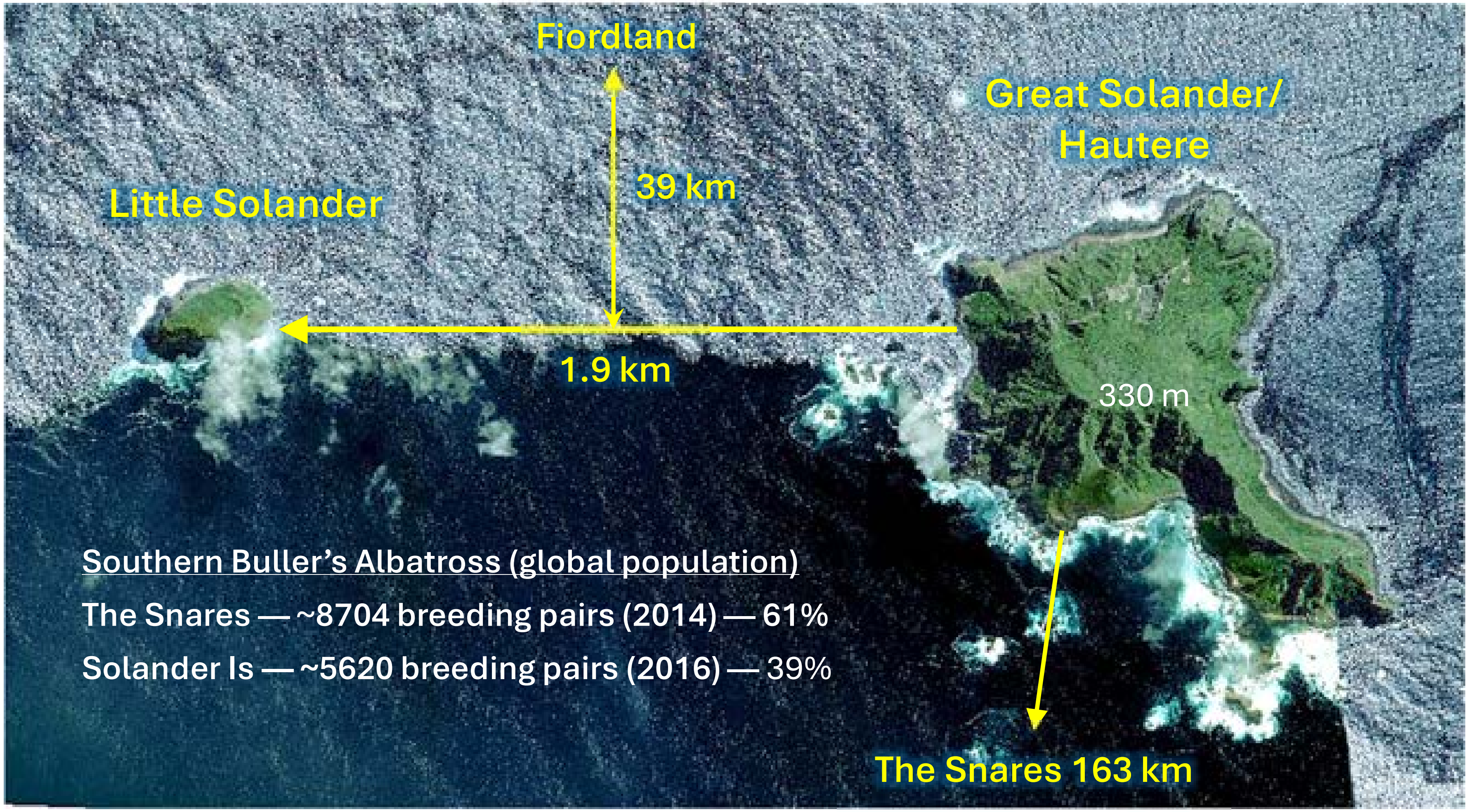
Aerial survey of nesting Southern Buller's Albatross on the Solander Is, March 2024

Peter Frost, Barry Baker, Johannes Fischer, Paul Sagar


Fiordland
Great Solander/
Hautere
39 km
Little Solander
1.9 km
330 m
Southern Buller's Albatross (global population)
The Snares — ~8704 breeding pairs (2014) — 61%
Solander Is — ~5620 breeding pairs (2016) — 39%
The Snares 163 km

Objectives for 9 March 2024 survey

- Undertake an aerial photographic survey of the Solander Islands | Hautere
- Analyse the aerial images to assess the present status of Southern Buller's Albatross breeding on the islands
- (Carry out on-ground vantage-point survey to calibrate the aerial survey counts)[1]
- Compare the results of this survey with those done previously

Apparently occupied nests (AOS) — most egg-laying completed by end of January

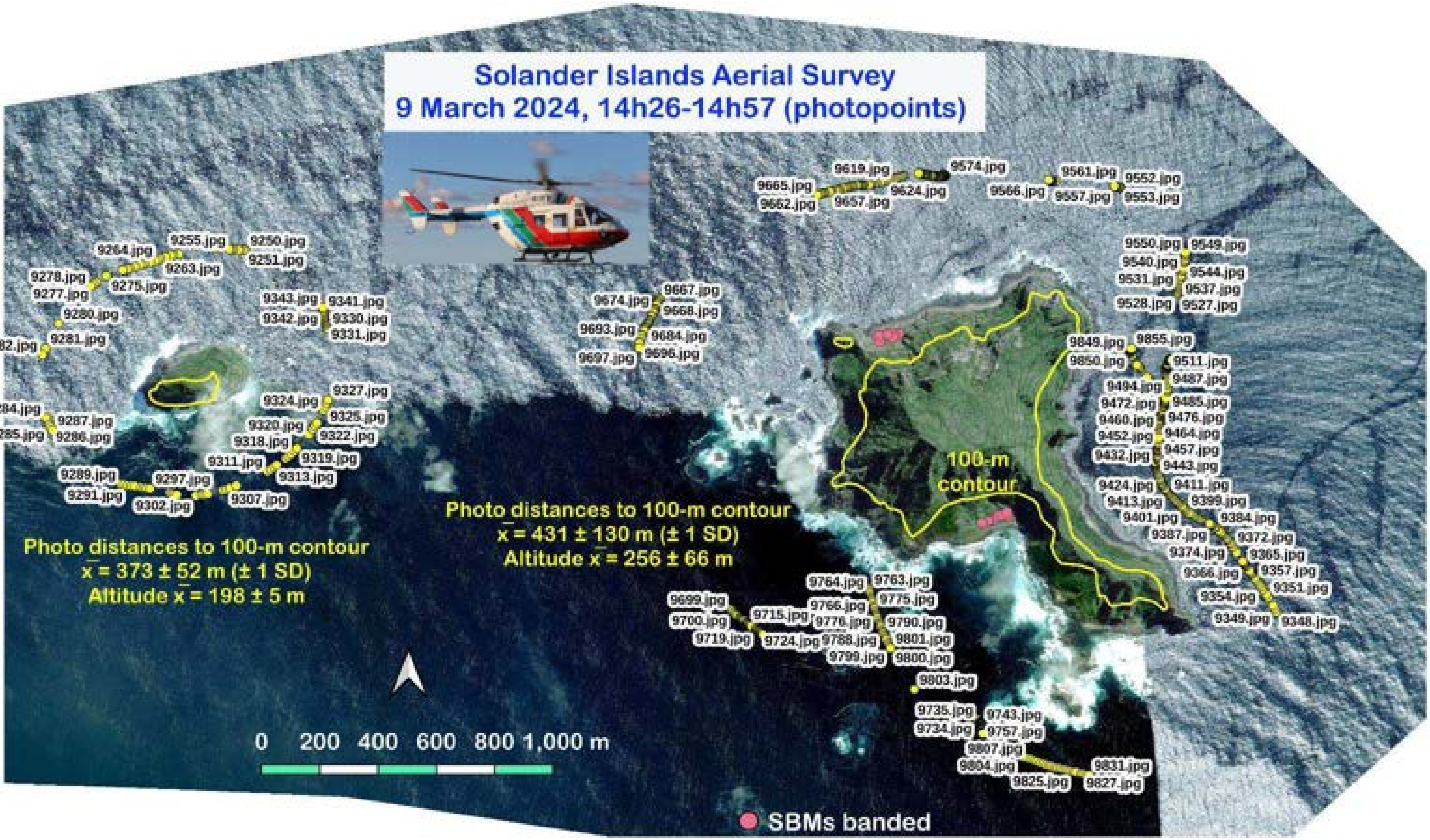
Year	Survey type and dates	Count (AOS)	
1996	Ground survey[2] (16–22 Feb), Aerial survey[3] (15 Feb)	4147[4]	Sagar et al. 1999
2002	Ground survey (22 Feb–8 Mar), Aerial survey (20 Feb)	4912	Sagar & Stahl 2005
2016	Ground survey (25–29 Feb), Aerial survey (29 Feb)	5620	Thompson et al. 2017

[1] No vantage point counts, only proportion of occupied nests (0.62, n = 54) with an incubated egg

[2] Accessible areas searched on foot; inaccessible areas surveyed from vantage points

[3] Aerial survey by helicopter—counts only of areas not covered by ground surveys

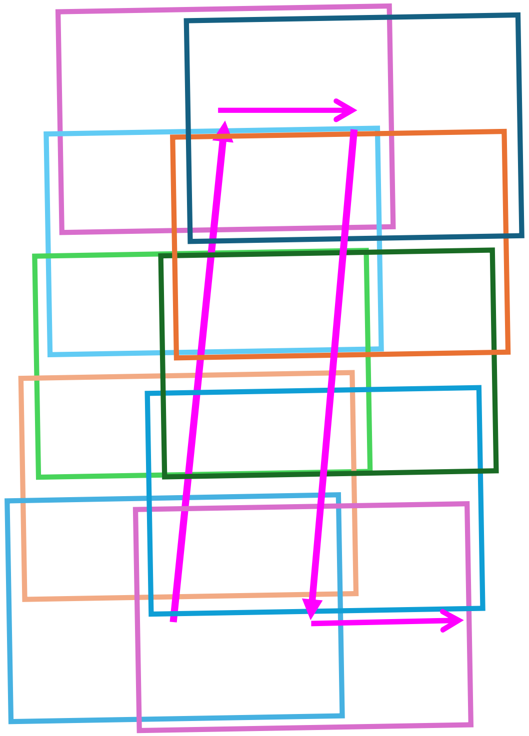
[4] Corrected later to account for missed colonies (Sagar & Stahl 2005)

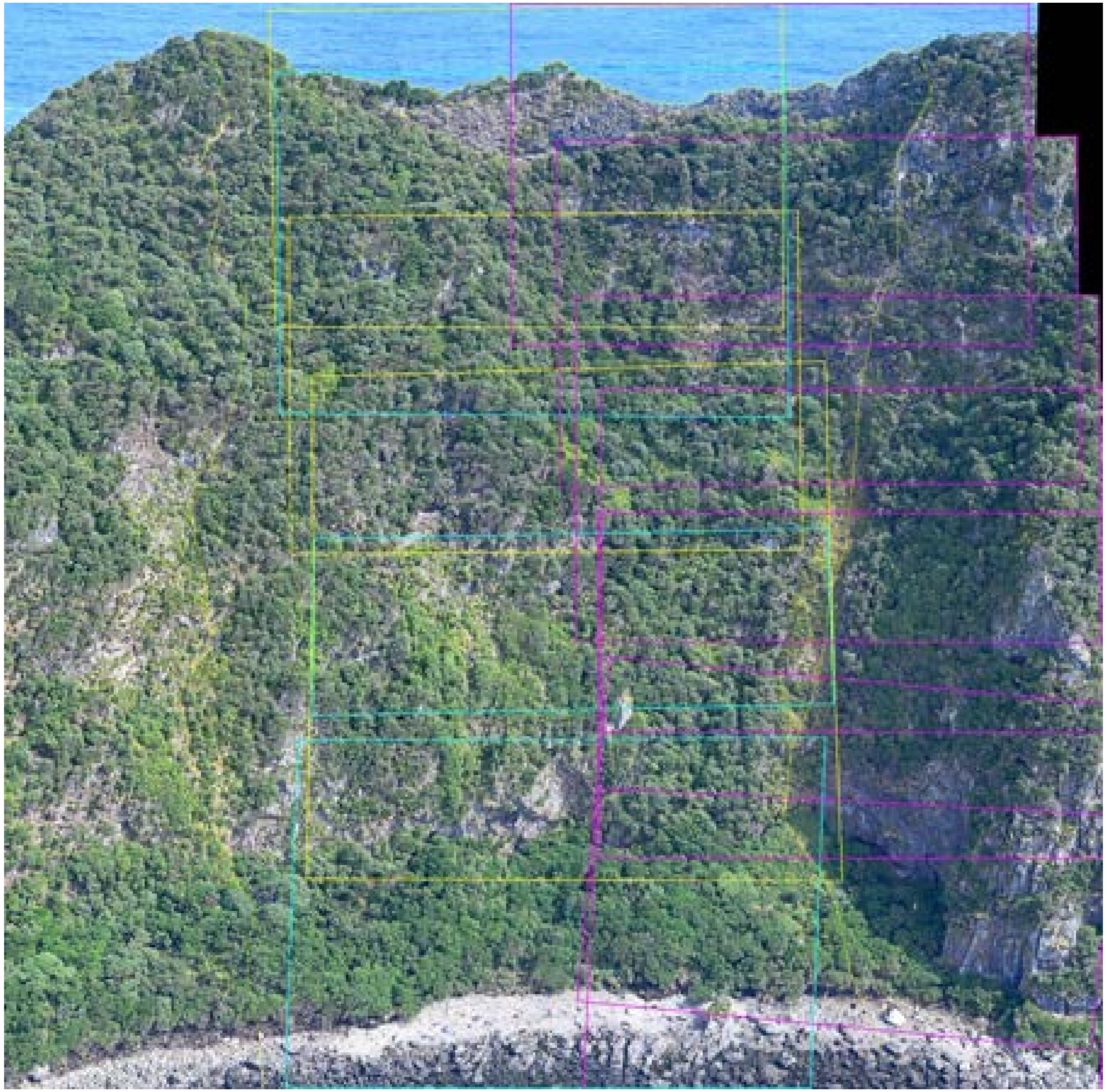


Solander Islands Aerial Survey
9 March 2024, 14h26-14h57 (photopoints)
Photo distances to 100-m contour
$\bar{x}$ = 373 ± 52 m (± 1 SD)
Altitude $\bar{x}$ = 198 ± 5 m
Photo distances to 100-m contour
$\bar{x}$ = 431 ± 130 m (± 1 SD)
Altitude $\bar{x}$ = 256 ± 66 m
100-m contour
0 200 400 600 800 1,000 m
SBMs banded

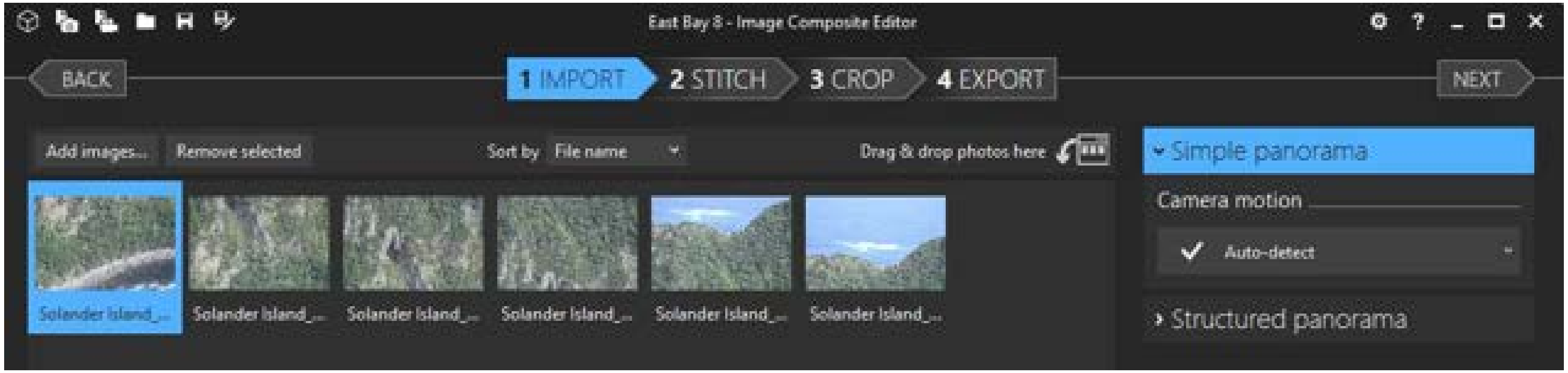

Plateau to 330 m peak
Great Solander | Hautere
Densely wooded, mainly *Macrolearia lyallii*

Images were taken from the seashore vertically up to the horizon then shifted partway to the right before photographing downwards, ensuring sizable overlap among the images, vertically and horizontally



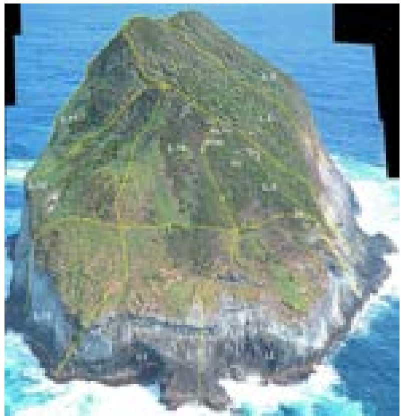


Successive images within a vertical series were stitched together with Microsoft's Image Composite Editor and the resulting product exported at the highest possible resolution. These stitched images were large, some up to 276 Mpx (~240 Mb). 'Ghosting' and 'Deletions' are always a problem with automated stitching.

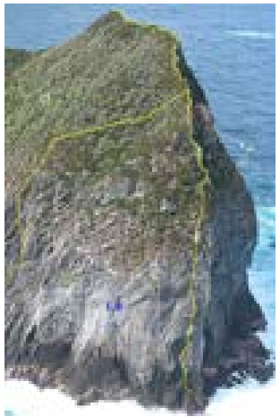


Great Solander was partitioned into 54 unique (non-overlapping, precisely contiguous) parallel sections, almost all photographed at 135 mm focal length

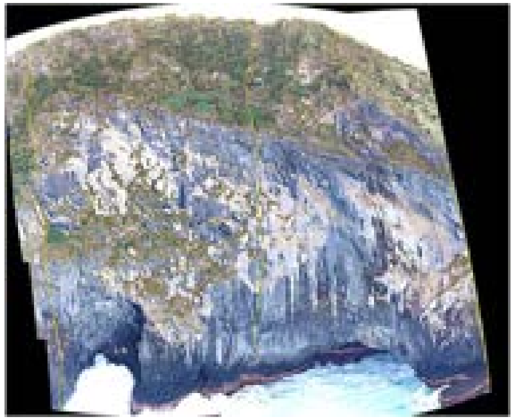
Little Solander presented more of a challenge to stitch because of varying focal lengths used (70–120 mm), but eventually 14 precisely abutting sections were demarcated, covering the whole island.



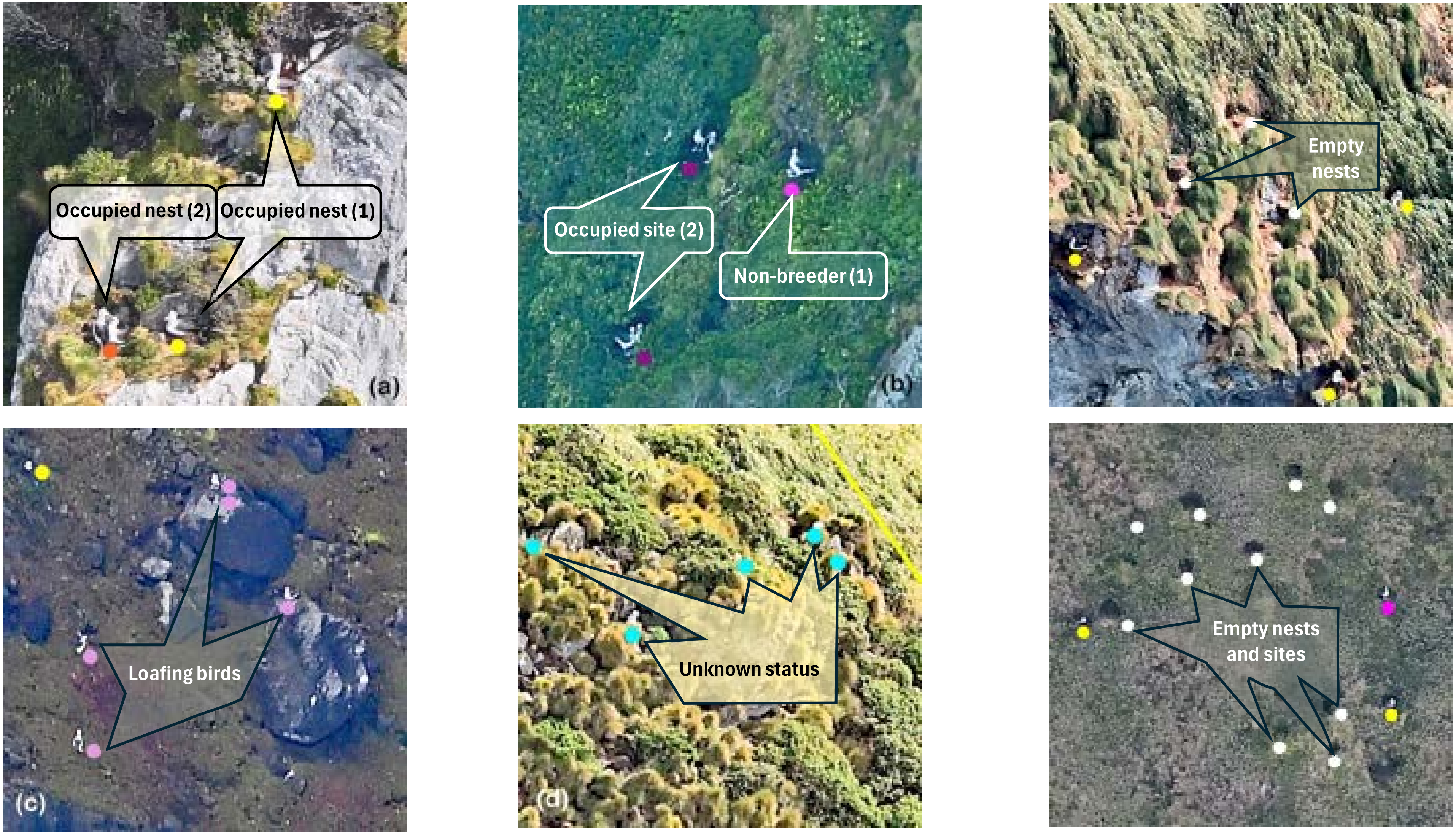
View from East



View from West



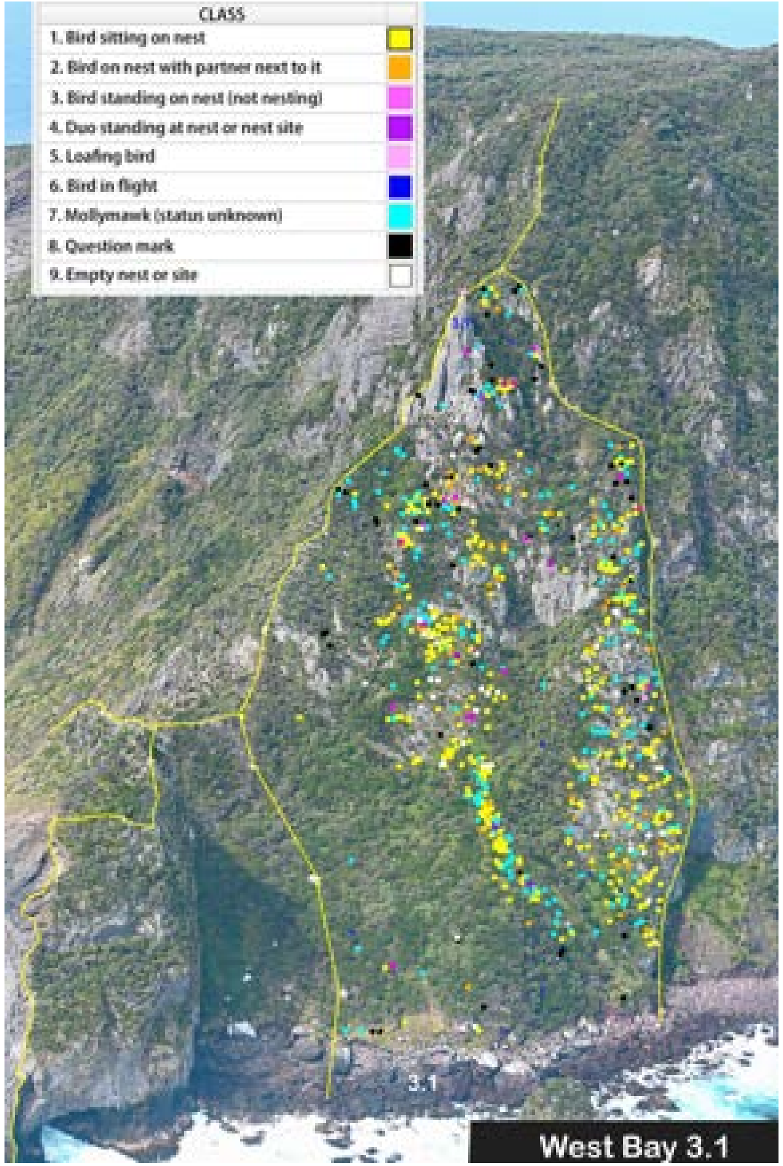
View from South


Occupied nest (2)
Occupied nest (1)
(a)
Occupied site (2)
Non-breeder (1)
(b)
Empty
nests
Loafing birds
(c)
Unknown status
(d)
Empty nests
and sites

Aerial photographs analysed with DotDotGoose

(http://biodiversityinformatics.amnh.org/open_source/dotdotgoose)

- Bird sitting on a nest
- Duo at a nest, one bird sitting
- Bird standing on a nest (assumed to be empty)
- Duo at an assumed empty nest
- Loafing bird not associated with a nest
- Bird present but status unknown
- Empty nest or nest site
- (Bird in flight)



Overall results

Status	Great Solander	Little Solander	Total
Bird on nest (occupied nests) *95% CL*	3537 *3288-3801*	308 *275-344*	3845 *3288-3801*
Bird on nest (additional occupied sites) + partner *(x 2)*	336 *265-422*	32 *22-45*	368 *287-408*
Single standing on 'empty' nest	387 *311-479*	48 *35-64*	435 *346-478*
Duo together on 'empty' nest *(x 2)*	64 *37-108*	10 *5-18*	74 *42-93*
Loafing (other than above)	135 *91-195*	10 *5-18*	145 *96-171*
Known occupied sites	3873 *3722-4030*	340 *297-389*	4213 *4055-4379*
Unknown (21.6 % of all 6771 birds on the ground)	1356 *1203-1524*	106 *87-128*	1462 *1290-1539*

‘Unknown’ birds comprised ~22% of all individuals counted across both islands. How were they considered?

- Assumed that the status of the 1462 ‘unknown’ birds (U) was in the same proportion to those whose status could be determined
- Of the 5309 individuals across both islands whose status had been determined:
  - 4575 were associated with an occupied nest, either as the sitting bird or as its partner:
  - $p(nest_{occ}) = 4575/5309 = 0.862$
  - Of the 4575 birds associated with an occupied nest, 4213 were sitting:
  - $p(sitting|nest_{occ}) = 4213/4575 = 0.921$
- The number of additional nests occupied by the birds whose status could not be determined initially was then estimated as the product of their number (U = 1462) and these two probabilities:
  - Added nests = U * $p(nest_{occ})$ * $p(sitting|nest_{occ})$ = $1462 * 0.862 * 0.921 = 1160$
- This was added to the 4213 known occupied nests to give an estimated total of 5373 occupied nests

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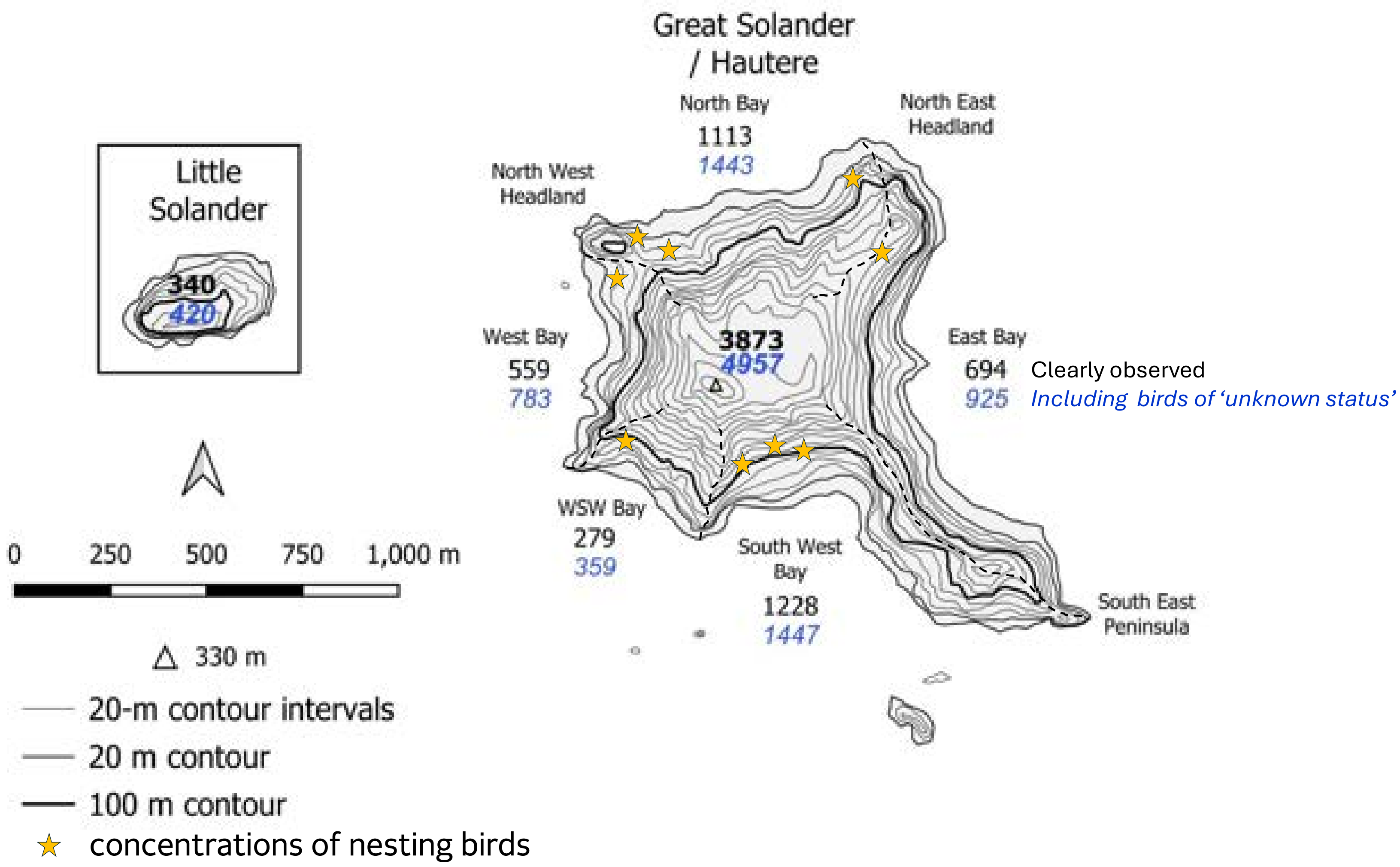
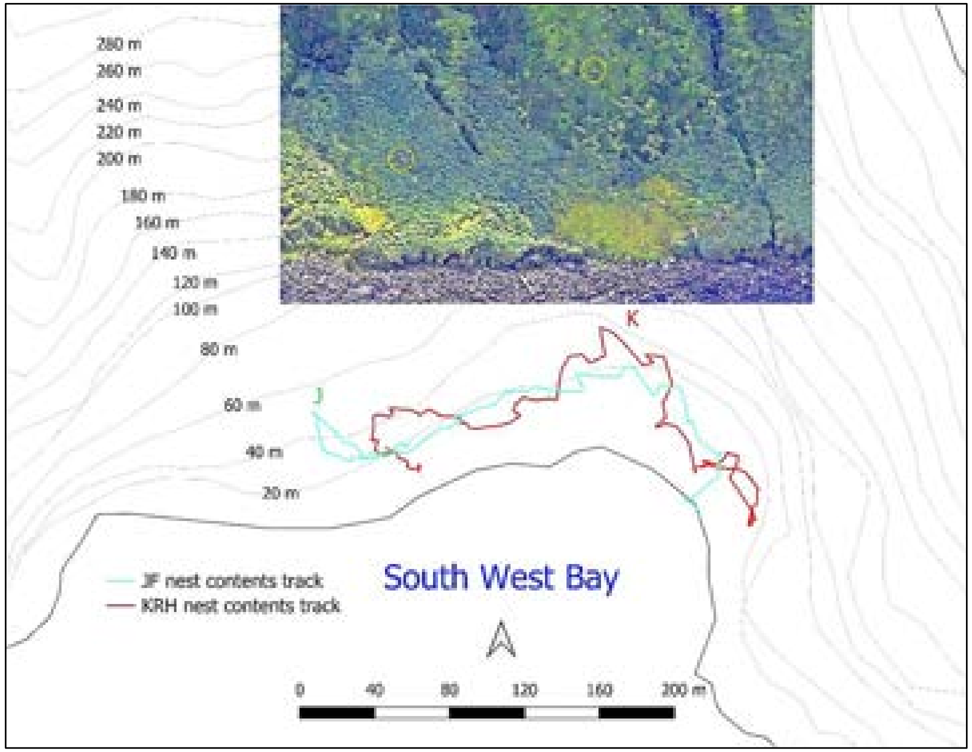
Estimated occupied nests ('unknown' allocated proportionately)	4953 *4774-5148*	420 *367-480*	5373 *5166-5566*

Distribution of <u>occupied nests</u> (may or may not have contained an egg)



Did all apparently occupied nests contain eggs?



On-ground nest contents survey (Sagar et al. 2024)

Transect	Survey time (min)	Distance (m) [1]	Bird on nest, egg	Bird on nest, no egg	Total checked	p(egg)	p(no egg)
k1-4	0:31	560	18	11	29	0.621	0.379
j1-3	0:16	950	10	5	15	0.667	0.333
g1 (N side)	0:19	*550* [2]	5	5	10	0.500	0.500
	1:06	2100	33	21	54	0.623 [3]	0.377

[1] Derived from GPS of tracks

[2] Estimated from distance between banded birds and pick-up point

[3] As given in Sagar et al. (2024) using a more granular survey analysis

In addition, at least 1739 vacant nests and nest hollows were counted across both islands in the aerial images, but these were not necessarily all occupied earlier in the breeding season

How should these data be used?

Are the nest-contents survey results representative of the wide breeding population on both islands?

If they are, should they be applied to the estimated number of occupied nests (5373) to more accurately assess the Southern Buller's Albatross breeding population in 2024 (e.g. 5373 * 0.623 = **3347** nesting pairs)?

Compared with a similarly calculated estimate in 2016 (4579 nesting pairs) **would suggest 27% fewer nesting pairs in 2024**.

What do we know about those birds sitting on or standing around empty nests

Possible nature of a non-breeding bird at a nest site	Adjustment to count
Pre-breeders ('tryers')? (May occupy a nest site for several years before breeding?)	–
Failed breeders (current season)? (May remain in the colony for up to 3 months post-failure)	+
'Widows' or 'widowers' waiting in vain for a partner to return?	–?
Mature birds taking a non-breeding 'sabbatical' ?	+

Southern Buller's Albatross:
comparison of survey results for the Solander Islands 1996–2024

Year	1996 [1]	2002	2016		2024		
Date (ground survey)	16–22 Feb	22 Feb–8 Mar	25–29 Feb		9 Mar (Sagar et al. 2024)		
Date (aerial survey)	15 Feb	20 Feb	29 Feb		9 Mar		
Area / Source	Sagar et al. 1999	Sagar & Stahl 2005	Thompson et al. 2017	If adjusted (p_{egg} = 0.815)	This study (min)	This study (max)	If adjusted (p_{egg} = 0.623)
Great Solander	3885	4579	5280	4303	3873	4953	3085
1. East Bay	709	876	666	543	694	923	575
2. North Bay	1086	1162	778	634	1113	1445	900
3. West Bay	387	489	829	676	559	783	488
4. WSW Bay	306	362	481	392	279	359	224
5. SW Bay	1397	1690	2536	2067	1228	1446	901
Little Solander	262	333	340	277	340	420	262
Solander Is total	**4147**	**4912**	**5620**	**4580**	(min) **4213**	(max) **5373**	**3347**
% difference from previous survey		*+18.4*	*+14.4*		*-25.0*	*-5.9*	*-26.9*

Conclusions and recommendations

- Up to 27% fewer pairs may have bred on the Solander Islands in 2024 than in 2016. This does not necessarily mean an overall decline in the Southern Buller's Albatross population, given the apparently large number of non-breeding birds present.
- More needs to be known about birds sitting on empty nests, not just what proportion are sitting on nests with eggs. The rest are often treated as a homogenous set—often lumped with floaters, birds not obviously connected to a nest—and written off as non-breeders. These latter birds may comprise failed breeders, pre-breeders and, perhaps, birds taking a sabbatical for some reason. More considered reporting and clearer use of terms would help.
- We need a better understanding of the extent of skipped breeding among mature birds ('breeding sabbaticals'), how it varies across years, and the circumstances in which it occurs (e.g., poor physical condition; divorce from, or death of, a partner; etc.). Aside from long-term trends in the breeding population through time resulting from changes in survival and recruitment, we need to better understand and explain annual fluctuations in the number of adults breeding, as assessed in aerial and ground-based surveys.

Conclusions and recommendations (cont.)

- More regular surveys are needed. Rather than trying to photograph both islands overall, establishing a series of survey sites, outlined using natural features as fixed points, might produce more comparable counts through time. These can be anchored periodically by multi-day, whole island, ground and aerial surveys, as done in the past.

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