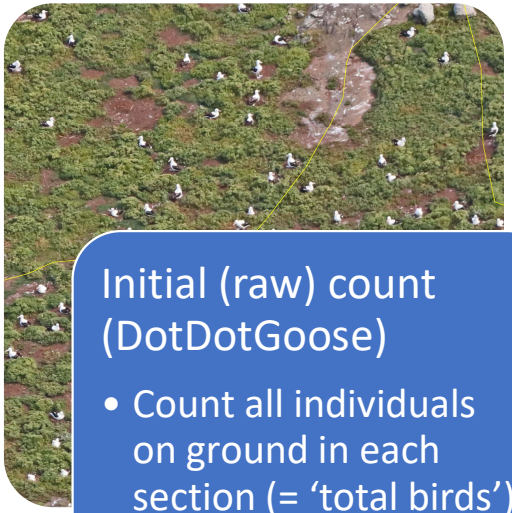
Island group	Number of circuits	Survey time (mins)	Mean airspeed (±1 SD), kph	Mean altitude (±1 SD), m a.s.l.	Distance offshore Mean (SD, Range)	Number of images
Rangitatahi	**9**	13.4	159 (13.6)	273 (22.4)	298 (97; 107-640)	620
Motuhara	**7**	12.5	161 (11.3)	243 (22.9)	361 (139; 32-678)	688

Fig. 3. Process



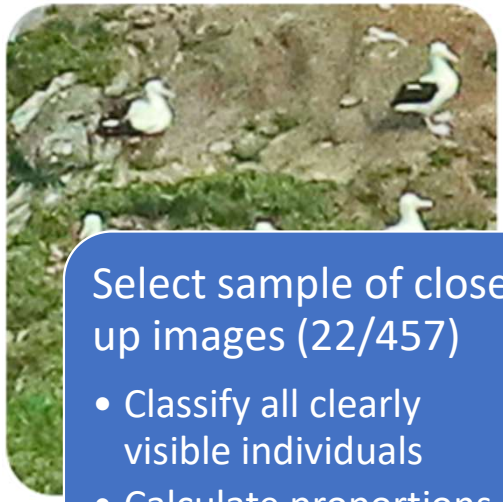
Select best wide-angle images (81/841)

- Mark boundaries and number areas
- Ensure no overlaps or gaps (i.e., no double-counting)



Initial (raw) count (DotDotGoose)

- Count all individuals on ground in each section (= 'total birds')
- Roughly categorise them based on apparent activity



Select sample of close-up images (22/457)

- Classify all clearly visible individuals
- Calculate proportions in each class (ignoring uncertain birds)
- Adjust totals (AON)

Fig. 4. Principal survey strata

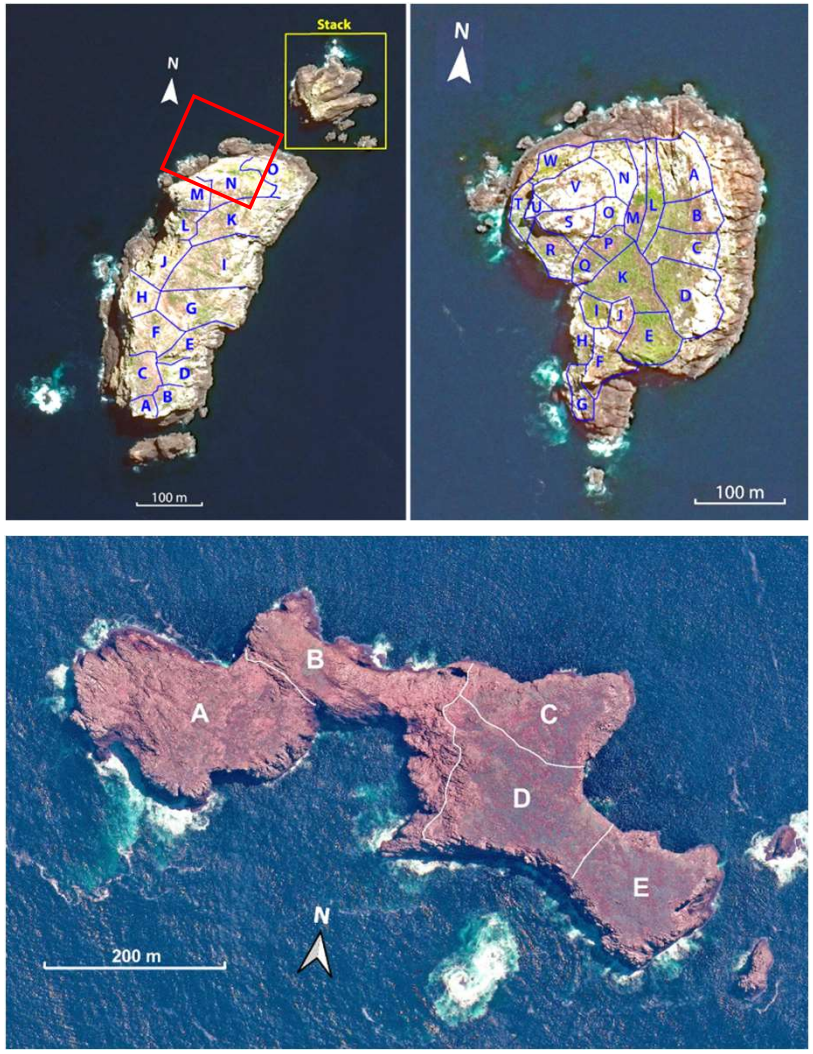


Fig. 5. Example of sub-strata from opposite viewpoints

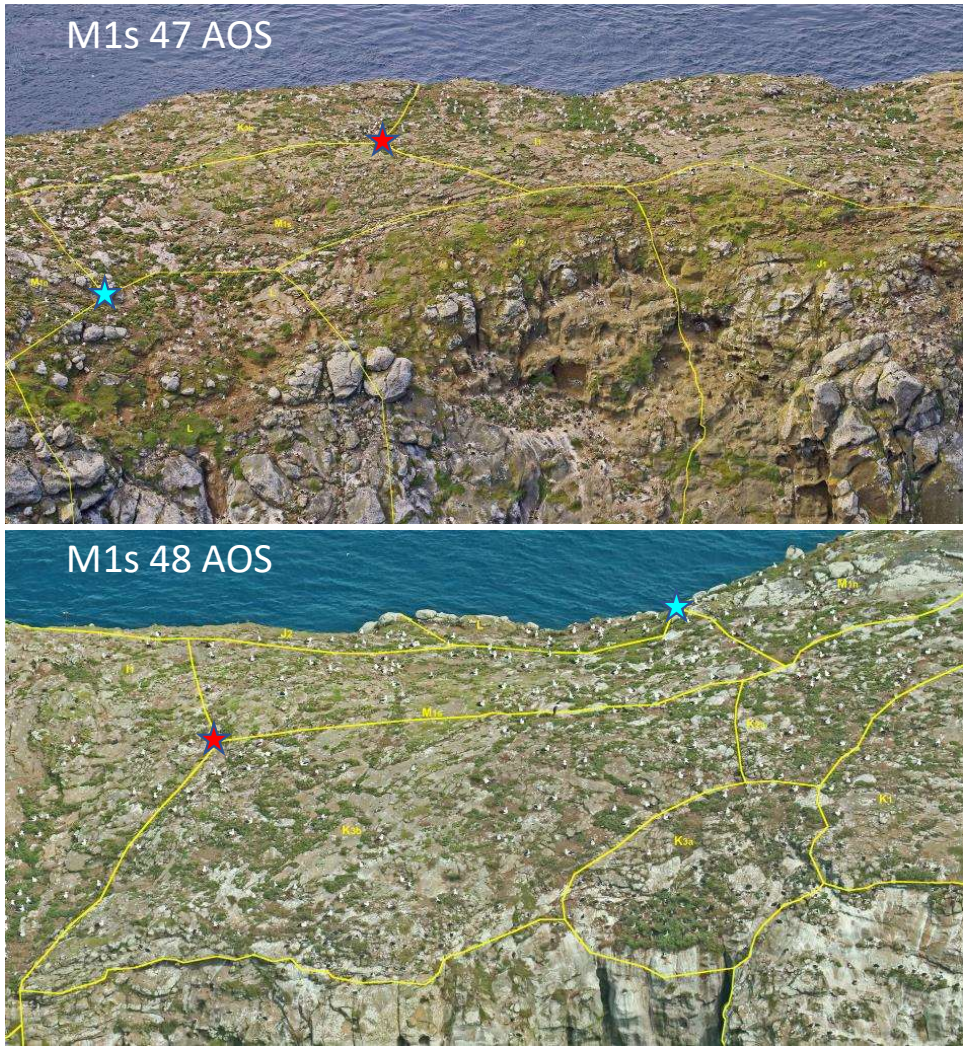


Fig. 6. Behavioural classes derived from close-up images

D – transient or loafing bird

C – bird on nest with partner

B – adult guarding chick

A – incubating

} AON

Island	# Images	Birds assessed
Rangitautahi	6	742
Te Awanui	10	652
Motuhara	6	1331

Unclassified birds made up 8–16% of these totals

Table 2. Initial ('raw') counts of numbers of individuals in different classes, and the adjusted number in each class after applying correction factors based on proportions of individuals in each class as observed in close-up photographs. Single-sample 95% confidence limits are given in parentheses (using the *poisson.exact* function in R package *exactci*).

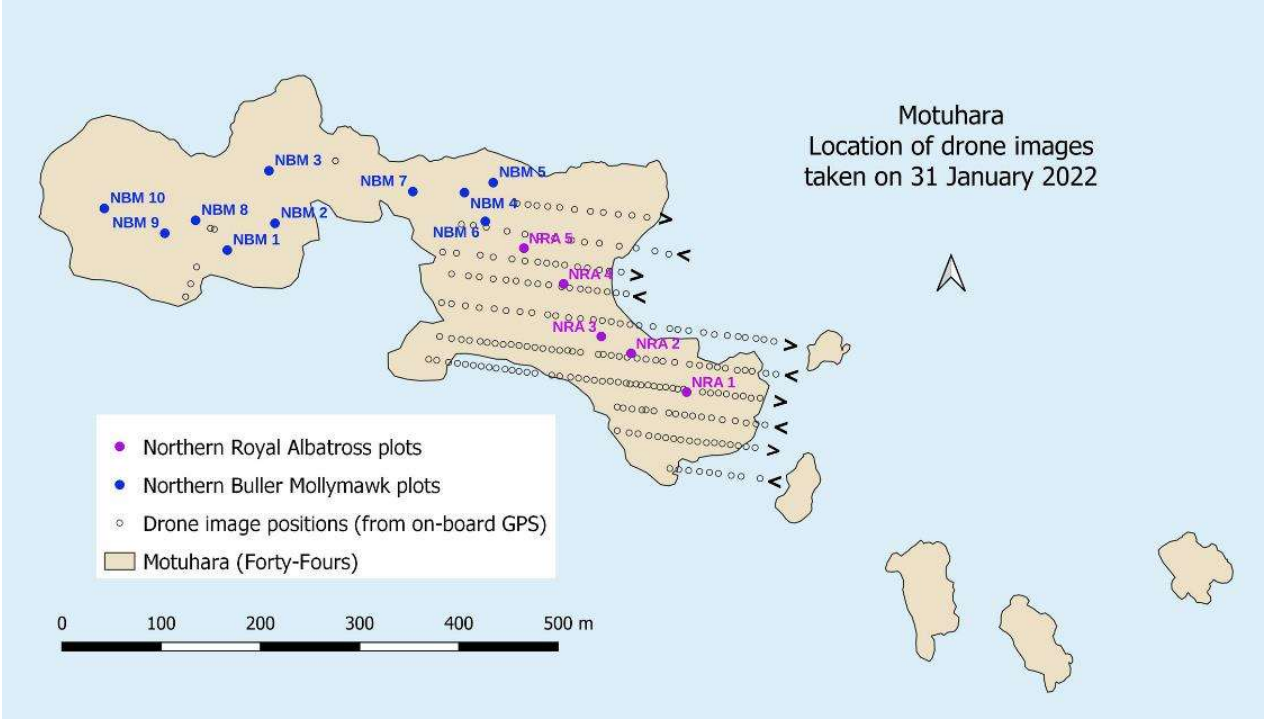
	Motuhara			Rangitautahi			Te Awanui		
Behaviour class	Raw count	*Proportion*	Adjusted count	Raw count	*Proportion*	Adjusted count	Raw count	*Proportion*	Adjusted count
On nest	1594 (1517-1674)	*0.939*	1601 (1501-1704)	988 (937-1062)	*0.899*	993 (911-1087)	665 (615-718)	*0.917*	675 (506-756)
Partner	32 (22-45)	*0.018*	31 (29-33)	35 (24-49)	*0.025*	32 (25-30)	14 (8-24)	*0.025*	18 (17-21)
Loitering/ in transit	72 (56-91)	*0.043*	73 (69-78)	59 (45-76)	*0.076*	72 (77-92)	41 (29-56)	*0.058*	43 (38-48)
Uncertain	7 (3-14)			13 (7-22)			16 (9-26)		
Total	**1705** (1598-1815)		**1705** (1599-1815)	**1105** (1013-1209)		**1105** (1013-1209)	**736** (661-824)		**736** (561-825)

Table 3. How do the number of Apparently Occupied Nests (AON) at hatching (in blue below) compare with previous counts?

Nesting stage	Month/Year	Motuhara	Rangitautahi	Te Awanui	Total
Incubation	November 2016	1726	1754	1293	4773
Incubation	December 2017	1789	1317	813	3919
Incubation	December 2020	1696	1368	930	3994
Mean AOS incubating (± 1SD)		*1737 ± 47*	*1480 ± 239*	*1012 ± 250*	*4229 ± 473*
Hatching	February 2022	1601	993	675	3269
Near-fledging	July 2017	1003	574	539	2116
Fledging	August 2018	1194	550	405	2149
Fledging*	September 2020	1202	483	357	2043
Mean number fledging (± 1 SD)		*1133 ± 113*	*536 ± 47*	*437 ± 94*	*2103 ± 54*

* September 2020 counts adjusted for the number of chicks assumed to have already fledged (12%) based on data on time-course of fledging of chicks at Taiaroa Head (2017-2020) (Frost 2021a)

Fig. 7. Location of Northern Royal Albatross and Northern Buller's Mollymawk monitoring quadrats on Motuhara, and the positions of drone images taken during the survey of NRA nesting areas carried out by Mike Bell on 31 January 2022.

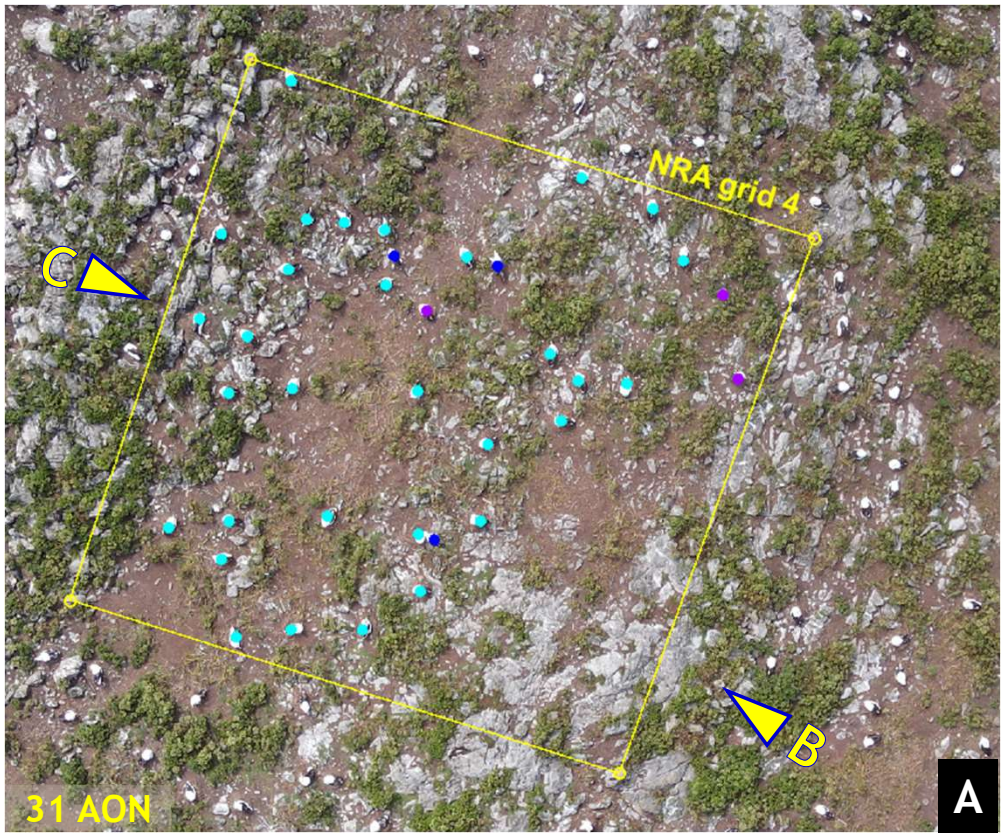


Note that the positions of the drone images are about 50-80m out along the drone flight lines [**<, >**], indicating a delay in coordinate registration

Table 3. Counts of Northern Royal Albatross nests and contents located within five 20 x 20 m quadrats (Bell 2022. Motuhara seabird research: field trip report January 2022. Draft report to Department of Conservation, July 2022)

AON

Study grid	Egg	Chick	Failed	Total
Grid 1	7	16	0	23
Grid 2	12	17	2	31
Grid 3	12	26	1	39
Grid 4	10	20	5	35
Grid 5	8	20	2	30



AON (adult) AON (adult + chick) Partner Loafer

Fig. 8. Comparison of views and counts of Northern Royal Albatross apparently on nests (AON) as seen from a drone image (A) and two opposing aerial images (B, C).

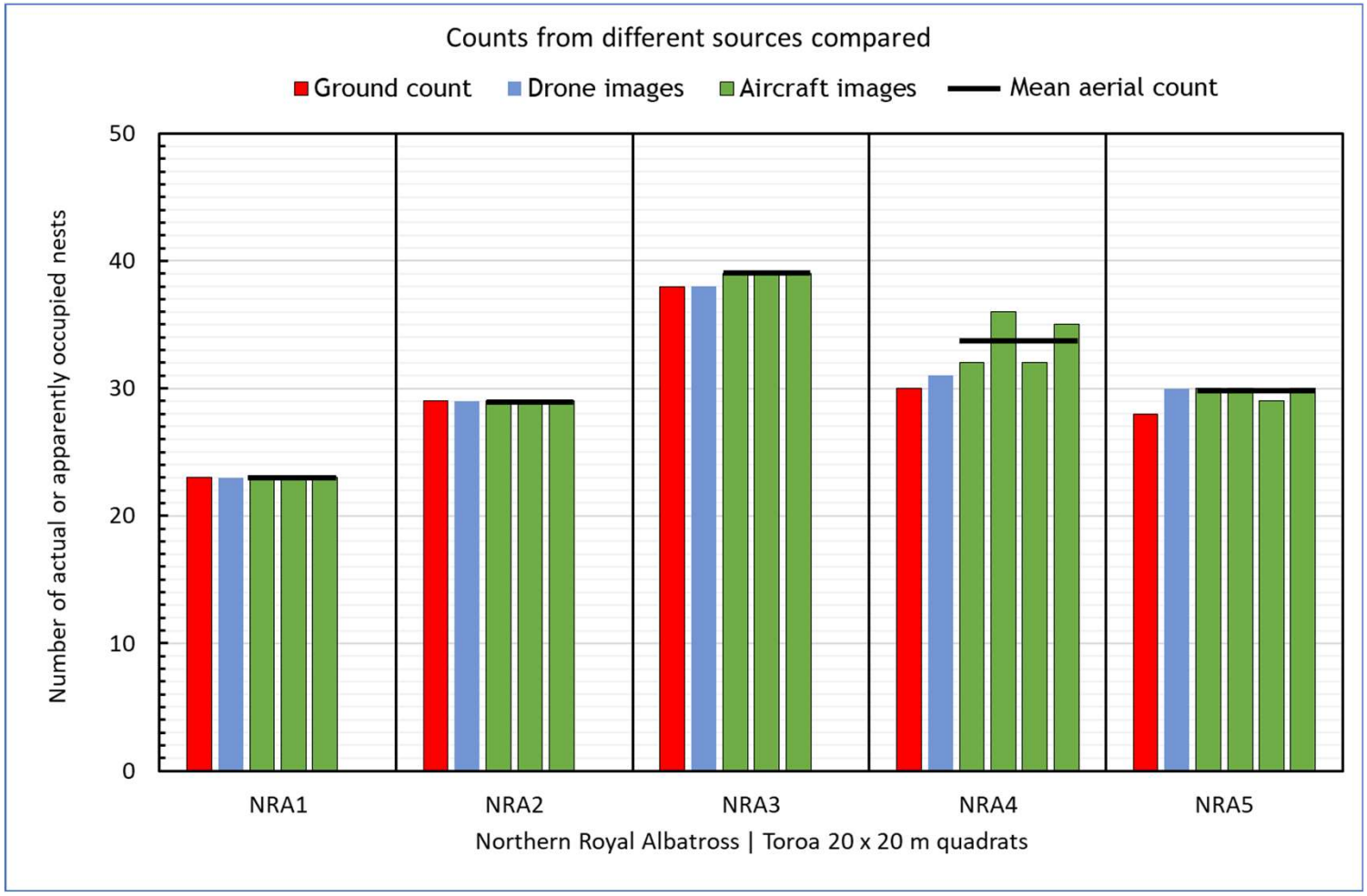


Fig. 9. Counts of Northern Royal Albatross in monitoring quadrats obtained from different sources were reasonably consistent (but with some exceptions)

Difficulties encountered in interpreting imagery

Drone imagery

- Distinguishing birds sitting on nests or brooding chicks from birds standing around when viewed vertically.
- Are birds that are intersected by the drawn lines between corner markers ‘in’ or ‘out’ of a quadrat?

  (Boundary lines were assessed visually from point to point when quadrats were surveyed in the field.)

  On-the-ground surveyors and air-photo analysts need an agreed protocol

Aerial photographs

- Locating quadrat corner markers.
- Telephoto compression of the square quadrats leading to the position of individuals being distorted relative to each other.
- Some birds obscured by the presence of other birds, by rocks, or by vegetation.
- Behaviour of individuals not always clear.
- Are birds close to the boundary lines ‘in’ or ‘out’ of a quadrat?

Nesting of Northern Buller's Mollymawk on Motuhara, February 2022

Northern Buller's Mollymawk

Breeding confined to Motuhara and Rangitatahi (17,967–19,650 pairs):

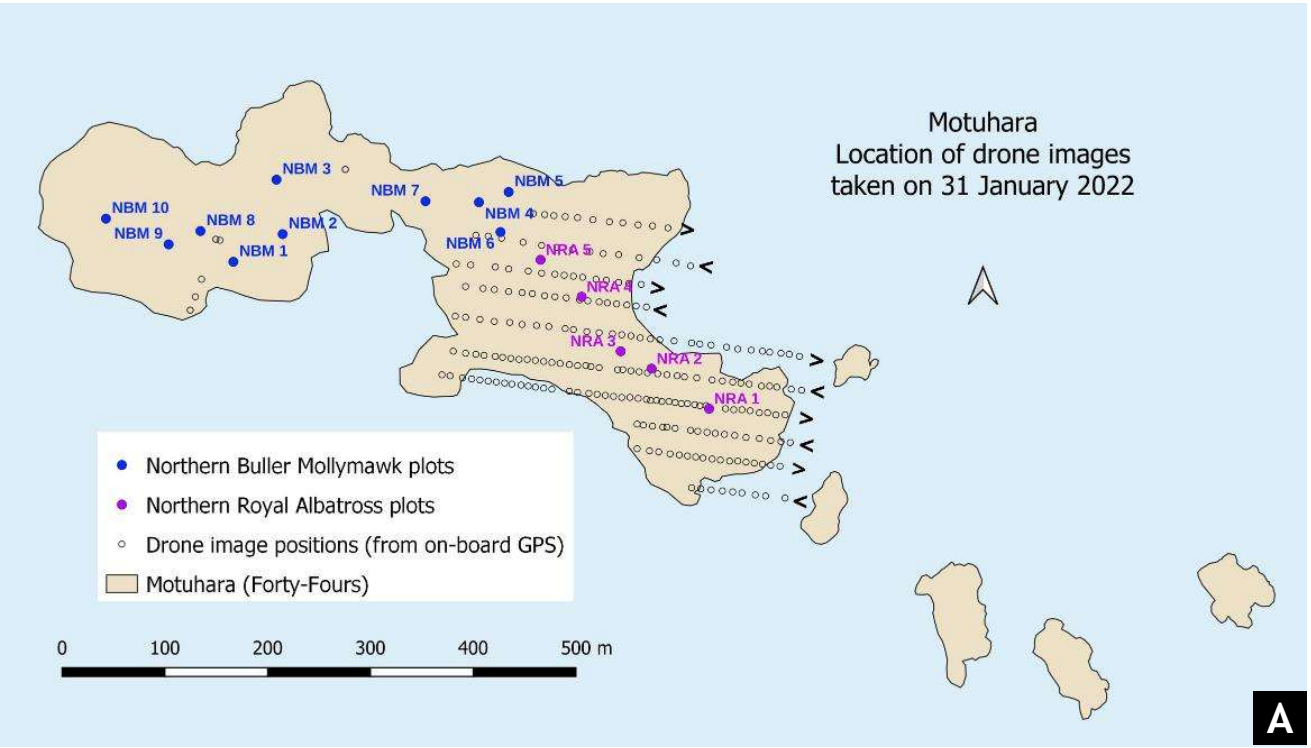
Motuhara (c.85%), Rangitautahi (c.12%), Te Awanui (c.3%); Baker et al. 2017; Bell et al. 2016, 2017

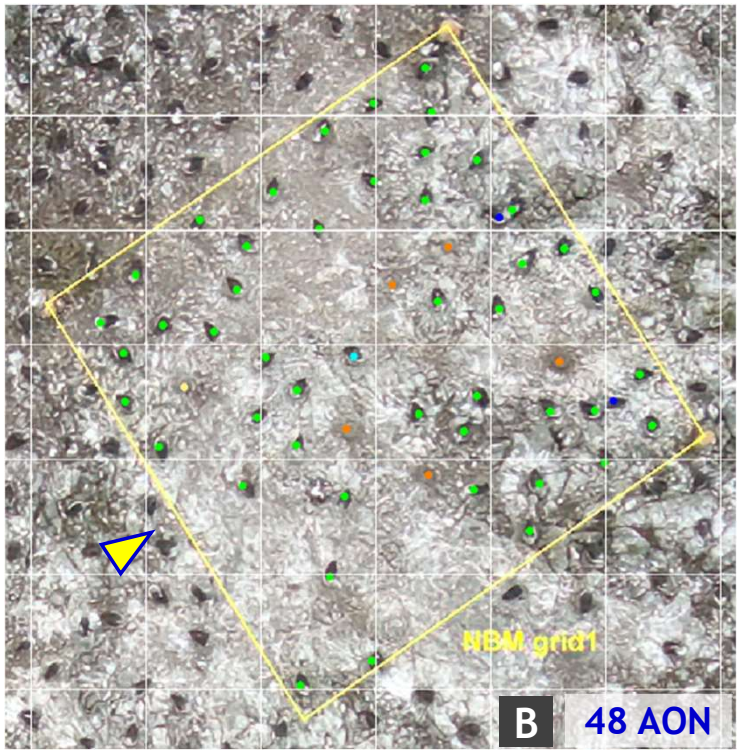
Fig. 10. On Rangitautahi and Te Awanui, most birds nest in recesses and on ledges on cliffs

Fig. 11. On Motuhara, most birds nest on the lower western plateau, as well as on cliffs and in fissures

To enable more frequent monitoring, five 10 x 10 m quadrats were laid out on Motuhara 2007-2008 (Fraser et al. 2010). Possible to monitor these from the air as well as on the ground.

In 2022, another five 10 x 10 m quadrats were laid out by Mike Bell (Bell 2022)





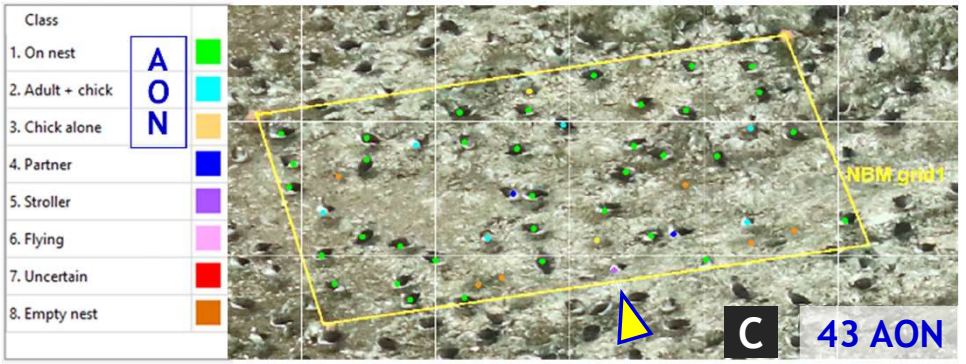


Fig. 12. A. Location of 10 x 10 m monitoring quadrats for nesting Northern Buller's Mollymawk. The number of occupied nests (eggs or chicks) were counted on the ground on 29 January 2022 (Mike Bell). Several quadrats were also covered by drone imagery taken on 31 Jan 2022 (B), and aerial imagery taken on 1 Feb 2022 (C).

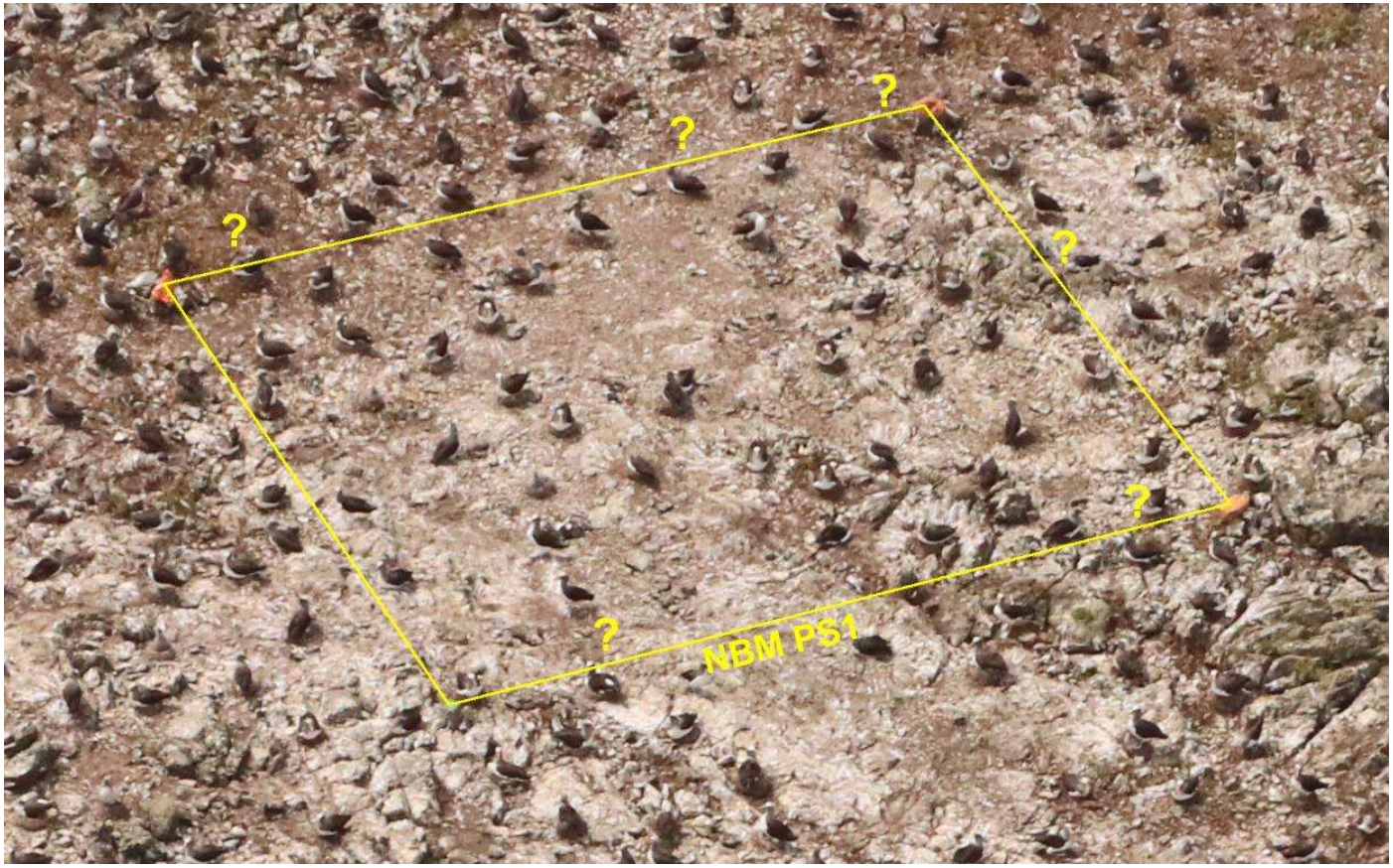


Fig. 13. Deciding which birds are ‘in’ or ‘out’ of the quadrats and which birds are sitting on low nests as opposed to just sitting around, are similar problems to those encountered when analysing toroa quadrats from oblique-angle aerial photographs.

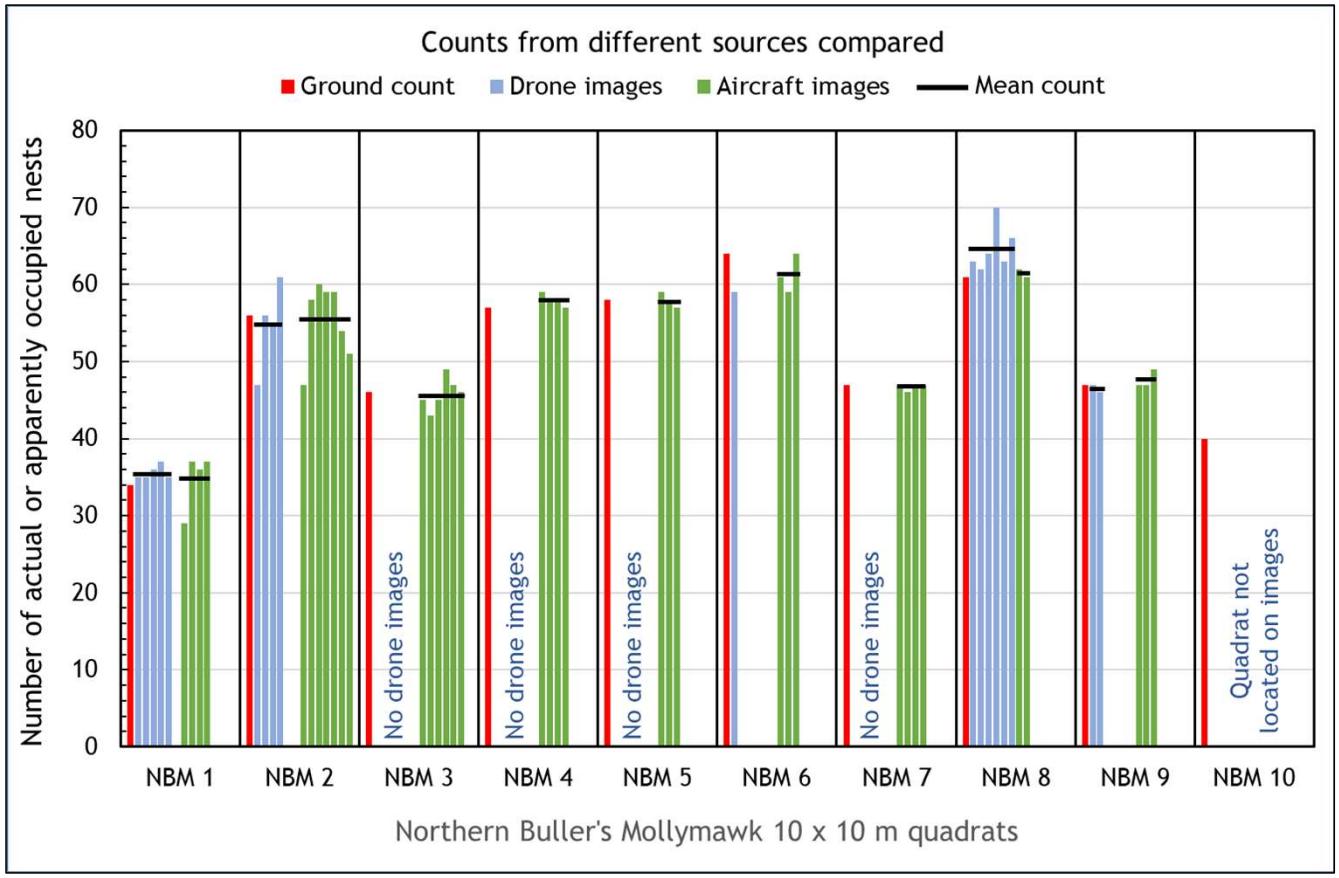


Fig. 14. Somewhat less consistency in the counts obtained from different sources, compared to the toroa quadrats. *A product of small quadrat size (high edge-to-area ratio) and higher density of birds = more 'uncertainty'*

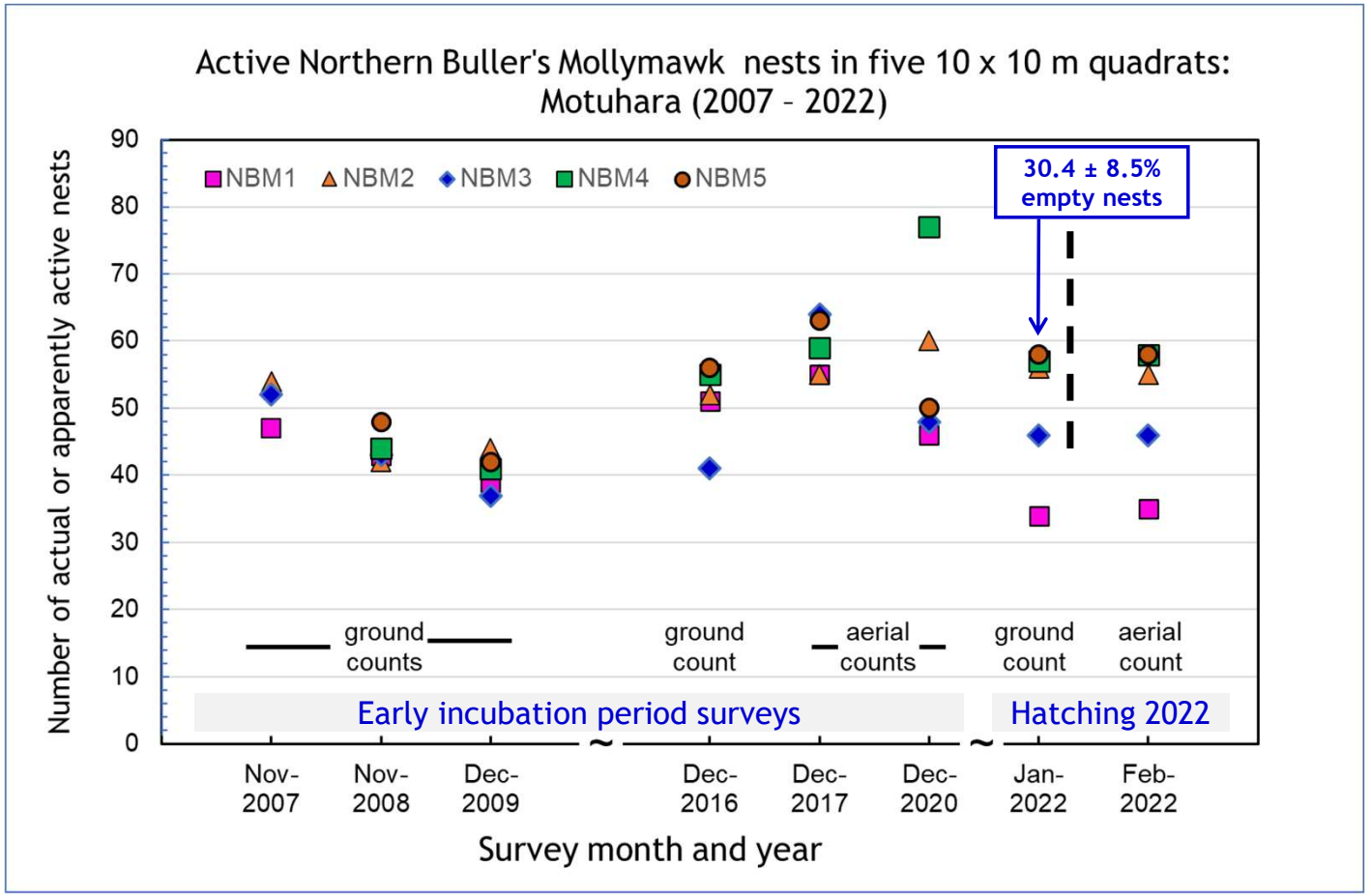


Fig. 15. Variations over time in counts of nesting NBM in five long-term monitoring quadrats. *To what extent do these variations reflect actual population changes as opposed to being due to assessment errors or differences in survey timing?*

Conclusions

- No obvious change in size of the Northern Royal Albatross|Toroa population. *The number of apparently nesting birds is broadly in line between previous estimates of the initial number of incubating birds and the number of chicks eventually fledging.*
- Apparent changes in the Northern Buller's Mollymawk population on Motuhara, as determined from the quadrat surveys, are difficult to assess because of differences in survey approaches and assumptions. *The population may even be increasing.*
- Currently no practical alternative to monitoring these populations through aerial survey, backed up by periodic ground surveys (supplemented with drone imagery), *but the intermittent nature of these surveys leaves gaps in our understanding.*

Recommendations

- Regular, twice-yearly, coordinated aerial and ground surveys of breeding Northern Royal Albatross —ideally in December, soon after egg laying has been completed, and in August, just before the chicks fledge—would enable more robust assessment of this species' population dynamics.
- Given the establishment and on-going monitoring of Northern Buller's Mollymawk numbers in permanent quadrats, another ground survey of this species on Motuhara would be useful, to test if the changes seen in these monitoring plots mirror wider changes in the population.
- Need to develop protocols to ensure that ground counts and aerial counts are comparable.

Acknowledgements

Sincere thanks to

- Gemma Greene and Levi Barton for arranging the flight, taking the aerial photographs, answering queries and supplying additional information
- Mike Bell for providing the drone images and his data from the ground counts of the NRA and NBM survey quadrats, and for feedback and discussion
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