NIWA
Taihoro Nukurangi

Seabird, marine mammal and surface fish surveys of Golden and Tasman Bays

Part C: Boat surveys

Prepared for Friends of Nelson Haven and Tasman Bay Incorporated and AWE New Zealand Pty. Ltd.

August 2011

Authors/Contributors:

Sean Handley, NIWA
Paul Sagar, NIWA
Dan Cairney, NIWA
Megan Carter, NIWA

For any information regarding this report please contact:

Sean Handley

Marine Ecology and Aquaculture
+64-3-548 1715
s.handley@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
217 Akersten Street, Port Nelson
PO Box 893
Nelson 7040
New Zealand

Phone +64-3-548 1715
Fax +64-3-548 1716

NIWA Client Report No:	NEL2011-020
Report date:	August 2011
NIWA Project:	AWE11401

Contents

Tables

Figures

Reviewed by	Approved for release by
…………………………………………	……………………………

Formatting checked by

…………………………………………

Executive summary

Seabirds, marine mammals and conspicuous fishes were visually surveyed by boat in Tasman and Golden Bays. North-south running transects with an effective strip width of 250 m were surveyed from the boat spaced approximately 20 km apart. Survey days were split between 2 days in December 2010 and 2 days in January 2011. The boat survey identified more seabird species (20 species) than a previous aerial survey in the area in November 2010 (15 species). The boat survey was more time consuming and covered approximately a third of the area surveyed by air per day.

The distributions of seabirds and marine mammals were very similar to those previously recorded by aerial survey in November 2010. Seabirds were present throughout Golden and Tasman Bays, with slightly more birds present in December as compared with the January surveys. The distribution of seabirds in December was similar to that seen on the November 2010 aerial surveys with most of the birds observed in the centre of Tasman Bay, along the Abel Tasman coastline, especially near Adele Island, and along the coastline between Cable Bay, Delaware Bay, Croisilles Harbour, and Current Basin approaching French Pass. In January, overall fewer birds were seen, with greater densities east of Farewell Spit, in inner Tasman Bay, and along the coastline between Croisilles Harbour, Current Basin and through French Pass into Admiralty Bay. Australasian gannet and fluttering shearwater were the most widespread species observed followed by fairy prion, white-fronted tern and flesh-footed shearwater. More seabirds were observed feeding (2.5 %) than previously observed by aerial survey, but as the boat surveys were not run concurrently, and were carried out over different months, the results of the aerial and boat surveys are not directly comparable.

1 Introduction

This research was undertaken in response to an approach from Friends of Nelson Haven and Tasman Bay Inc. ("FNHTB"). AWE Limited ("AWE") and FNHTB jointly agreed to commission a study to obtain more information and baseline data about the distribution of prey fishes, seabirds and marine mammals within Tasman Bay, Golden Bay, and French Pass so as to better understand the biodiversity in these areas.

Tasman Bay is considered an important area for prey fish such as pilchards *Sardinops neopilchardus* and, to a lesser extent, anchovies *Engraulis australis*, and yellow-eyed mullet *Aldrichetta forsteri* (Young & Clark 2006, Argue & Kearney 1983, Baker 1972). There is an assumption that because of the presence of these sources of food, seabirds such as the Australasian gannet *Morus serrator*, spotted shag *Stictocarbo punctatus* and little penguin *Eudyptula minor* feed on these prey and therefore are able to breed in and around Tasman and Golden Bays (OSNZ- Rob Schuckard). Information about the distribution and numbers of prey fish and seabirds is considered essential for future RMA consent applications in Tasman/Golden Bay (R. Schuckard pers. com.), and/or valuable for territorial authorities and the Department of Conservation.

2 Methods

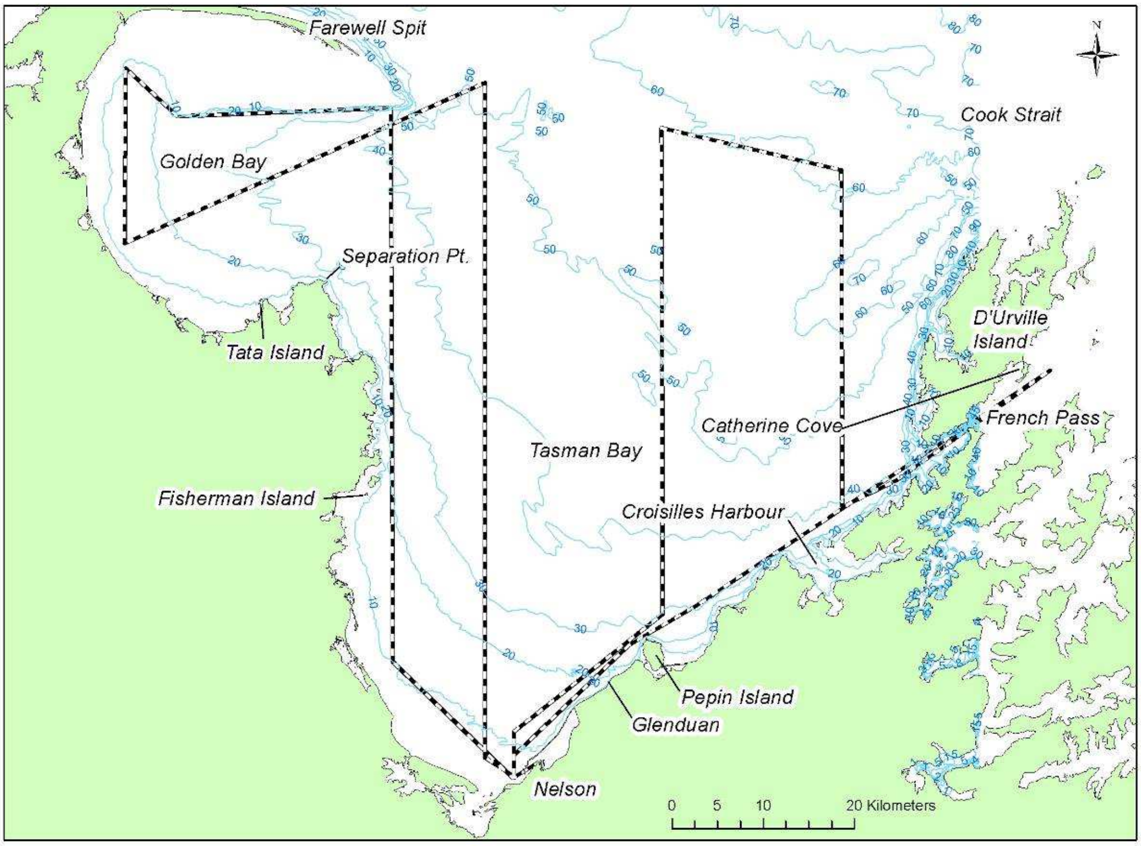

Figure 2-1: Boat survey transects in Golden and Tasman Bays.

2.1 Boat surveys

The boat-based surveys were completed on 1 and 14 December 2010 and 10 and 14 January 2011. Similar methods to those used for the aerial survey (Handley & Sagar 2011) were used for the boat surveys. The vessel used was a 13 m alloy mono-hull with a cabin and the roof which was 2.5 m above the sea surface. For most survey days, observers were positioned on the roof of the vessel to give greatest view, unless weather conditions forced them to the after deck[1]. An effective strip width of 250 m was established by inclinometer away from the sun, so as to avoid glare and increase observer accuracy of seabird identifications and counts. The distance travelled daily in each transect was between 255 and 230 km for west and east transects respectively from Nelson, at a cruising speed of 15-16 knots (Figure 2-1). Search pattern was for equal effort through a 90° arc perpendicular to the vessel direction out to 250 m. As for the aerial surveys, one observer recorded seabirds while another observer recorded marine mammals, fish, and environmental variables. Position and time were recorded by a Global Positioning System (GPS; Garmin 496) which was downloaded and positions matched to timestamps of records electronically. Birds were recorded as clusters if they were within 2 m of each other, or if they were slightly farther apart, and foraging together or exhibiting similar behavioural cues. All observations were recorded on electronic hand-held Dictaphones (Thomson RCA RP5022) recording timestamps from synchronised electronic clocks and later transcribed to data sheets (Handley & Sagar 2011).

2.2 GIS methods

Observer data and GPS data were merged in a spreadsheet, so that the timestamps of observations matched coincident GPS positions of the vessel transect path. The data were then plotted first as graduated bubble plots, and interpolation using a natural neighbour technique in ArcMap 10 (ESRI Inc. 1999-2010) was attempted. Natural neighbour interpolation uses only a subset of samples that surround a query point, and interpolated counts are guaranteed to be within the range of the samples used. It does not infer trends and will not produce peaks, pits, ridges, or valleys that are not already represented by the input samples.

3 Results

3.1 Distribution and abundance of seabirds

The four boat surveys were carried out on 1 and 14 December 2010, and on 10 and 14 of January 2011. Seabirds were present throughout Golden and Tasman Bays, with slightly more birds present in December as compared with the January surveys (Figure 3-1 and Figure 3-2). For unknown reasons, the skipper of the vessel did not take a direct north transect on the eastern side of Tasman Bay after heading along the boulder-bank past Pepin Island; rather he headed about 15 degrees east of north from near Glenduan. The distribution of seabirds in December was similar to that seen on the November 2010 aerial surveys (Handley & Sagar 2011) with most of the birds observed in the centre of Tasman Bay, along the Abel Tasman coastline, especially near Adele Island, and along the coastline between Cable Bay, Delaware Bay, Croisilles Harbour, and Current Basin approaching

[1] Due to rough sea conditions on 14 December most of the survey from 09:11:37 was conducted from open deck of the boat, i.e. from the start of the first northern transect.

French Pass. In January, fewer birds were seen, with greater densities east of Farewell Spit, in inner Tasman Bay, and along the coastline between Croisilles Harbour, Current Basin and through French Pass into Admiralty Bay.

Similar to the results of the aerial surveys (Handley & Sagar 2011), Australasian gannets were recorded with the highest frequency (278 observations) with a mean cluster size of 2.7 birds, whereas fluttering shearwaters were numerically dominant as their average cluster size was 6.5 birds with 225 clusters recorded (Table 3-1). The next most commonly observed species was the fairy prion, which had the largest cluster size of 800 birds. A total of 24 species of birds including 20 seabirds was recorded on the boat surveys, with 2 individuals (a mollymawk and a shearwater) unable to be identified to species level.

Comparisons of the distribution of individual species revealed similar patterns to that found by aerial survey (Handley & Sagar 2011) with fairy prion (Figure 3-6) and white-capped albatross (Figure 3-11) found predominantly in outer Tasman Bay. Also similar to the November aerial survey, a very large cluster of 800 fairy prion was recorded south-east of Farewell Spit during December 2010, but this large cluster was not observed in January 2011 (Figure 3-12). Australasian gannets (Figure 3-4) and fluttering shearwaters (Figure 3-5) were recorded throughout the bays, and the flesh-footed (Figure 3-8), sooty (Figure 3-12) and Buller's shearwaters (Figure 3-15) were mostly seen in the centre of Tasman Bay. Species found around the edge of the bays close to the coastline were white-fronted tern (Figure 3-7), spotted shag (Figure 3-9), black-backed gull (Figure 3-13) and Arctic skua (Figure 3-14). Pied shags were seen only in inner Tasman Bay and at French Pass (Figure 3-16). Little penguin were patchy in distribution from Golden Bay, Inner Tasman Bay, French Pass area back to Delaware Bay and 2 individuals were seen way offshore between D'Urville Island and Farewell Spit (Figure 3-10).

3.2 Distribution and abundance of fishes and association with seabirds

Schools of unknown species of fish were greatest in size east of Farewell Spit toward D'Urville Island and inner Tasman Bay (Figure 3-3 and Figure 3-18). Individual sharks and a school of barracouta were scattered across the bays. It was not possible to identify the species within the schools easily, unless they were large predatory fish breaking the water surface near the boat.

The high temporal variability of the distribution and density of seabirds recorded by boat between December 2010 and January 2011 and the low spatial resolution of the data as compared with the aerial survey technique (Handley & Sagar 2011) prevented any meaningful results from attempts to interpolate the data in GIS or to compare seabird distributions with schooling fish. Aerial and boat survey data, along with stable isotope data will be integrated in a final report.

When seabird behaviour was plotted, more seabird clusters than previously seen via aerial survey (Handley & Sagar 2011) were observed actively feeding (2.5 %, involving 4.2% of the total number of birds recorded) and again these were mostly around the edge of inner Tasman Bay especially between French Pass and Delaware Bay (Table 3-2 and Figure 3-17). Clusters of seabirds recorded as sitting on the sea surface (34.7 % of clusters, 48.9 % of total number of birds) were scattered across the study area, whereas the majority of clusters that were flying (62.7 %; 46.9 % total number of birds) were most numerous east of Farewell Spit.

3.3 Distribution and abundance of marine mammals

Marine mammals were present throughout the area, as were schools of fish (Figure 3-3 and Figure 3-19). Fur seals *Arctocephalus forsteri* were the most common marine mammal scattered across the bays, with some swimming in small groups of 2 and 3 individuals, south of Farewell Spit and between the Spit and D'Urville Island. The largest group of dolphins was common dolphin *Delphinus delphis* seen south-west of French Pass. Hector's dolphin *Cephalorhychus hectori* were seen south-east of Farewell Spit where there are high currents and the seafloor drops away rapidly (Handley & Sagar 2011), and a small pod of Dusky dolphins *Lagenorhynchus obscurus* was recorded west of Pepin Island.

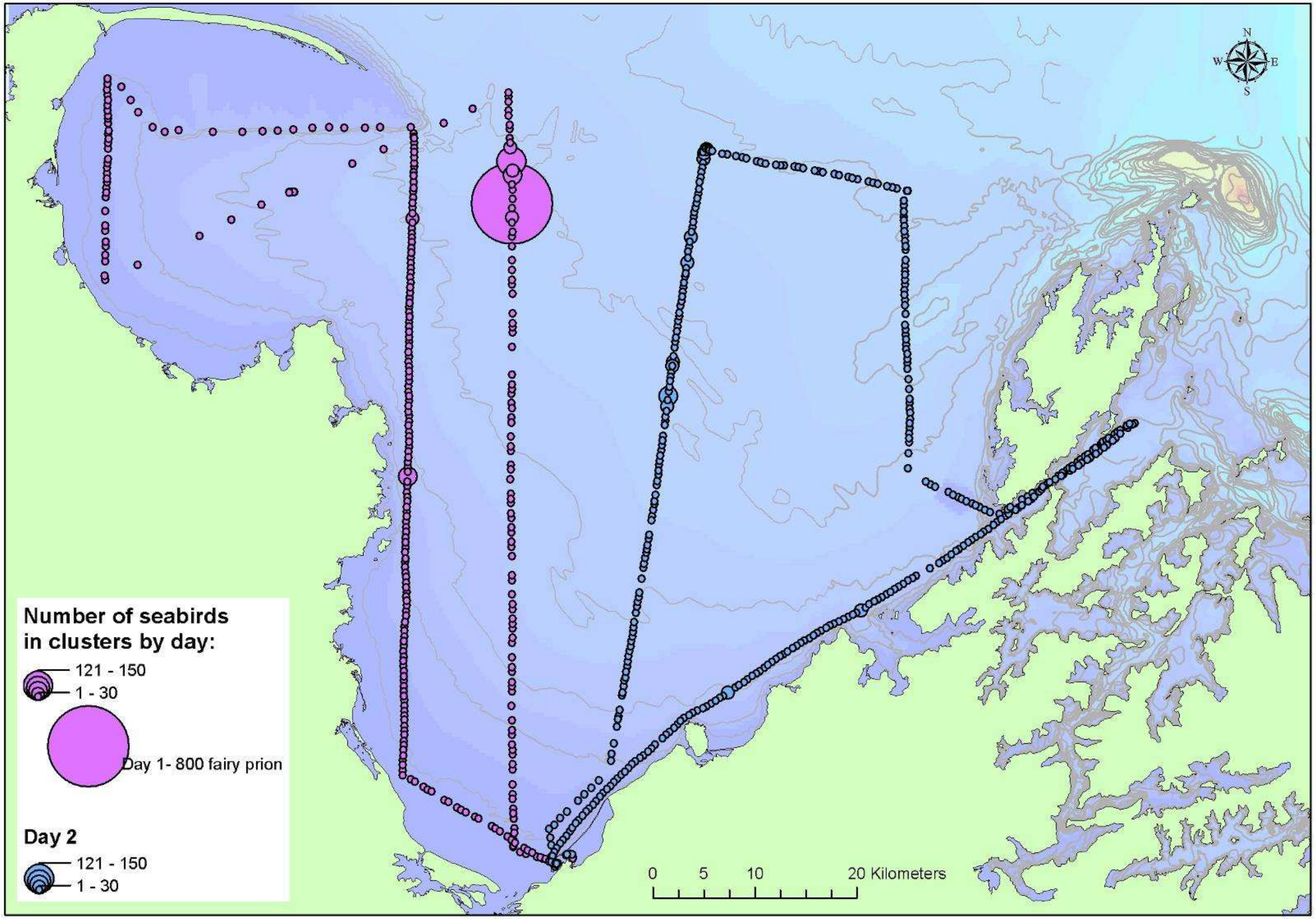

Figure 3-1: Seabird clusters surveyed by boat in Tasman and Golden Bays on 1 (day 1) and 14 (day 2) December 2010.

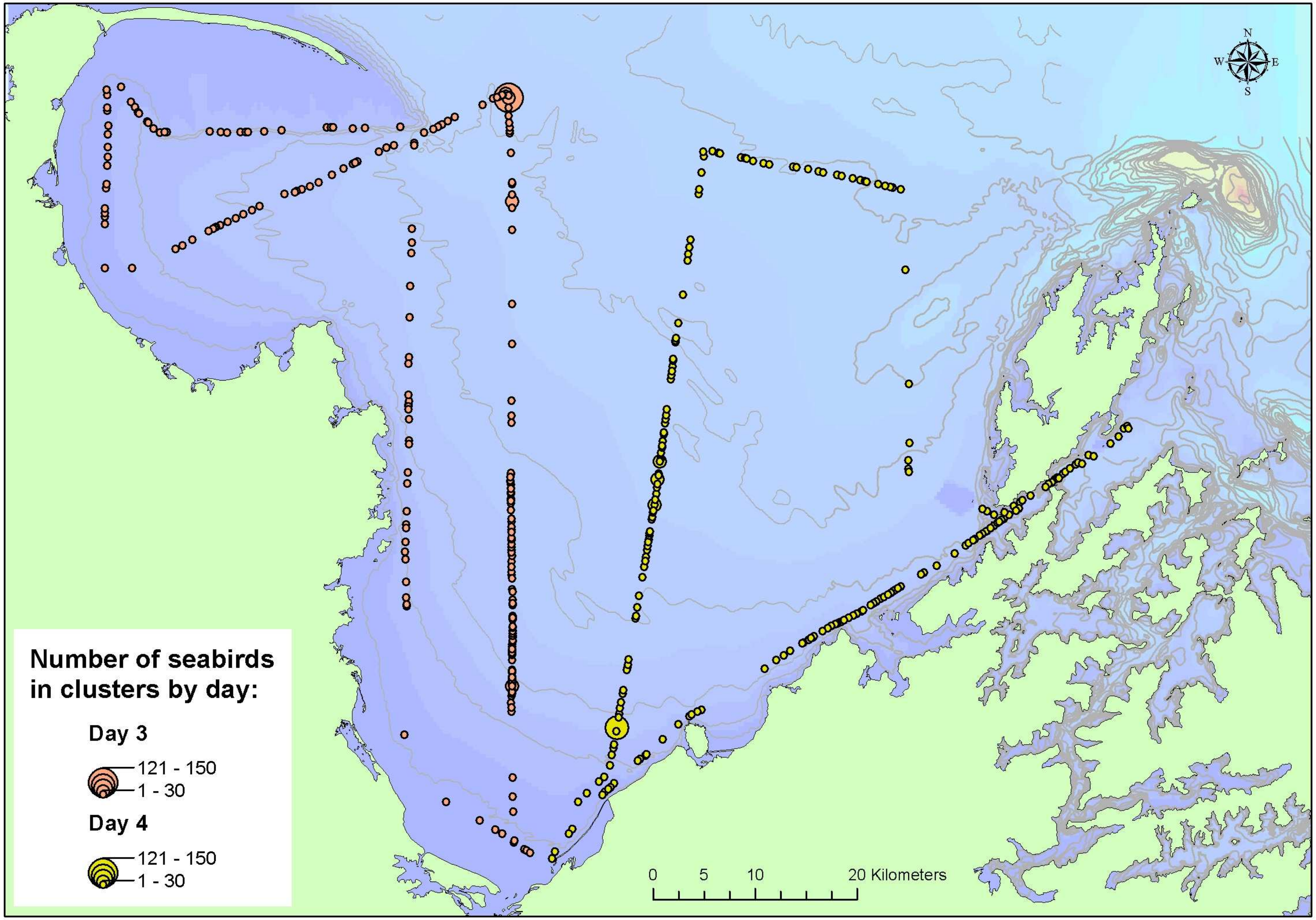

Figure 3-2: Seabird clusters surveyed by boat in Tasman and Golden Bays on 10 (day 3) and 14 (day 4) January 2011.

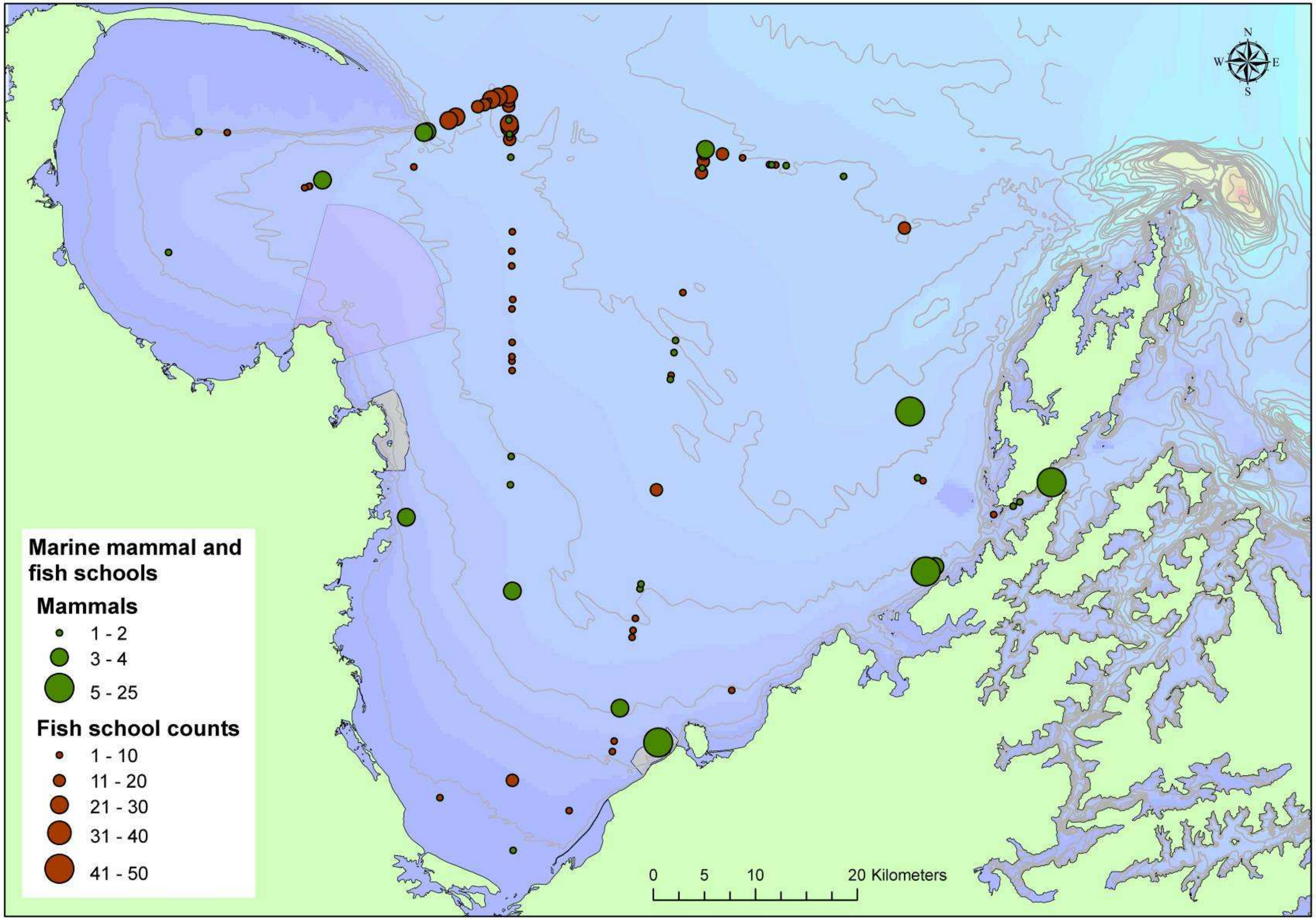

Figure 3-3: Clusters of marine mammals and schooling fish surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011.

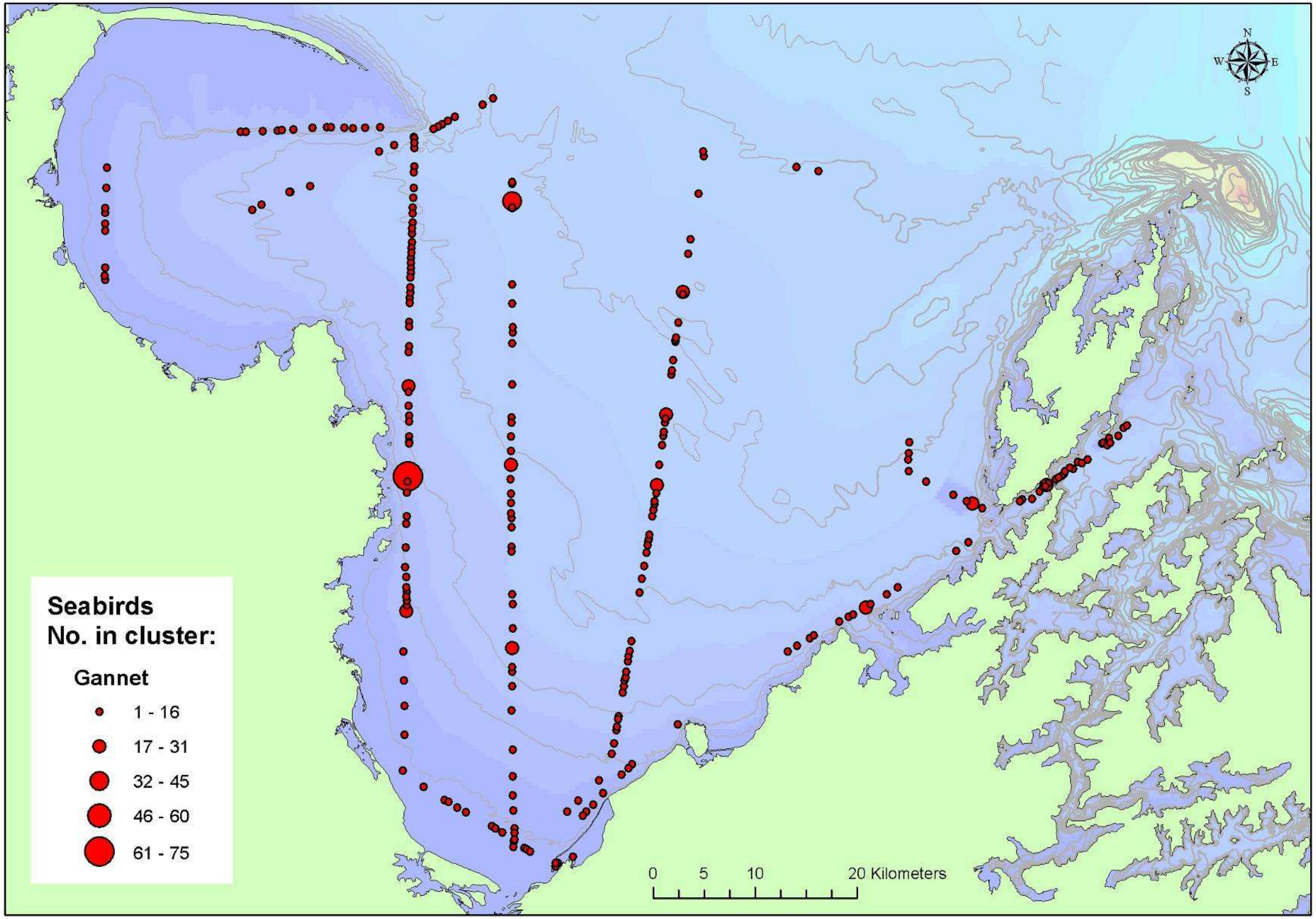

Figure 3-4: Clusters of Australasian gannet surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

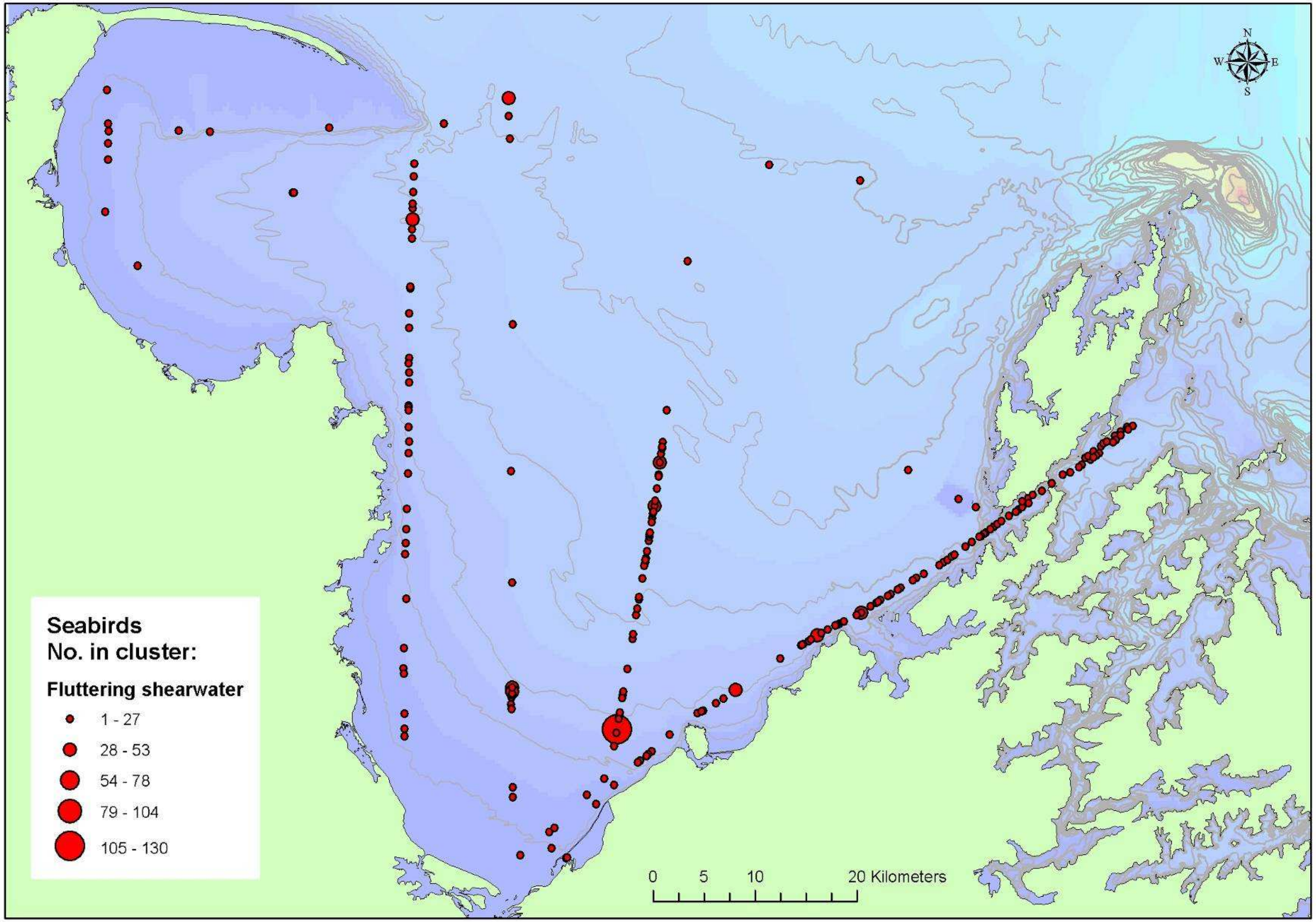

Figure 3-5: Clusters of fluttering shearwater surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

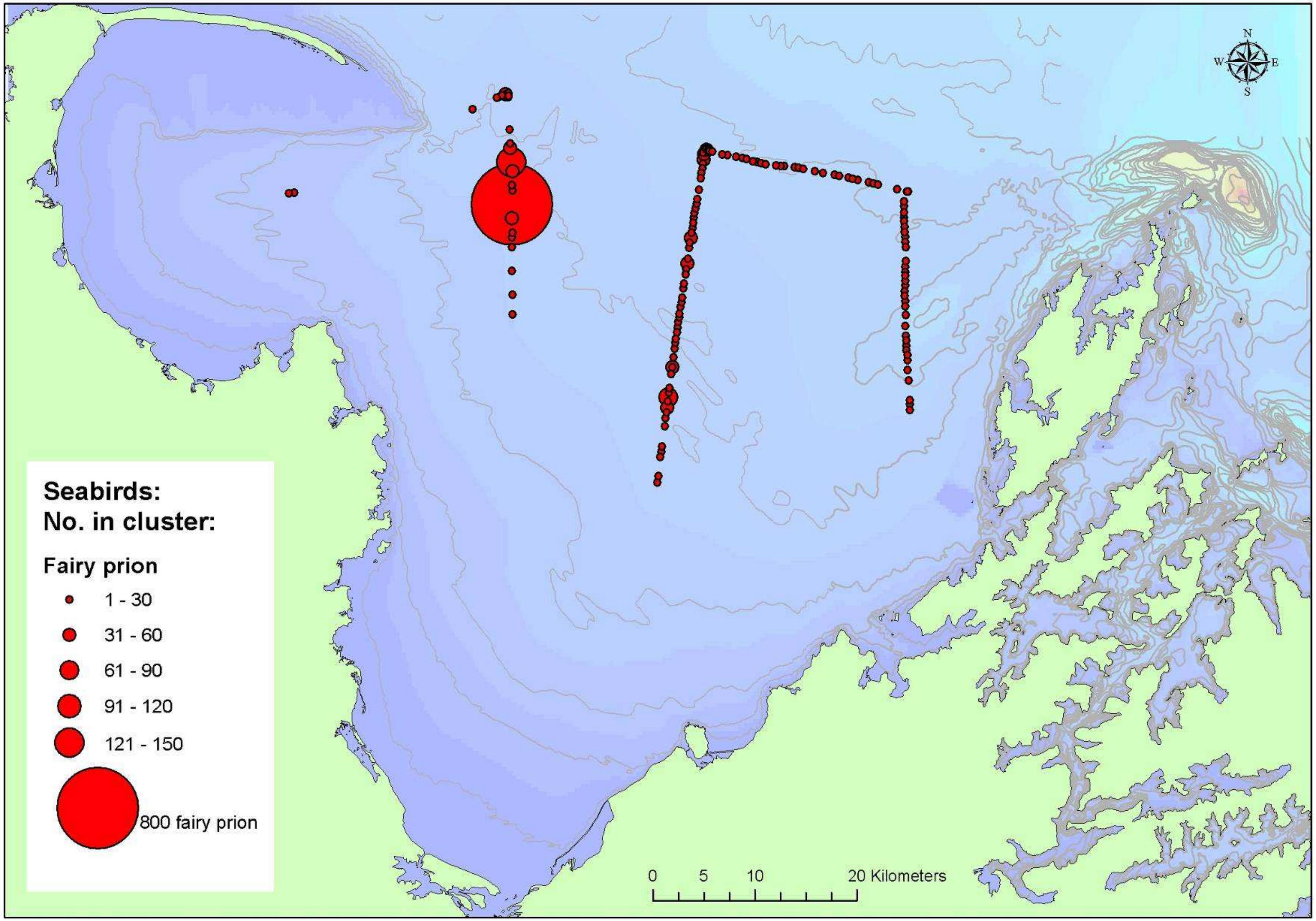

Figure 3-6: Clusters of fairy prion surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

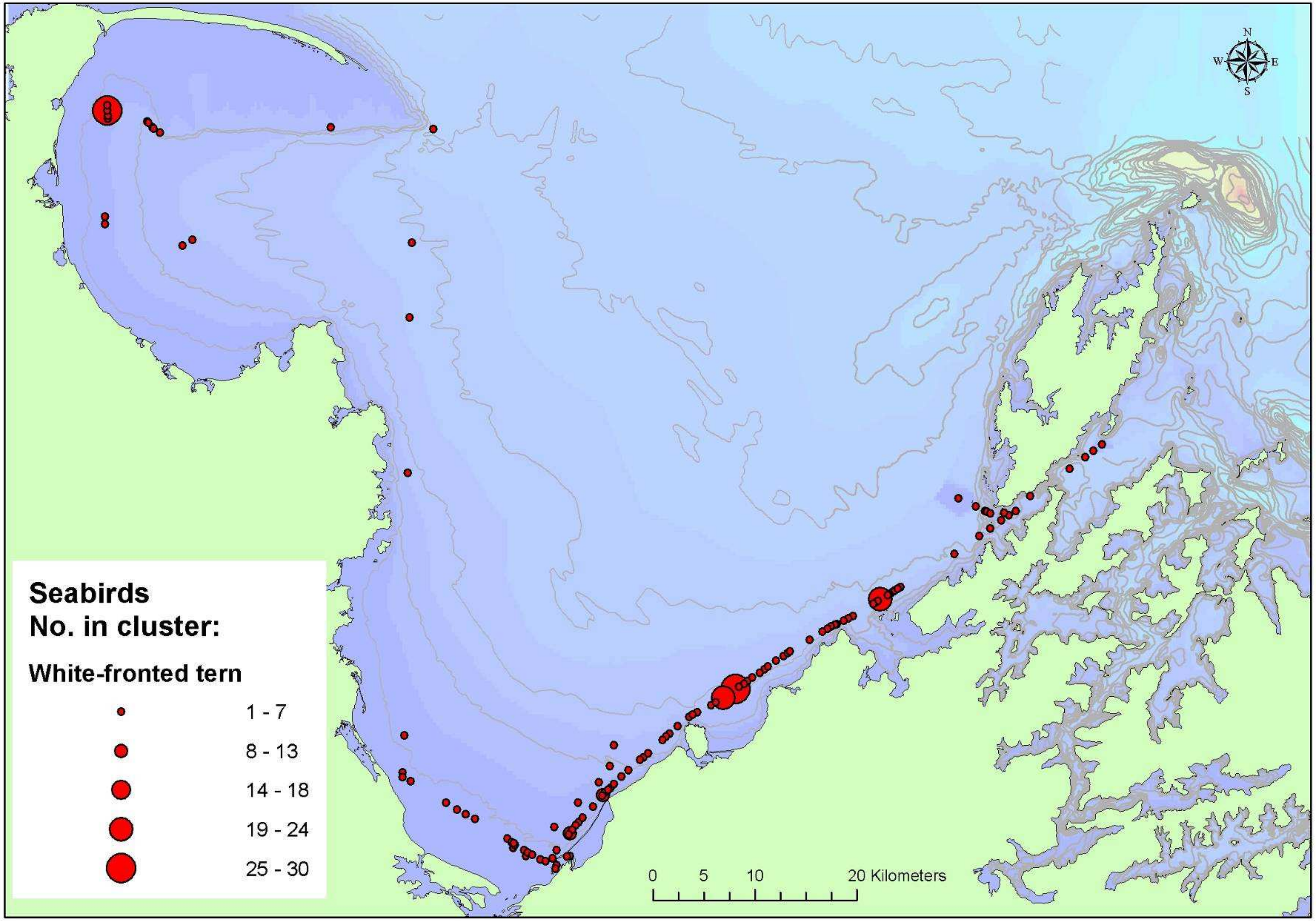

Figure 3-7: Clusters of white-fronted tern surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

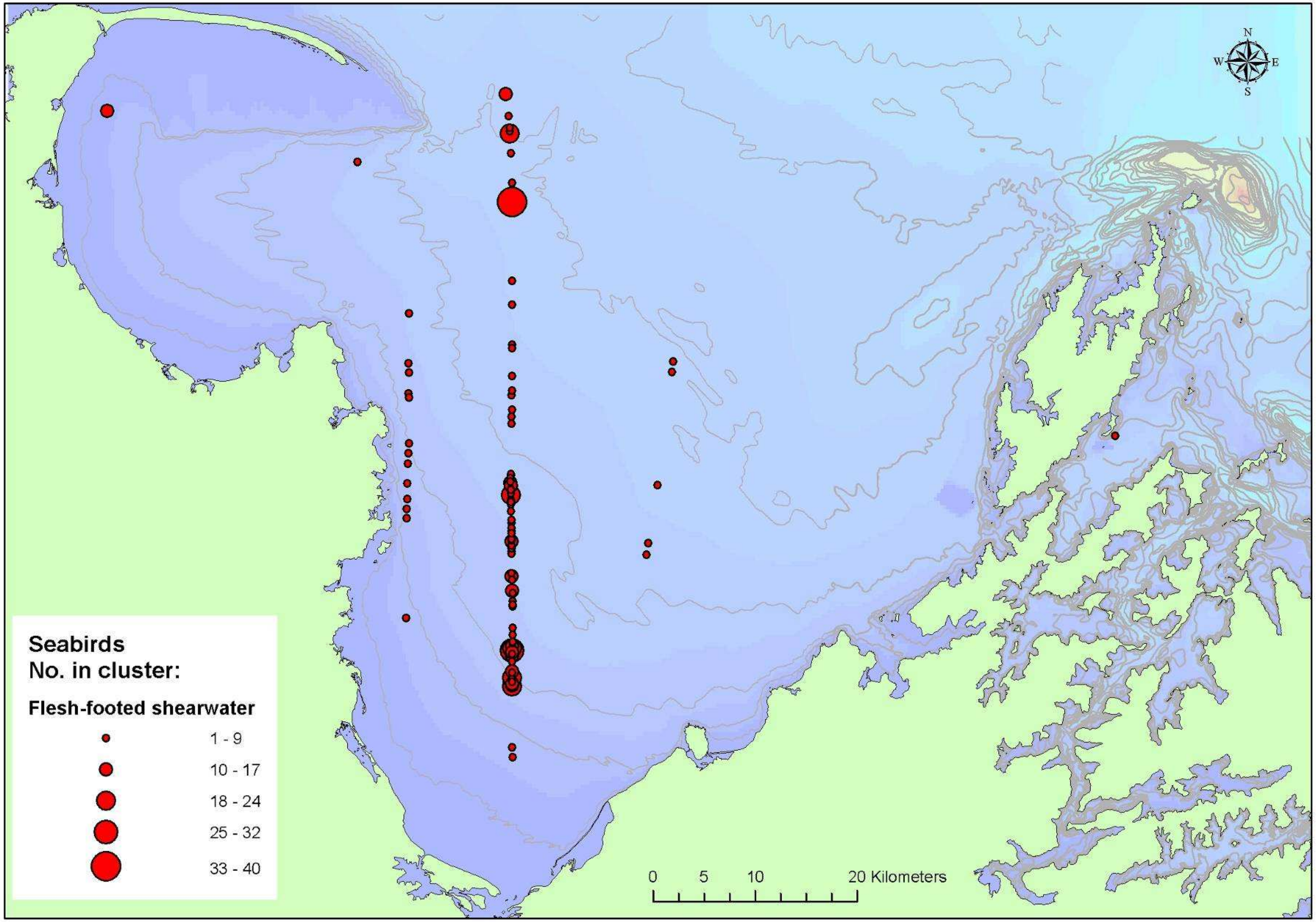

Figure 3-8: Clusters of flesh-footed shearwater surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

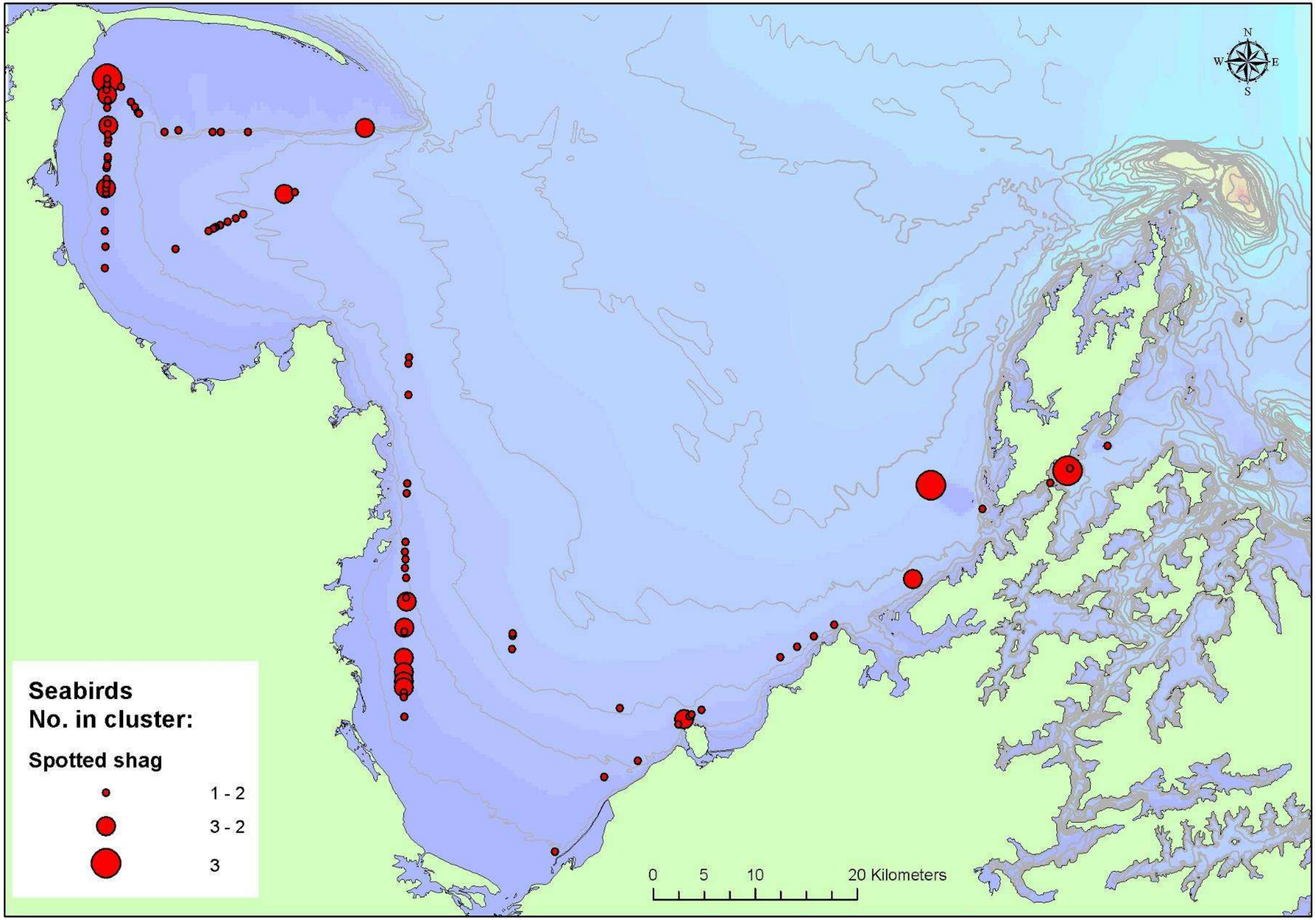

Figure 3-9: Clusters of spotted shag surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

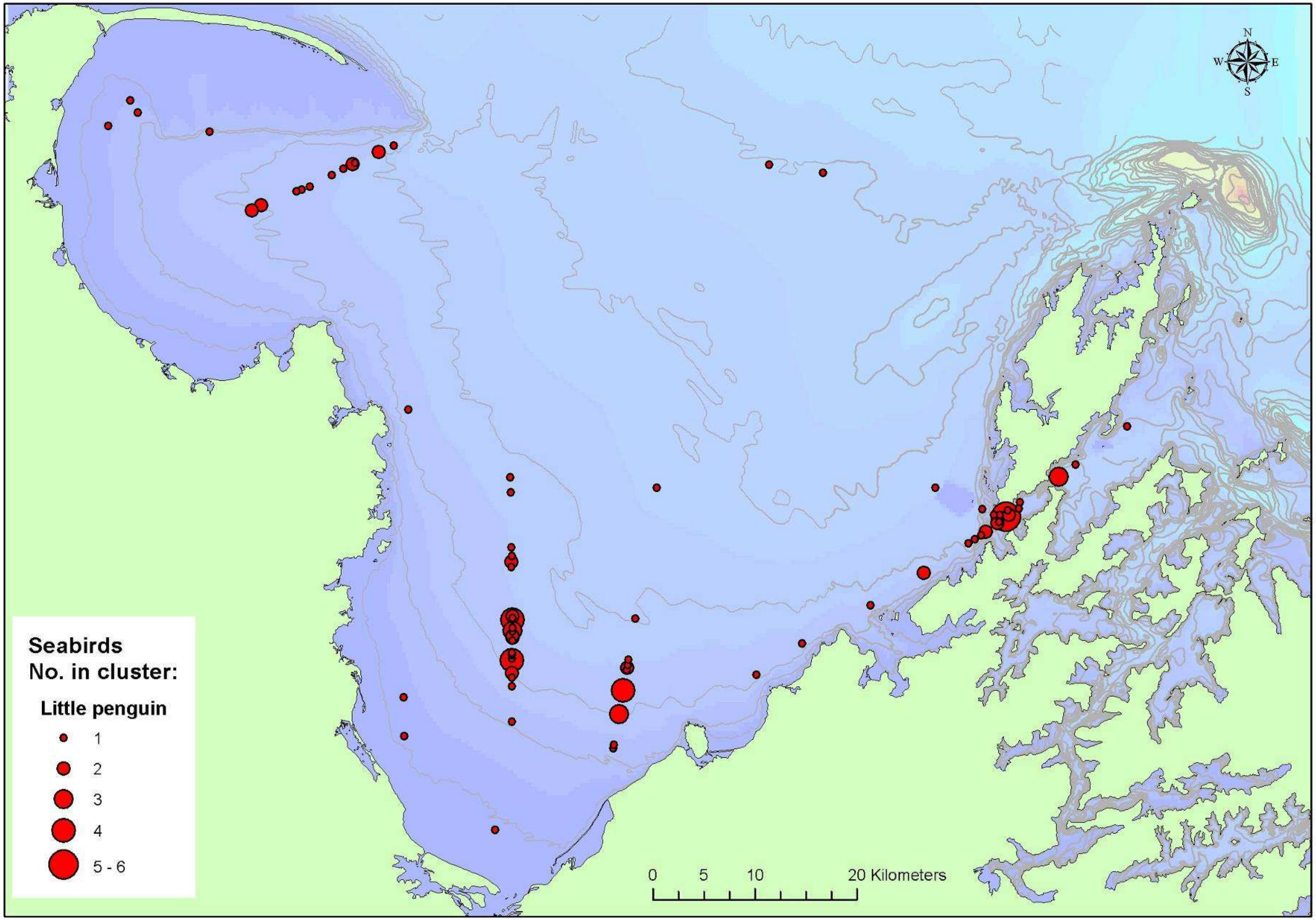

Figure 3-10:Clusters of little penguin surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

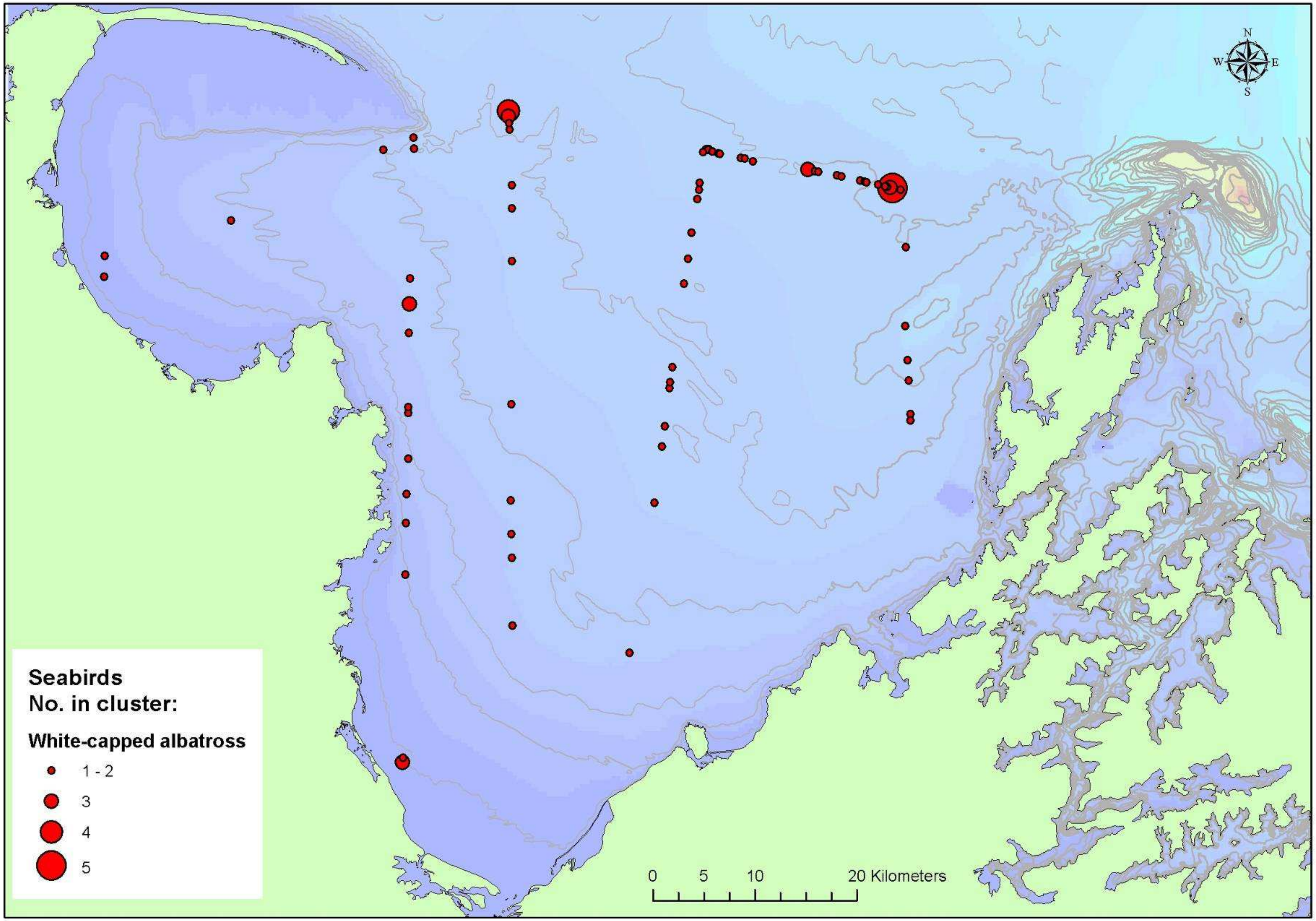

Figure 3-11:Clusters of white-capped albatross surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

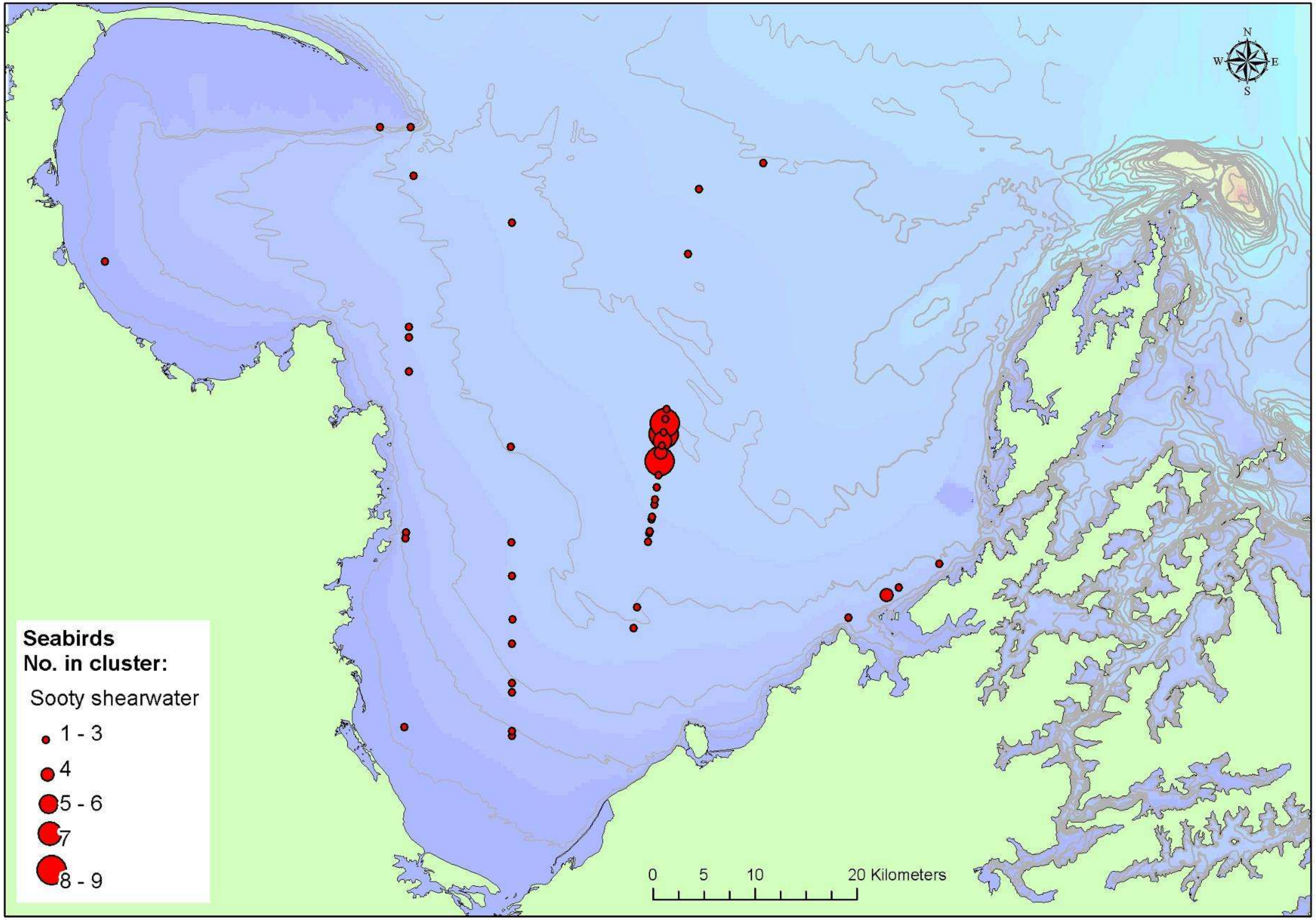

Figure 3-12:Clusters of sooty shearwater surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

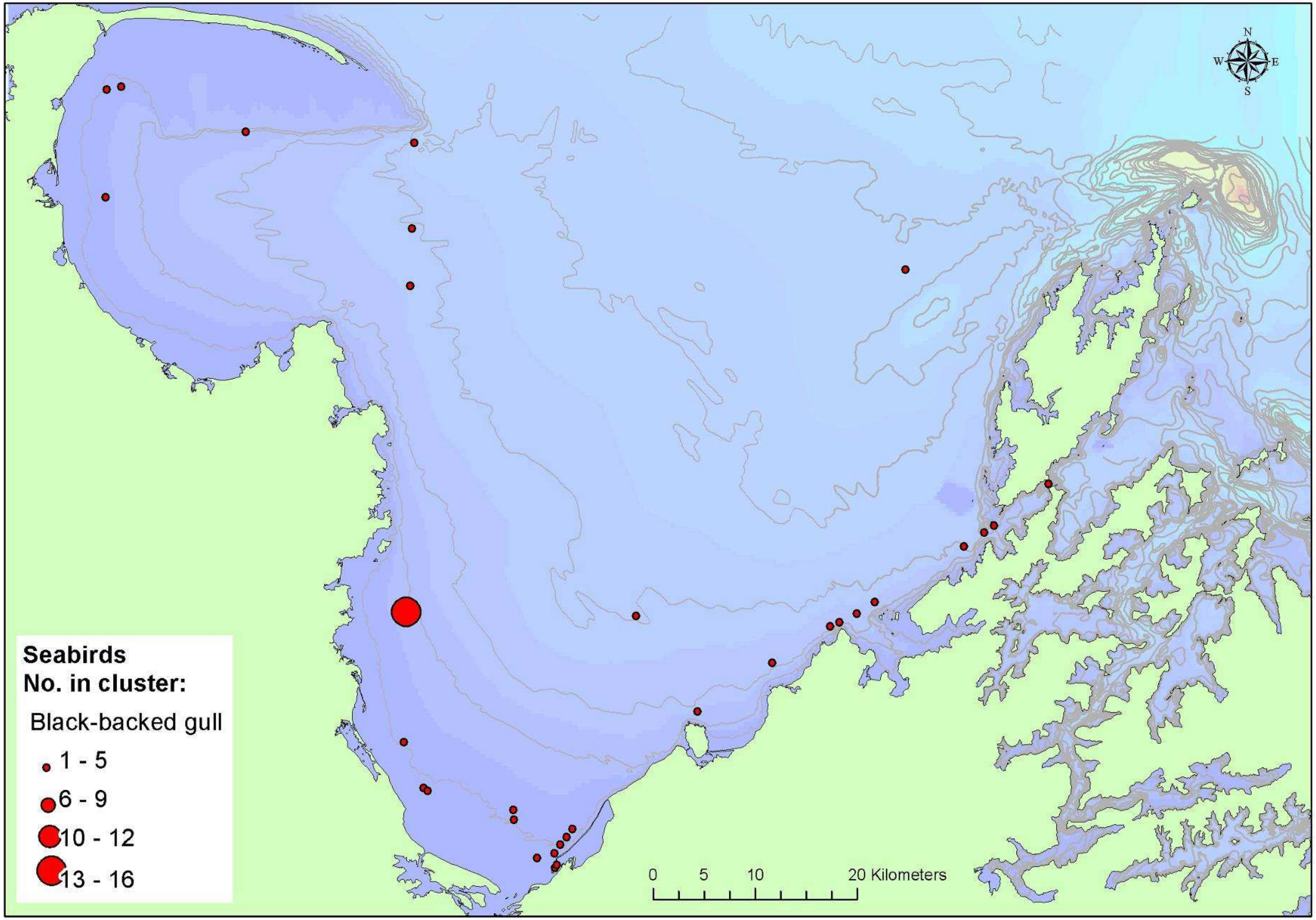

Figure 3-13:Clusters of black-backed gull surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

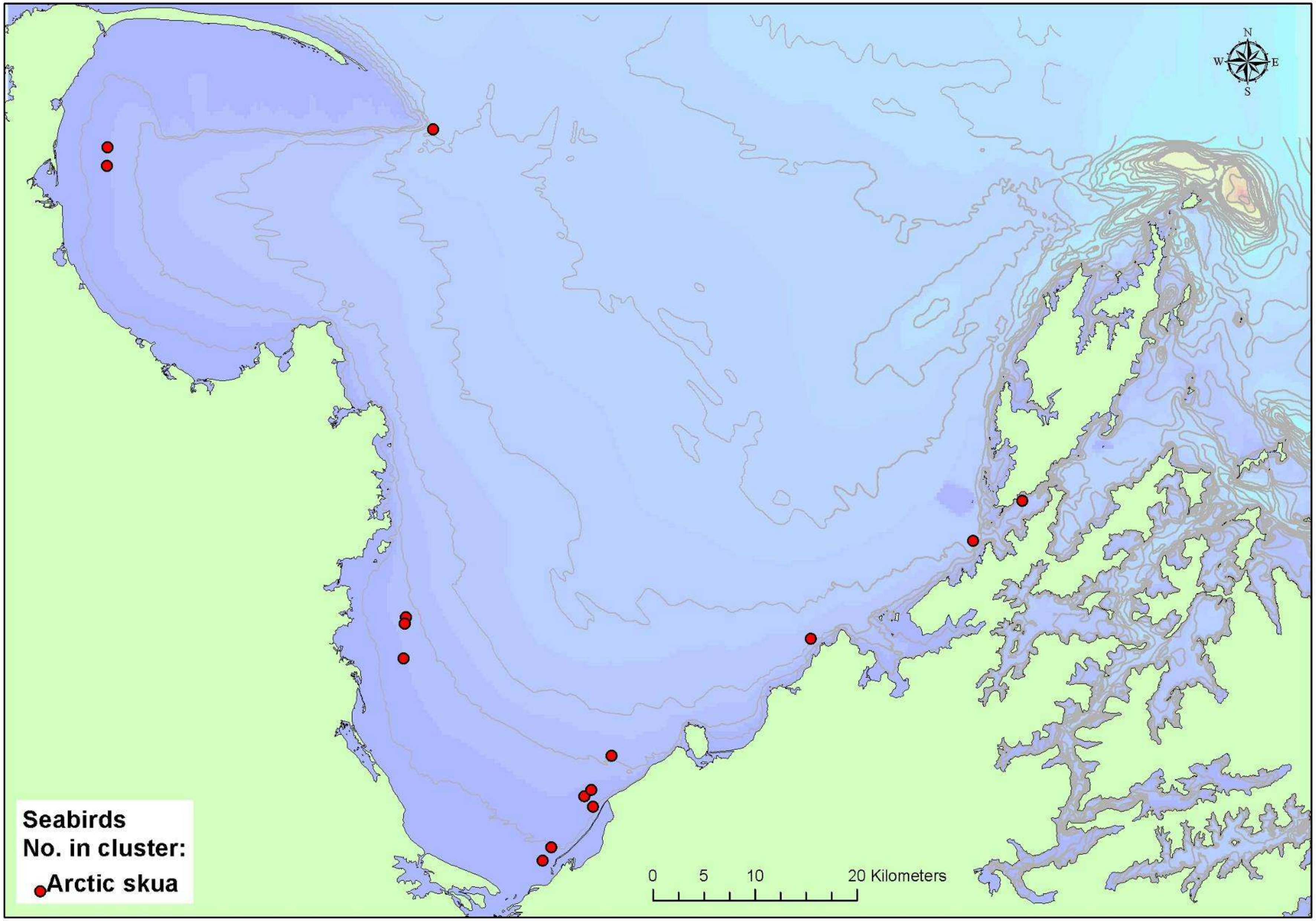

Figure 3-14: Individual arctic skua observed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

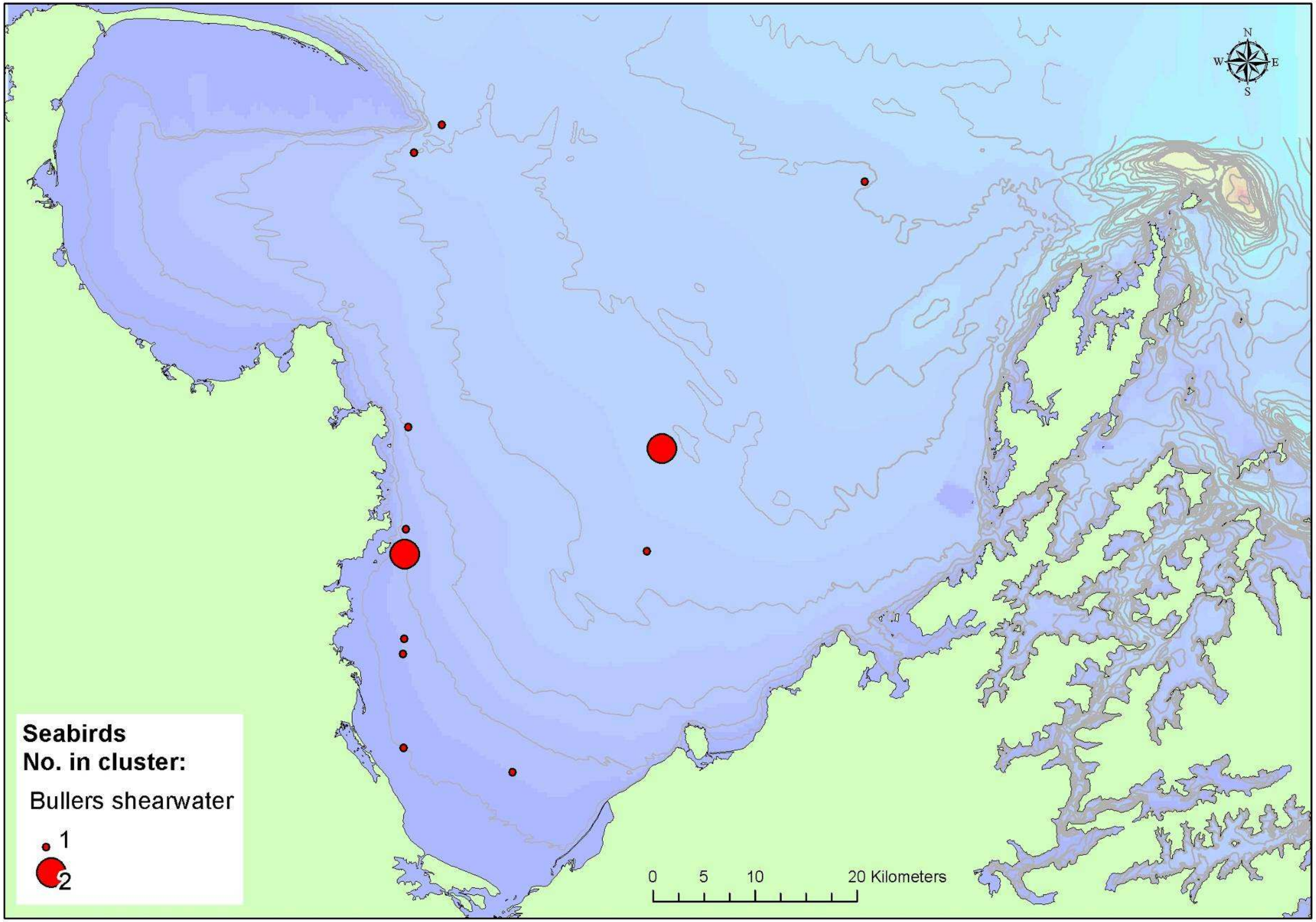

Figure 3-15:Clusters of Buller's shearwater surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

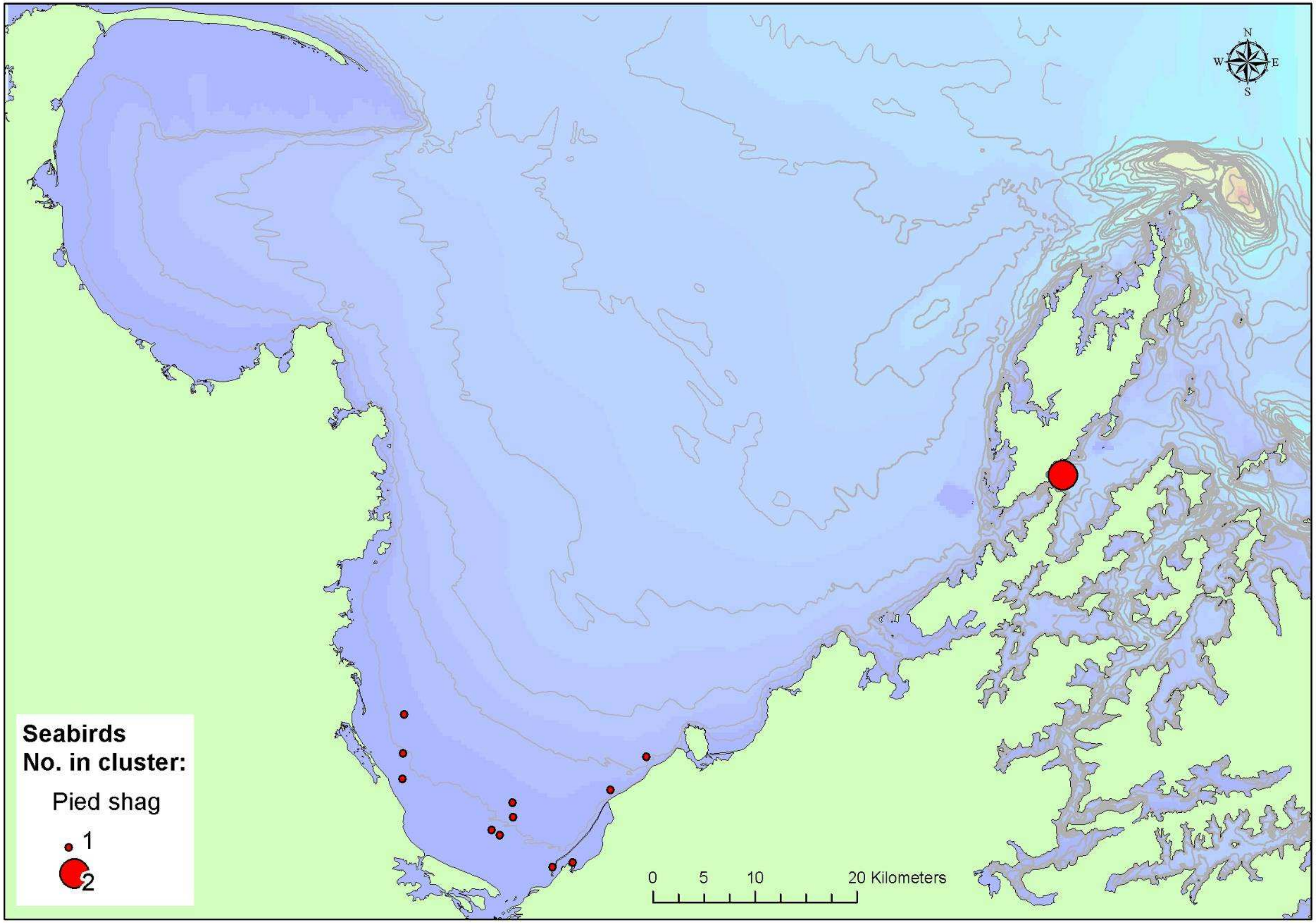

Figure 3-16:Clusters of pied shag surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

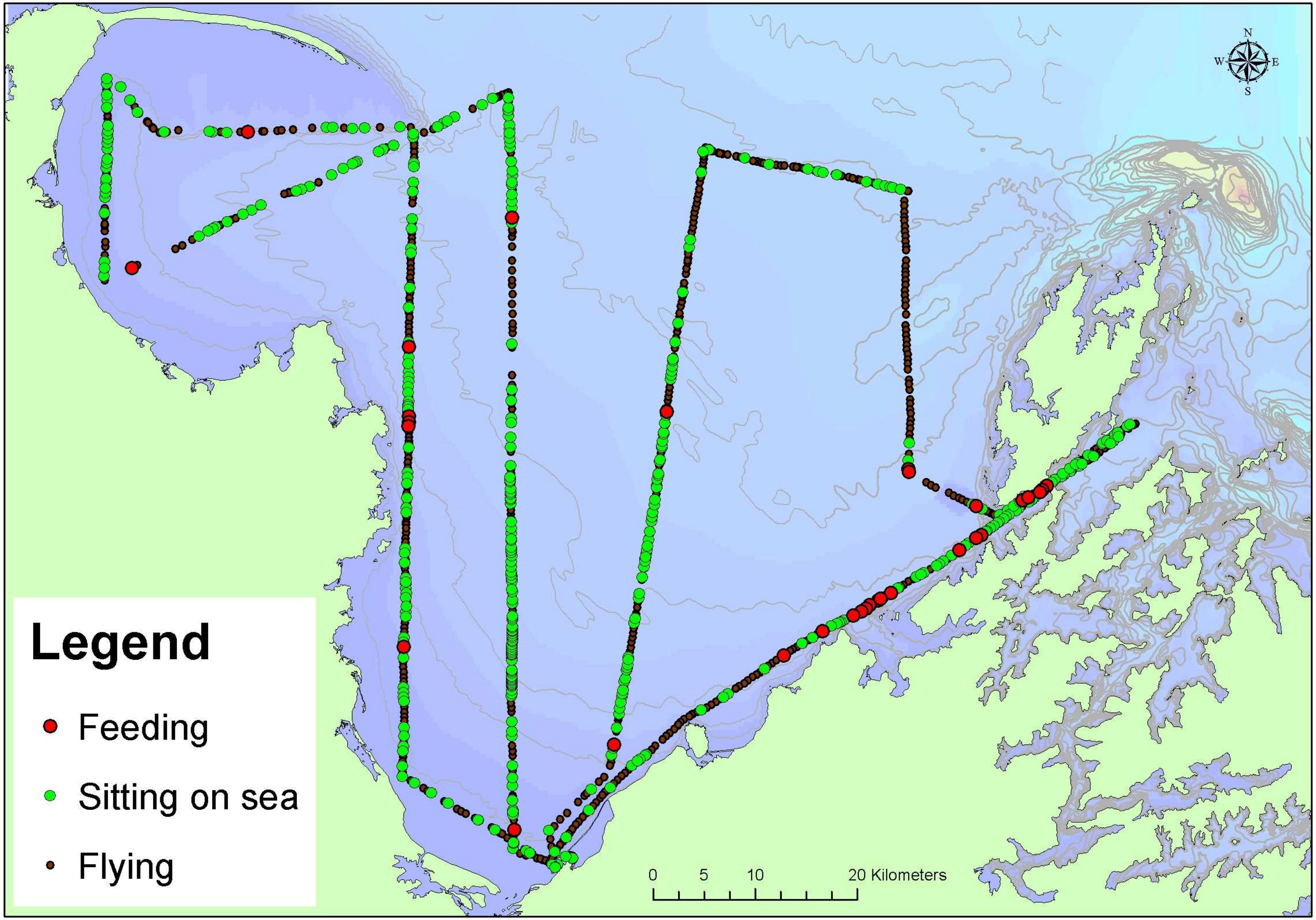

Figure 3-17:Location of seabirds by behaviour surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined.

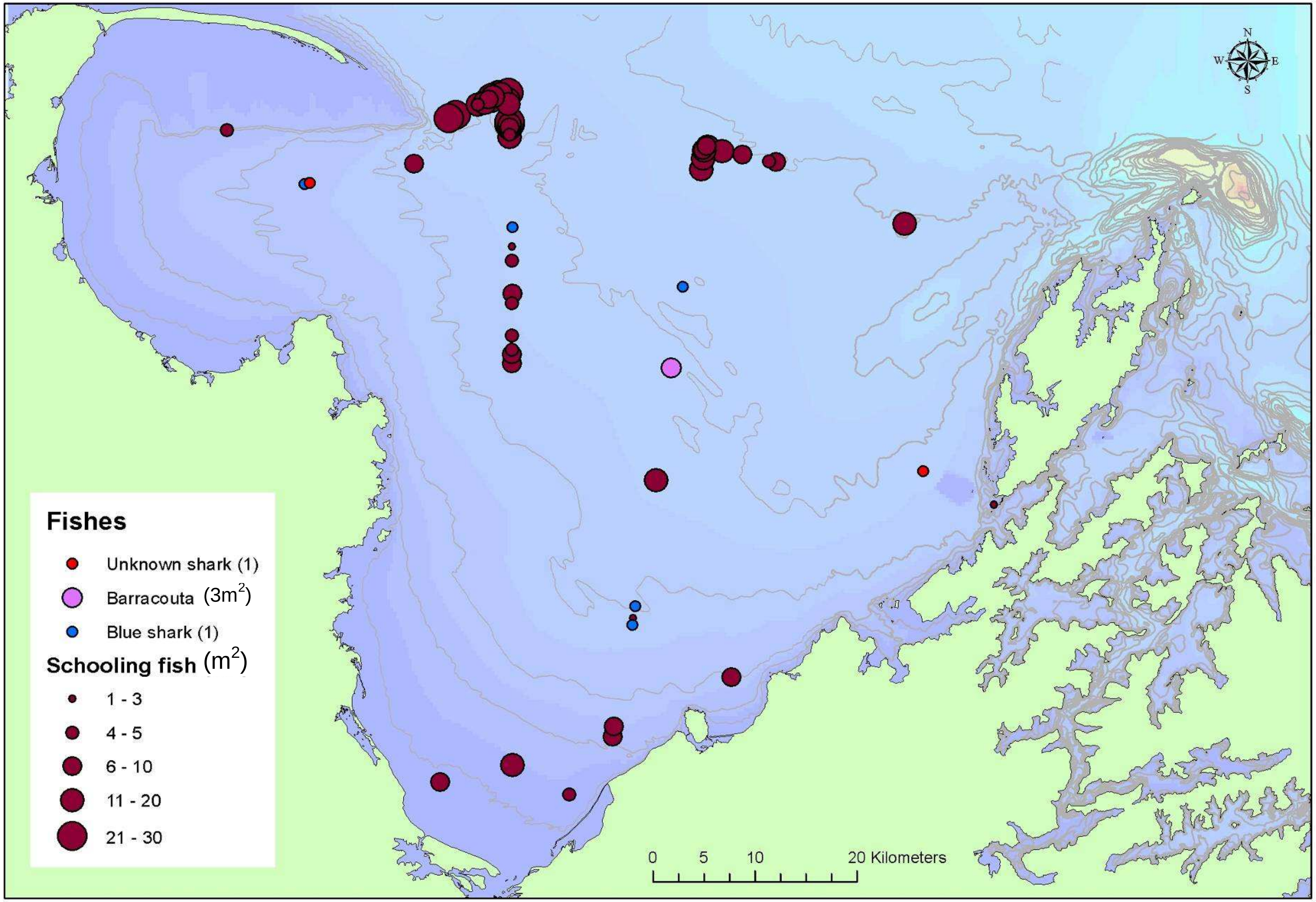

Figure 3-18:Fishes surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined, number of individuals or estimated area of schools (m^2) are in brackets.

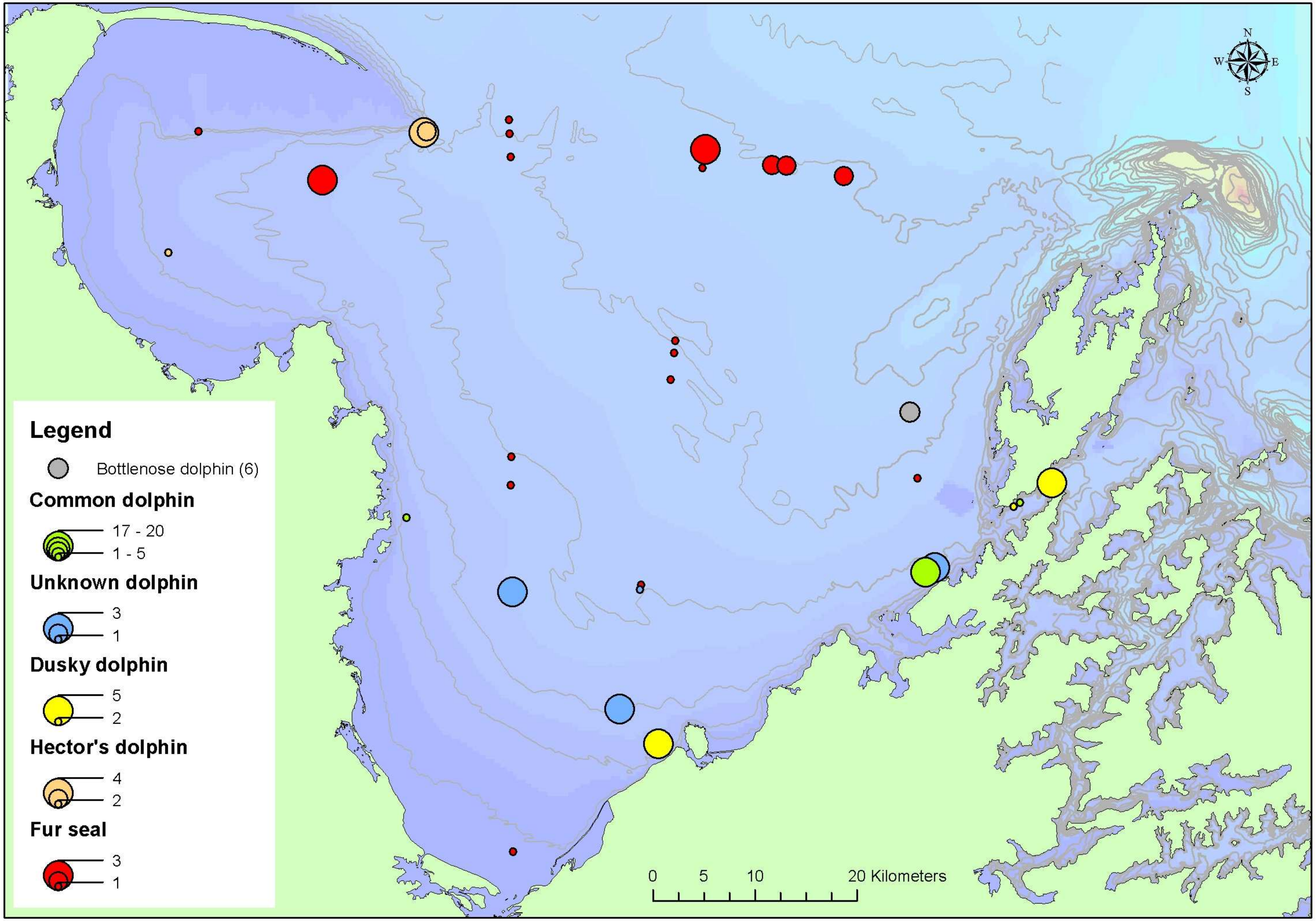

Figure 3-19:Clusters or individual marine mammals surveyed by boat in Tasman and Golden Bays during December 2010 and January 2011. Data for both months combined

Table 3-1: Total, and mean numbers of birds, fish and mammals observed by boat survey, pooled for December 2010 and January 2011. Bird Pel: pelagic species with distribution in deeper waters of study area. Bird Cst: Coastal species with distribution ion shallow areas of study area. Bird PelCst: pelagic species occurring in both shallow and deeper waters.

Type	Common name	Species	Total No. birds	Mean No. in cluster (± se)	Mean No. flying (± se)	Mean No. on the sea (± se)
Bird PelCst	Australasian gannet	*Morus serrator*	278	2.7 (± 0.34)	1 (± 0.1)	1.5 (± 0.34)
Bird Pel	Fluttering shearwater	*Puffinus gavia*	225	6.5 (± 1)	1.8 (± 0.23)	3.6 (± 0.74)
Bird PelCst	Fairy prion	*Pachyptila turtur*	163	18 (± 5.1)	10.1 (± 1.07)	7.4 (± 5)
Bird Cst	White-fronted tern	*Sterna striata*	131	2.5 (± 0.4)	2 (± 0.32)	0.2 (± 0.15)
Bird Pel	Flesh-footed shearwater	*Puffinus carneipes*	100	5.1 (± 0.7)	1.3 (± 0.24)	3.9 (± 0.71)
Bird Cst	Spotted shag	*Stictocarbopunctatus*	98	1.2 (± 0)	0.6 (± 0.07)	0.5 (± 0.07)
Bird Cst	Little penguin	*Eudyptula minor*	83	1.5 (± 0.1)		1.5 (± 0.1)
Bird Pel	White-capped albatross	*Thalassarche steadi*	78	1.4 (± 0.1)	0.9 (± 0.08)	0.4 (± 0.11)
Bird Pel	Sooty shearwater	*Puffinus griseus*	52	1.8 (± 0.3)	0.9 (± 0.21)	0.9 (± 0.25)
Bird Cst	Black-backed gull	*Larus dominicanus*	32	1.7 (± 0.5)	1 (± 0.11)	0.6 (± 0.5)
Bird Cst	Arctic skua	*Stercorarius parasiticus*	15	1 (± 0)	0.8 (± 0.11)	0.1 (± 0.09)
Bird PelCst	Buller's shearwater	*Puffinus bulleri*	14	1.3 (± 0.2)	0.7 (± 0.16)	0.3 (± 0.16)
Bird Cst	Pied shag	*Phalacrocorax varius*	13	1.1 (± 0.1)	0.3 (± 0.13)	0.5 (± 0.14)
Bird Cst	Red-billed gull	*Larusscopulinus*	9	4 (± 2.6)	0.4 (± 0.18)	0.8 (± 0.36)
Bird Pel	Diving petrel	*Pelecanoides* sp.	9	1.2 (± 0.1)	1.1 (± 0.2)	
Bird Pel	Giant petrel	*Macronectes* sp.	3	1.0	0.7 (± 0.33)	1.0
Bird Pel	White-faced storm petrel	*Pelagodroma marina*	2	1.0	1.0	
Bird Cst	King shag	*Leucocarbocarunculatus*	2	1.0		1.0
Bird Cst	NZ shoveler	*Anas rhynchotis variegata*	1	27.0	27.0	
Bird Pel	Mollymawk	*Thalassarche* sp.	1	1.0		1.0
	Welcome swallow	*Hirundo neoxena*	1	2.0	2.0	
Bird Pel	Grey backed storm petrel	*Garrodia nereis*	1	1.0	1.0	
Bird Cst	Middle sized shearwater	*Puffinus* sp.	1	1.0		1.0
Bird Cst	Black swan	*Cygnus atratus*	1	2.0	2.0	
Bird Cst	Caspian tern	*Hydroprogne caspia*	1	1.0	1.0	
Bird Cst	Bar tailed godwit	*Limosa lapponica*	1	1.0	1.0	

Continued next page…

Table 2 Cont.

Type	Group	Common name	Species	Total	Mean No. or size of cluster (m^2) (± se)
Fish	Fish aggregation	Fish aggregation	Unknown	51	13.9 m^2 (± 1.1)
	Predatory fish	Blue shark	*Prionace glauca*	6	1.0
	Predatory fish	Shark	Unknown	2	1.0
	Predatory fish	Barracouta	*Thyrsites atun*	1	3.0 m^2
Mammal	Seal	Fur seal	*Arctocephalus forsteri*	18	1.5 (± 0.2)
	Dolphin	Dolphin	Unknown	4	2.5 (± 0.5)
	Dolphin	Dusky dolphin	*Lagenorhynchus obscurus*	4	8 (± 4.1)
	Dolphin	Common dolphin	*Delphinus delphis*	3	8.3 (± 5.9)
	Dolphin	Hector's dolphin	*Cephalorhynchus hectori*	3	3 (± 0.6)
	Dolphin	Bottlenose dolphin	*Tursiops truncatus*	1	6.0

Table 3-2: Totals and percentage estimates of seabird behaviour observed by boat survey, pooled for December 2010 and January 2011.

	Flying	Sitting on the sea	Feeding	Totals
No. Clusters (% of total)	830 (62.7%)	459 (34.7%)	33 (2.5%)	1322 Clusters
Estimated No. birds (% of total)	3002 (46.9%)	3126 (48.9%	268 (4.2%)	6,396 Seabirds

4 Discussion

The boat survey method, whilst slower appeared more accurate for identification of seabirds especially the shearwaters, than the November 2010 aerial surveys, as predicted by Handley & Sagar (2011). As the boat survey only recorded observations on one side of the vessel as compared with both sides of the aircraft, the boat effective strip width was only half that recorded by plane, and due to the much slower speed only approximately a third of the distance could be covered per day. Despite this, as twice the time (8 hours) was allocated to boat surveys, more discreet cluster observations were recorded per survey-day by boat as compared to aerial survey (Handley & Sagar 2011). This resulted in more seabird species recorded by boat, with more seabirds being able to be identified to species level, assuming there were no seasonal differences. This increase in accuracy of identification was, however, at the expense of area covered and time spent surveying.

A direct comparison of aerial versus boat-based survey techniques of seabirds in California found that density estimates from the air were significantly greater for taxa that occurred in large flocks (grebes and gulls), but density estimates increased when abundance increased (Henkel et al. 2007). Their results indicated that aerial surveys provided more accurate density estimates than boat-based surveys for some taxa, under certain conditions. While other comparative surveys have concluded similar species composition from the two different platforms (Briggs et al. 1985), our lower number of seabird species identified via aerial survey (Handley & Sagar 2011) could either be due to, differences in species diversity between survey dates, inexperience of observers, or difficulty identifying shearwater species present in New Zealand waters. Storm petrel and diving petrel would be difficult to distinguish by air, and very few little penguins were identified by aerial survey (2) as compared with the boat survey (83). Henkel et al. (2007) concluded that density estimates from the two platforms based on certain survey methods may be similar enough to be considered directly comparable, but given our aerial and boat surveys covered differing spatial extents of the Bays, during different months, and over differing durations, we consider that they cannot be directly comparable. More birds were observed feeding (2.5%) from the boat than previously by air (Handley & Sagar 2011; 0.6 %), but we cannot determine if the difference is an artefact of the sampling methods, times, or a real difference.

Differences between observations in December 2010 and January 2011, especially the absence of large aggregations of fairy prion in December is unknown. It was unfortunate that the vessel availability and windows of weather prevented all the survey days being run concurrently, but the results highlight that there can be significant variability in seabird distributions within one month during summer and that the data herein are a snapshot in time and require more replication for future surveys. The resulting low number of replicate concurrent survey days precluded any GIS interpolation of the data. Despite this, the bubble plots of the data strongly supported the previous aerial survey results which showed that Tasman and Golden Bays are utilised by a diverse range of seabirds, marine mammals and fishes. It was hoped that identification of fishes would have been easier from the boat than from the plane. It would have been detrimental to the progress and aims of the project to stop the boat during the visual surveys to undertake fish sampling (e.g. fine mesh seine) as this action would likely attract seabirds. For future surveys, another vessel, preferably a purse seine as recommended by Parrish (1998) could be used to sample prey fish in areas previously surveyed.

4.1 Recommendations:

As boat-based survey methods are more accurate for species diversity, future studies will have to weigh up the added cost of aerial surveys that can cover larger areas more rapidly versus boat-based surveys or consider using high definition video from aircraft (e.g. Thaxter & Burton 2009).

5 Acknowledgements

Thanks to Barrie Bird from Seabird Charters for accommodating the observers. Of immense support to the project was the knowledge of OSNZ member Steve Wood. Also great thanks to other members of OSNZ for participating in this study; they were David Melville, Rob Schuckard, Ingrid Hutzler, Til Melis and Lesley Hadley. Rob Schuckard and David Melville provided valuable comments on the drafts of this report.

6 References

Argue, A.W., Kearney, R.E. 1983. An assessment of the skipjack and baitfish resources of New Zealand. Skipjack survey and assessment programme Final Country Report No. 6. South Pacific Commission, Noumea, New Caledonia. 68p.

Baker, A.N. (1972). Reproduction, early life history, and age-growth relationships of the New Zealand pilchard, *Sardinops neopilchardus* (Steindachner). *Fisheries Research Bulletin 5*: 64p.

Briggs, K.T., Tyler W.B., Lewis, D.B. 1985. Comparison of ship and aerial surveys of birds at sea. *Journal of Wildlife Management 49(2)*: 405-411.

Handley, S., Sagar P. 2011. Seabird, marine mammal and surface fish surveys of Golden and Tasman Bays: Part A – Aerial surveys. NIWA client report prepared for AWE New Zealand Pty. Ltd. and Friends of Nelson Haven and Tasman Bay Incorporated. AWE11401, No. NEL2011-018.

Henkel L.A., Ford R.G., Tyler W.B., Davis J.N. 2007. Comparison of aerial and boat-based survey methods for Marbled Murrelets *Brachyramphus marmoratus* and other marine birds. *Marine Ornithology 35*: 145-151.

Parrish, J.K. 1998. Seabird-Prey-base interaction. Final report to the Tenyo Maru Trustees Council. 41p.

Thaxter, C.B., Burton, N.H.K. 2009. High definition imagery for surveying seabirds and marine mammals: a review of recent trials and development of protocols. British Trust for Ornithology Report commissioned by Cowrie Ltd. 30p.

Young, R., Clark, K. 2006. Native fish distribution in Nelson City Council Area. Prepared for Nelson City Council. Cawthron Report No. 1241. 11p.

Appendix A Survey form

AWE11401

Date:				Observer				Record from 0-31° with
Page:				Of:				inclinometer
	Time (hh:mm)	Species	Age	No. in Cluster	Fly	Sea	Feed	Notes
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								