Taihoro Nukurangi

Salvin's albatrosses at the Bounty Islands: at-sea distribution

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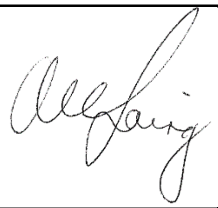	Approved for release by:	Dr Andrew Laing

Contents

Tables

No table of figures entries found.

Figures

Executive summary

A total of 50 light-based geolocation data-logging devices were deployed on breeding Salvin's albatrosses *Thalassarche salvini* at Proclamation Island, Bounty Islands, in October 2012. In October 2013, a return visit to the Bounty Islands resulted in the retrieval of 23 loggers, with a further six loggers accounted for but missing from the birds on which they were deployed. One additional logger was retrieved from a Salvin's albatross killed as bycatch on a commercial fishing vessel. Twenty loggers remain at large and unaccounted for. Due to technical issues, all loggers had to be returned to the manufacturer in order for location data to be extracted. Of the 24 tags retrieved, data were extracted from 20, and of these seven sets proved to be unusable. The 13 usable data sets ranged in duration from 49 to 371 days, with a mean duration of 161 days. During incubation and chick-rearing, Salvin's albatrosses from the Bounty Islands disperse both north (mostly) and south of the Bounty Islands, remaining towards the east of a line corresponding approximately to 170 degrees east. During the non-breeding period birds traversed the Pacific Ocean to occupy an area off the coast of Chile.

Additional, comparative location data were included from Salvin's albatross breeding at the Western Chain in the Snares group. Salvin's albatross from the Western Chain similarly disperse north and south from the breeding site during incubation and chick-rearing, but tend to remain further to the west, approximately to the west of a line corresponding to 170 degrees east. During the non-breeding period, most Western Chain birds were off the coast of Chile, but a second group of birds occupied an area off the coast of Peru further to the north, between 10 and 20 degrees south. Also, one bird from the Western Chain remained in Australasian seas throughout the non-breeding period. The differences in distribution of the two populations of Salvin's albatross in New Zealand waters have clear implications for exposure to risk from commercial fishing operations. However, the relatively small number of data sets acquired from Salvin's albatrosses from the Bounty Islands preclude drawing firm conclusions with respect to the non-breeding distribution. In particular, questions around whether Bounty Islands birds occupy a single zone off Chile during this period, or whether they also occur off Peru and remain in Australasia, remain to be definitively answered.

1 Introduction

Salvin's albatross *Thalassarche salvini* is essentially endemic to New Zealand. The Bounty Islands support the vast majority of breeding pairs; in October 2013 Baker et al. (2014) recorded nearly 40,000 breeding pairs across the archipelago. Elsewhere in New Zealand, Salvin's albatross breed at the Western Chain in the Snares group: 1,195 and 1,116 breeding pairs were recorded in 2008-09 and 2009-10, respectively (Charteris *et al*. 2009, Carroll *et al*. 2010), suggesting the Western Chain population is relatively stable. Elsewhere, Salvin's albatross may occasionally breed at The Pyramid, Chatham Islands, where two nests were occupied in 1995 (C.J.R. Robertson in Croxall & Gales 1998), and four pairs of Salvin's albatross were recorded at Penguin Island, Crozet Islands, in the southern Indian Ocean in 1986 (Jouventin 1990).

In New Zealand, the conservation status of Salvin's albatross is defined as 'threatened – nationally critical' (Robertson et al. 2013), based largely on a declining population trajectory at the Bounty Islands reported by Amey & Sagar (2013). Further, Salvin's albatross is ranked second of all New Zealand seabird species, behind black petrel *Procellaria parkinsoni*, in terms of risk from commercial fishing activity (Richard & Abraham 2013). Seabird species distributions, and the relationships between seabird distributions and the spatial extent of fishing activity, form an important component in defining the risk from commercial fishing. This project aims to provide at-sea distribution data for Salvin's albatross breeding at the Bounty Islands.

Purpose of the Project:-

Overall Objective

To estimate the at-sea distribution of Salvin's albatross at the Bounty Islands.

Specific Objectives

a. determine the foraging range of Salvin's albatross at the Bounty Islands; and

b. collect information to ground truth aerial survey techniques in 2013.

This report covers specific objective 'a' only.

2 Methods

2.1 Deployment of geolocation loggers

Landings were made on Proclamation Island, the Bounty Islands on 16 and 17 October 2012. In the first instance a geographically distinct area 20 x 5m along a broad ledge at the top of the eastern part of the island was chosen as an appropriate location for the deployment of the geolocation loggers.

Using GPS we determined that this study area is centred at S47.74936 E179.02776. The location of the study colony is indicated in Figure 2-1. In this area (Figure 2-2), breeding Salvin's albatrosses were most abundant in the relatively open areas between boulders, with erect-crested penguins *Eudyptes sclateri* usually nesting adjacent to the boulders. Fewer New Zealand fur seals *Arctocephalus forsteri* occurred in this area than elsewhere on the island making it relatively easy to work and reducing the potential for disturbed seals to cause further disturbance to nesting seabirds. At the Bounty Islands, egg-laying of Salvin's albatrosses occurs from the end of August and the peak of hatching in mid-November, and so during the deployment trip all breeding albatrosses were incubating their single egg.

Figure 2-1: Eastern end of Proclamation Island, the Bounty Islands, taken from anchorage in Bucket Cove, 16 October 2012. The red line shows the width of the study area (approximately 20m).

Figure 2-2: View of the study colony from above. This photograph was taken from approximately the point of the arrow shown in Figure 2-1.

A total of 50 new Biotrack MK3005 (formerly BAS Mk 19) geolocator logging devices were deployed on breeding Salvin's albatrosses. Each logger was packaged in resin, weighed 2.5 g and had a battery life of about five years. Each logger was attached to a plastic leg band by two cable ties which were inserted through holes drilled in the plastic band; the logger was then glued to the plastic band. The process of deploying each logger was as follows. An incubating bird was approached from the front and if it did not show any undue concern (for example, the bird did not stand up) its egg was removed and replaced by a dummy egg, with the natural egg being wrapped in protective material and put in a safe location nearby. The bird was then removed from the nest, fitted with a uniquely numbered stainless steel band on one leg and the plastic band with geolocator attached on the other leg (Figure 2-3). The bird was then released beside its nest and once it had settled on the dummy egg the natural egg was returned and the dummy egg removed. Using this method, all birds returned to their nest and no egg losses were recorded.

Figure 2-3: Salvin's albatross fitted with a geolocator (on red plastic leg band), Proclamation Island, Bounty Islands, 17 October 2012.

2.2 Retrieval of geolocation loggers

Proclamation Island was re-visited in October 2013, and landings were made on three consecutive days (21, 22 and 23 October). Deteriorating weather after these visits prevented any further retrieval opportunities. During these visits, a total of 23 geolocators was retrieved. A further six birds on which a geolocator had been deployed were observed to be missing their loggers, either through a broken plastic leg band or through the plastic band being missing completely. One further geolocator tag was retrieved from a bird captured and killed by a fishing vessel. Therefore, of the original 50 geolocators deployed, 24 were retrieved, a further six were accounted for but were missing, leaving 20 loggers remaining at large on birds that were not observed at the colony during the visits to the island in October 2013.

2.3 Geolocation data

Communicating with the retrieved loggers using established hardware and software protocols proved impossible: all loggers appeared 'dead'. All 24 retrieved loggers were returned to Biotrack Ltd. in the UK for assessment, in the hope that data could be extracted. Discussions with Biotrack revealed that a different temperature chip had been used in the loggers deployed on Salvin's albatross and that this chip resulted in elevated temperature values and increased power consumption. In short, the change of temperature chip effectively reduced the lifespan of the geolocation loggers and the majority had suffered power failure prior to retrieval.

Biotrack Ltd. were able to extract data from 20 of the 24 returned loggers, but on average, the loggers had a lifespan of 125 days, which corresponded to sometime in February 2014. Only two loggers had collected data up to the point of retrieval. Further, of the 20 data sets returned by Biotrack Ltd., seven proved to be unusable, either because the temporal extent of the data was so short, or for unexplained reasons that resulted in entirely unbelievable location data. Consequently, all further data analyses were undertaken on a data set from 13 birds. Summary information on device deployment, data duration and data quality is presented in Table 2-1Table 2-1: Summary information for the 20 geolocation devices from which data were extracted by Biotrack Ltd.

Bird Band No.	Tag No.	Deployed	Data Ends	Data (days)	Useable
14452	V179_005	16.10.12	06.03.13	141	Yes
37177	V179_016	16.10.12	05.02.13	112	No
37183	V179_017	16.10.12	13.02.13	120	Yes
37169	V179_020	16.10.12	30.01.13	107	Yes
29056	V179_024	16.10.12	06.01.13	82	No
29059	V179_025	16.10.12	08.11.12	23	No
29060	V179_026	16.10.12	22.10.13	371	Yes
37176	V179_028	16.10.12	04.01.13	80	No
37180	V179_032	16.10.12	22.10.13	371	Yes
37152	V179_039	16.10.12	05.12.13	50	No
37173	V179_043	16.10.12	09.01.13	85	Yes
37175	V179_051	16.10.12	27.10.12	11	No
29055	V179_053	16.10.12	23.01.13	99	Yes
37153	V179_055	16.10.12	22.12.12	67	No
37171	V179_057	16.10.12	25.01.13	101	Yes
37151	V179_062	16.10.12	04.12.12	49	Yes
37159	V179_079	16.10.12	25.03.13	160	Yes
37161	V179_085	16.10.12	27.03.13	162	Yes
37162	V179_087	16.10.12	27.12.12	72	Yes
37167	V179_088	16.10.12	07.06.13	234	Yes
		Mean Data, Useable (days)		161±109	

Geolocation data were processed following established and standard methods as detailed by Phillips et al. (2004) and Shaffer et al. (2005, 2006). All geolocation locations were combined to generate an overall probability map. All density rasters of geolocation locations were generated using the Kernel Density function in ArcGIS (ESRI, V 10.2; search radius = 200 km; cell size = 50 km). The probability contours (90, 75 and 50%) were created for each density raster using the isopleth function in Geospatial Modelling Environment (Spatial Ecology LLC). Bird location data have been grouped according to stage of the breeding season: August-November were classified as 'incubation, December-March were classified as 'chick-rearing' and combined 'guard' and 'post-guard' stages, and April-July were classified as 'non-breeding'.

Additionally, and for comparison, geolocation data from Salvin's albatross breeding at the Western Chain within the Snares group have also been included with the report, and treated in the same way as outlined above. These geolocation data are unpublished and were acquired as part of an earlier contract to NIWA from the then Ministry of Fisheries. In total, 35 geolocation devices were deployed in the spring of 2008 on Salvin's albatross at the Western Chain, 23 were retrieved in 2009 and a further device was retrieved in 2010. Complete data sets were extracted from all retrieved devices.

Finally, kernel probability contours based on the locations of fishing events contemporaneous with the tracking of Salvin's albatrosses, in this case the start locations of trawls, were generated for trawl fisheries targeting squid, scampi and hoki. All three fisheries have returned Salvin's albatross as bycatch in recent years. Fishing effort kernel plots were laid over bird distribution plots.

3 Results and Discussion

Figure 3-1 summarises the geolocation data acquired from Salvin's albatross at the Bounty Islands. During incubation (August through to November: Figure 3-1, upper panel) birds dispersed both north (mostly) and south of the Bounty Islands, remaining towards the east of a line corresponding approximately to 170 degrees east. By the chick-rearing period (December through to March: Figure 3-1, middle panel), some birds, presumably failed breeders, had already traversed the Pacific Ocean to occupy an area off the coast of Chile, while the remaining birds in New Zealand utilised an area roughly the same as during incubation. During the non-breeding period (April through to July: Figure 3-1, lower panel), the few birds with functioning geolocation loggers (six) were all off the coast of Chile.

By way of comparison, Figure 3-2 summarises similar geolocation data acquired from Salvin's albatross at the Western Chain within the Snares archipelago: the time frames are the same as for Figure 3-1. Salvin's albatross from the Western Chain similarly dispersed north and south from the breeding site during incubation (Figure 3-2, upper panel), but tended to remain further to the west, approximately to the west of a line corresponding to the 170 degrees east line of longitude.

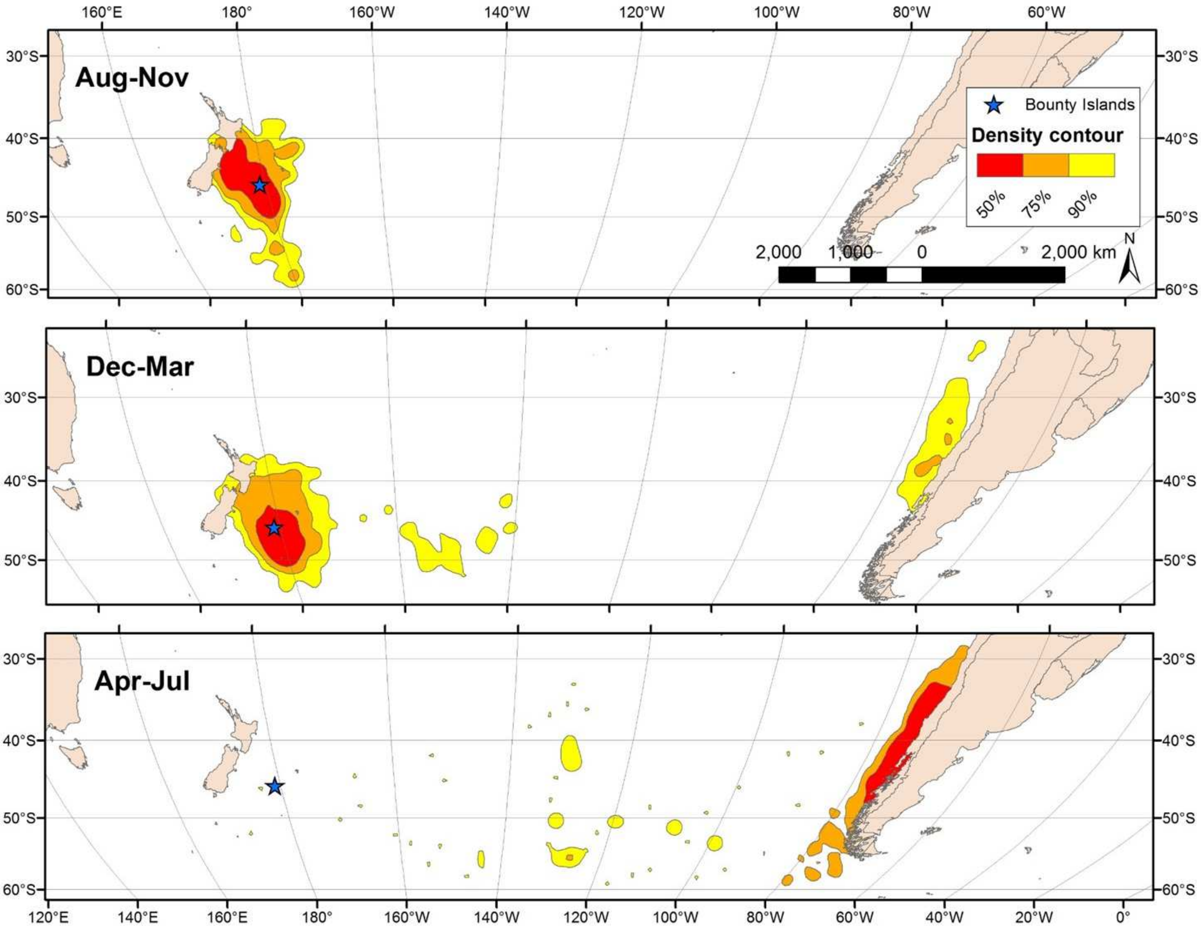

Figure 3-1: Kernel density plots, showing the 90, 75 and 50% probability contours, for Salvin's albatross in the South Pacific Ocean that breed at the Bounty Islands. Upper panel corresponds to 'incubation', middle panel to 'chick-rearing' and the lower panel to 'non-breeding' distributions.

By the chick-rearing period (Figure 3-2, middle panel), some birds, presumably failed breeders, had already traversed the Pacific Ocean to occupy an area off the coast of Chile, while the remaining birds in New Zealand utilised an area roughly the same as during incubation, again remaining to the west of the 170 degrees east line of longitude. During the non-breeding period (Figure 3-2, lower panel), most birds appear off the coast of Chile, but a second grouping of birds occupy an area off the coast of Peru much further to the north, between 10-20 degrees south. Note also that one bird remained in Australasian seas throughout the non-breeding period, and spent some of this time to the north of Tasmania (Figure 3-2, lower panel).

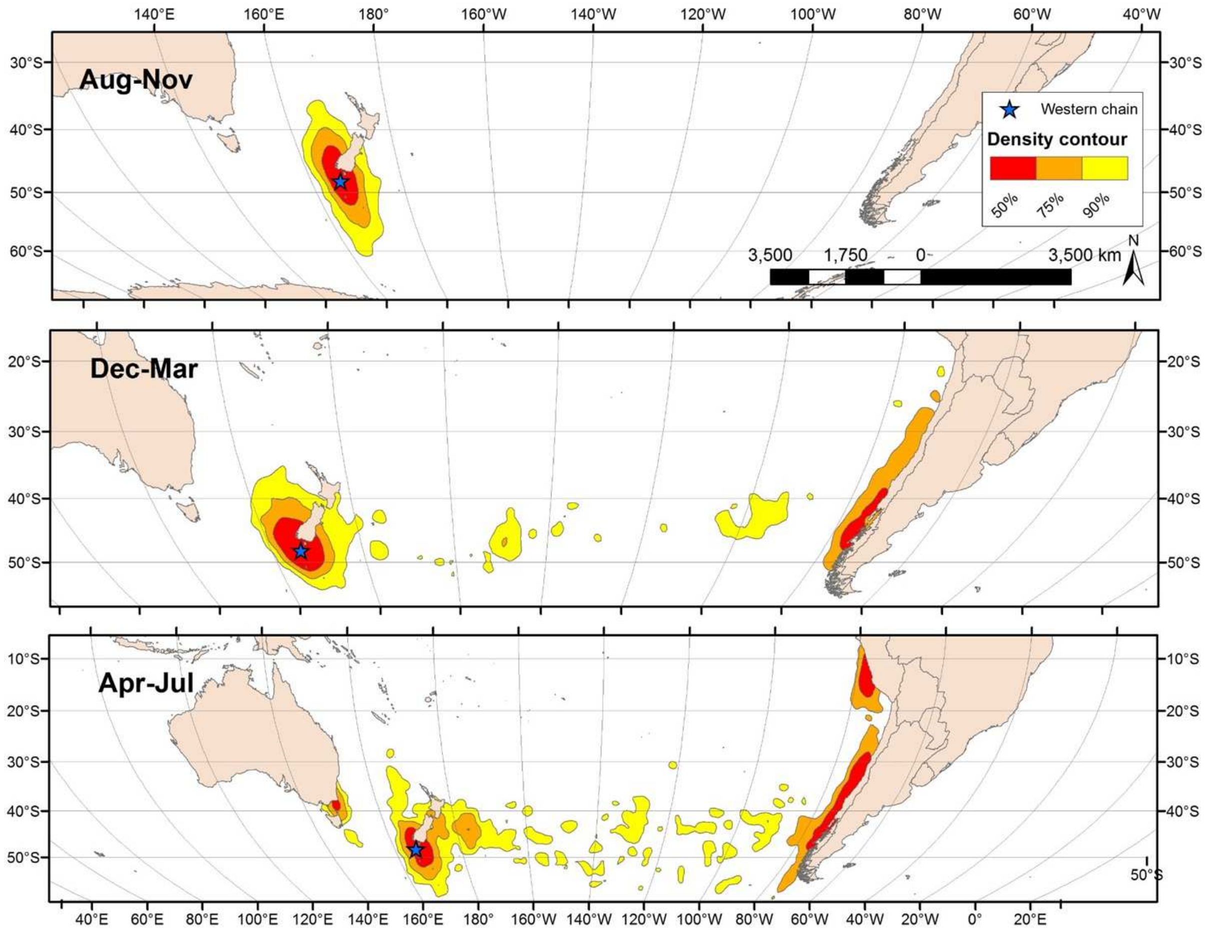

Figure 3-2: Kernel density plots, showing the 90, 75 and 50% probability contours, for Salvin's albatross in the South Pacific Ocean that breed at the Western Chain, Snares Islands. Upper panel corresponds to 'incubation', middle panel to 'chick-rearing' and lower panel to 'non-breeding' distributions.

The kernel plots presented in Figure 3-1 and Figure 3-2 are combined in Figure 3-3 to aid a comparison between Salvin's albatross from the two New Zealand breeding sites. Figure 3-3 reveals clearly the spatial segregation between the two populations within New Zealand waters during the incubation and chick-rearing phases of the breeding cycle. For both the 50% and 75% contours there is no overlap between the two groups. Interestingly, the lower panel of Figure 3-3 (reflecting the non-breeding period) reveals that some spatial segregation between the two populations persists: birds from the Bounty Islands appear to occupy one extensive zone off the coast of Chile, whereas birds from the Western Chain occupy zones off Chile (in common with birds from the Bounty Islands), but additionally off Peru to the north, and one individual remained in Australasia rather than migrating across the Pacific Ocean. However, it worth noting that the non-breeding distribution of birds from the Bounty Islands presented in Figure 3-1 and Figure 3-3 is based on data from only six birds, and further information would be required to confirm the non-breeding distribution for this population as being restricted to the waters off the coast of Chile. Indeed, bycatch data for the Chatham Rise reveals that three Salvin's albatross were captured in trawl fisheries during June and July (i.e. during the non-breeding period) in 2004 and 2005 (see: https://data.dragonfly.co.nz/psc/v20121101/salvins-albatross/trawl/all-vessels/chatham-rise/all/), suggestive of some birds from the Bounty Islands population remaining in Australasia throughout the year.

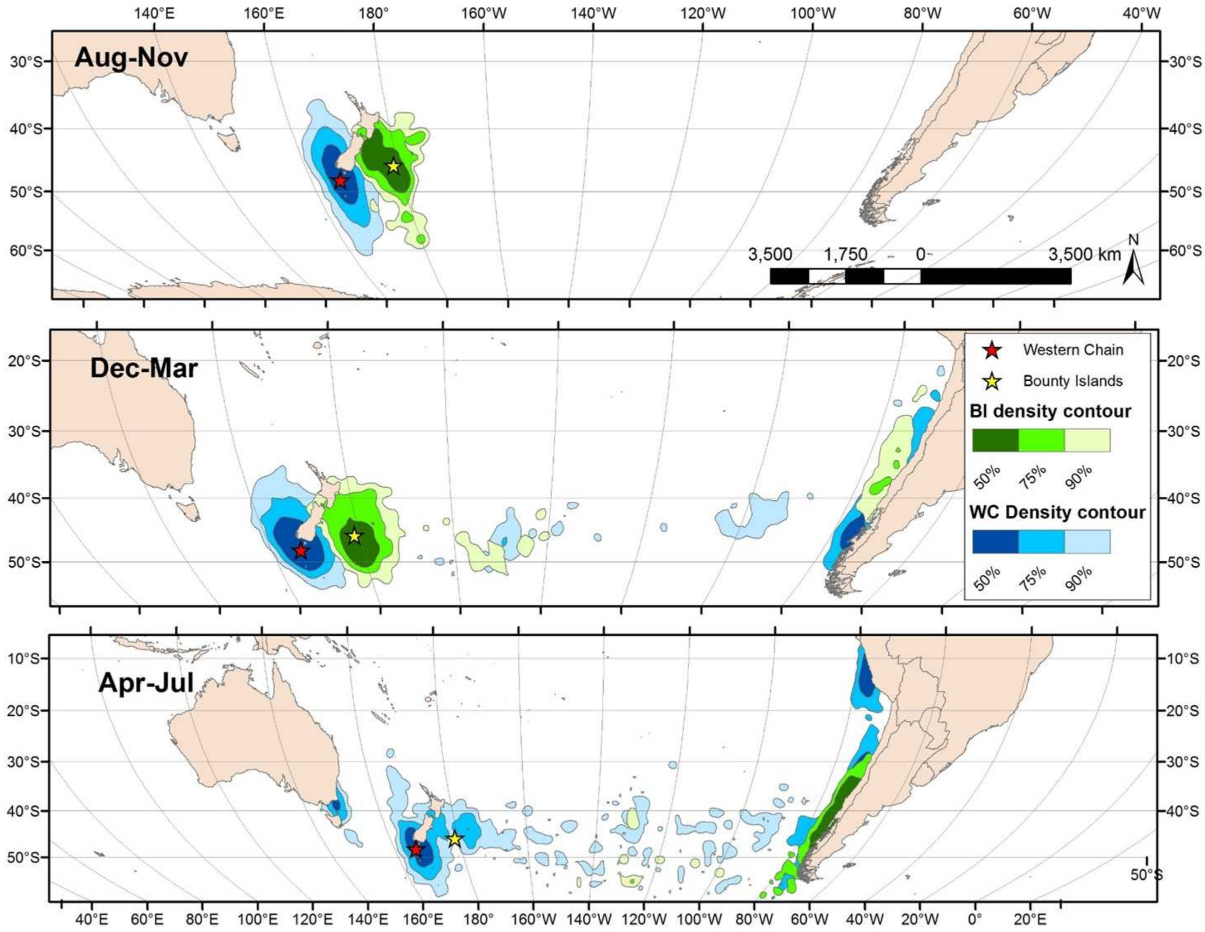

Figure 3-3: Comparison of kernel density plots for Salvin's albatross at the Bounty Islands (BI) in green and at the Western Chain (WC) in blue. The 90, 75 and 50% probability contours are shown. Upper panel corresponds to 'incubation', middle panel to 'chick-rearing' and lower panel to 'non-breeding' distributions.

One key implication of the segregation in distribution of Salvin's albatross within New Zealand waters during the breeding season (Figure 3-3) is the exposure of the two populations to risk from commercial fishing operations. Preliminary overlays of Salvin's albatross distributions with distributions of three fisheries known to impact this species are presented in Figure 3-4. Although the location data for Salvin's albatross presented in this report will feed into the Level 2 Risk Assessment process (Richard & Abraham 2013), it is clear from Figure 3-4 that different fisheries have the potential to pose different levels of risk to the two populations of Salvin's albatross. For example, the sub-Antarctic squid *Notodarus sloanii* trawl fishery poses little or no risk to Salvin's albatross breeding at the Bounty Islands, but overlaps extensively with the distribution of birds from the Western Chain (Figure 3-4). Conversely, Salvin's albatross from the Western Chain are unlikely to be exposed to risk from trawlers targeting hoki *Macruronus novaezelandiae* on the Chatham Rise (Figure 3-4).

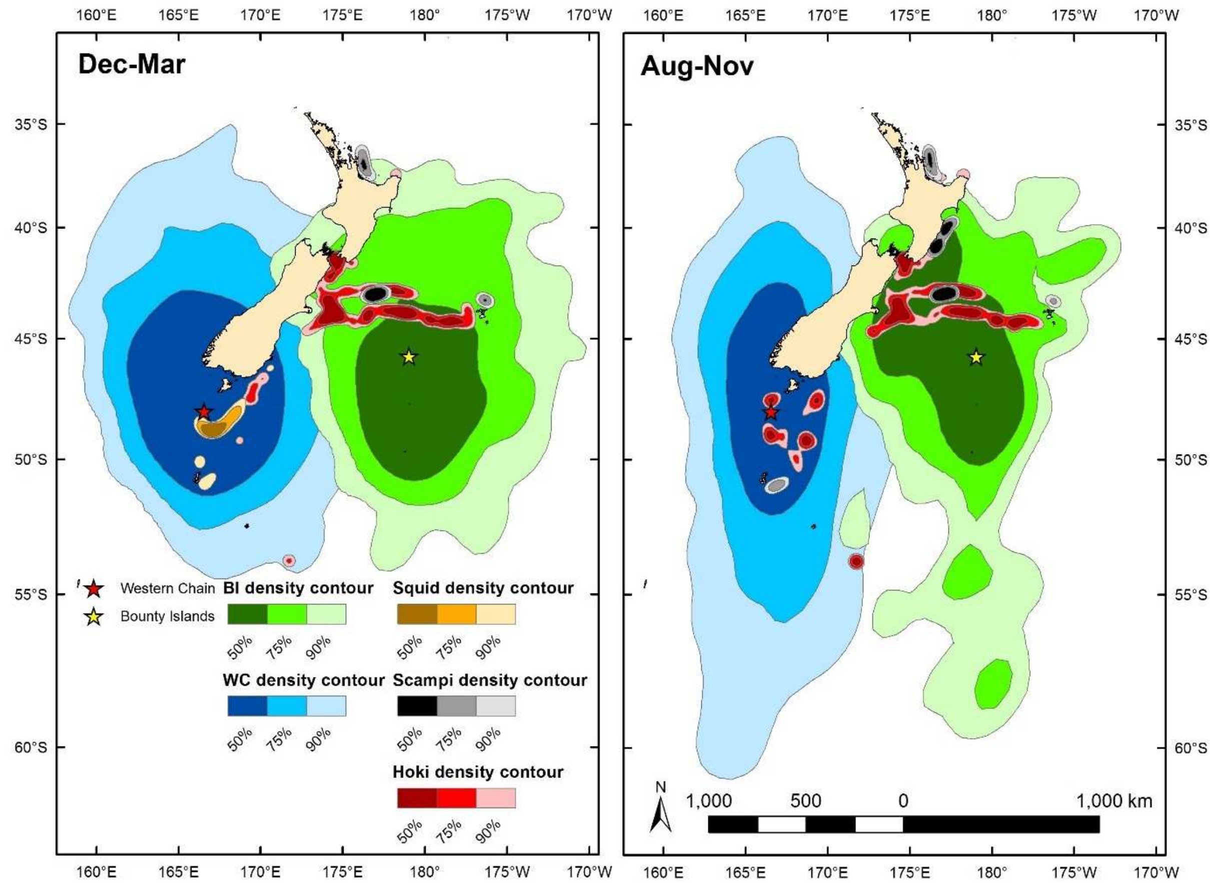

Figure 3-4: Comparison of Salvin's albatross kernel density plots overlaid with corresponding probability contours of fishing effort for squid, hoki and scampi. The 90, 75 and 50% probability contours are shown. Birds at the Bounty Islands (BI) in green and at the Western Chain (WC) in blue.

4 Recommendations

The results and conclusions for the distribution of Salvin's albatross at the Bounty Islands, by far the most important breeding site for this species, presented here are based on a relatively modest number of data sets. In particular, the non-breeding distribution is based upon data from only six birds, and these data are further truncated with only two data sets extending throughout the non-breeding period. Acquisition of further geolocation loggers from the Bounty Islands, which were not sighted in October 2013, would augment the data set for this population notwithstanding issues with the devices. It is likely, based upon logger performance to date, that any of the remaining 20 devices that are retrieved will have expired and will require data extraction from the manufacturer. Further, it is also likely, therefore, that complete, annual data sets will be lacking from any additional devices retrieved. Nevertheless, given the challenges associated with working on this species and the resources devoted to this work to date, it would be very worthwhile to maximise any opportunity to retrieve any of the remaining devices. Additional location data from Bounty Islands birds will help confirm the within-New Zealand segregation of the two populations, and will help delineate non-breeding distributions in this population, which in turn will have implications for the global risk from commercial fisheries in this species.

5 Acknowledgements

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