

# **Six monthly summary of the capture of protected species in New Zealand commercial fisheries, summer 2007–08**

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## EXECUTIVE SUMMARY

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A summary is presented of captures of seabirds and marine mammals in trawl and surface longline fisheries within the New Zealand Exclusive Economic Zone (EEZ), for the first half of the 2007–08 fishing year (1 October 2007 to 31 March 2008, inclusive). Data from other fisheries, such as bottom longline and set-net, were not available for the period covered.

Ministry of Fisheries observers report captures of protected species when they occur, and these data are presented here. Observers in trawl fisheries recorded 177 bird captures in the first half of 2007–08, an increase from 124 bird captures in the first half of 2006–07. The most frequently caught birds in trawl fisheries were 65 sooty shearwater (*Puffinus griseus*), 45 white-chinned petrel (*Procellaria aequinoctialis*) and 30 white-capped albatross (*Thalassarche steadi*). Other captures included eight Salvin's albatross (*Thalassarche salvini*), three Buller's albatross (*Thalassarche bulleri*), and single captures of Campbell albatross (*Thalassarche impavida*) and southern royal albatross (*Diomedea epomophora*). One black petrel (*Procellaria parkinsoni*) was caught in a scampi trawl, and was confirmed by necropsy. A Westland petrel (*Procellaria westlandica*) was reported caught alive by an observer, but the identity could not be confirmed as it was released.

There were 25 New Zealand fur seals (*Arctocephalus forsteri*) observed caught in trawl fisheries, 21 of them south of 48° south. Seven New Zealand sea lions (*Phocartos hookeri*) were caught, four of them in the Auckland Islands squid fishery and three in the southern blue whiting fishery to the east of Campbell Island. There were 20 dolphins, identified by the observers as common dolphin (*Delphinus delphis*), caught in the jack mackerel fishery on the west coast of the North Island. This was twice as many as were observed caught in the first half of 2006–07. No other species of marine mammal were observed caught, and there were no marine mammals caught in surface longline fisheries. No turtles were caught in either trawl or surface longline fisheries.

Between the first half of 2006–07 and the first half of 2007–08 the total trawl effort decreased from 54 500 to 48 300 tows. In contrast, the number of observed tows increased from 3884 to 4436. Most bird captures were in the squid trawl fishery. There was a small increase in the number of observed tows in the squid fishery, from 1075 to 1194. Observed captures rose from 89 to 136 birds, and the capture rate increased from 8.3 to 11.4 birds per one hundred tows. However, across all trawl fisheries, observed captures of white-capped albatross decreased from 42 to 30 birds. Observed captures of other albatross species increased slightly from 12 to 14 birds. Of the 30 white-capped albatross caught in the first half of 2007–08, only eight were caught on trawl warps. Coverage of inshore trawl fisheries remains low. During the first half of the 2007–08 fishing year 97 inshore trawls were observed, 0.3% of the fishery. During these trawls two birds were caught, a cape petrel (*Daption capense*) and a white-capped albatross.

There were seven birds observed caught in surface longline fisheries, compared with 85 in the first half of 2006–07. All birds were caught by domestic vessels. The species caught were two flesh-footed shearwaters, two Buller's albatross, one Salvin's albatross, one Gibson's albatross (*Diomedea gibsoni*) and one unidentified petrel. The large decrease in the total observed captures can be attributed to the absence of charter surface longline vessels fishing operating in the first half of 2007–08. Although observer coverage in the domestic longline fishery was low (only 3.4% of hooks were observed), there was a decrease in the seabird capture rate within this fishery, from 3.8 to 3.2 birds per 10 000 hooks.

## 1. INTRODUCTION

In this report, a summary is presented of the captures of protected species in New Zealand trawl and surface longline fisheries. The report focuses on the first half of the 2007–08 fishing year, from 1 October 2007 to 31 March 2008. Seabird, marine mammal and other protected species captures are recorded by Ministry of Fisheries observers when they are on fishing vessels, and these data are given here. To provide a context for the capture data, fishing effort and observer coverage are also summarised.

There have been a series of annual summaries of seabird and marine mammal captures in New Zealand fisheries (e.g., Baird 2005, 2008, Smith & Baird 2007, Baird & Smith 2008). Recently, a complete summary of protected species captures was presented for the nine years from 1998–99 to 2006–07 (Abraham & Thompson 2009a). The capture data were summarised by target fishery and by groups of protected species, and included turtle capture data. Bringing all the capture data together in a single publication allows for trends and patterns to be readily identified. In this report, the focus is on a half fishing year. Data from the 2006–07 fishing year is also given, split into two half years, so that a direct comparison can be made between these two half year periods.

Stratified ratio methods are used to provide an estimate of the total captures within fisheries, with bootstrap methods being used to calculate confidence intervals. These estimates are necessarily preliminary, and are expected to be superseded by more detailed statistical modelling. The estimates are only applied to fisheries and area strata with sufficient numbers of observed tows for the observer data to be generalised. The ratio estimates are prone to bias if the observer coverage is not representative of the fishing effort in some way. For example if observations are concentrated at a time of year when a seabird is breeding, captures may be overestimated. Despite this caveat, the ratio estimates have compared well with more detailed modelling where a comparison has been made (Abraham & Thompson 2009a).

Data and estimates are presented for trawl and surface longline data. Data from bottom longline fisheries were not complete at time of writing, and could not be included. Similarly, there have been observations made in set net fisheries, but these data are not yet available. Summaries are given for seabird, New Zealand fur seal (*Arctocephalus forsteri*), New Zealand sea lion (*Phocarctos hookeri*) and dolphin captures in trawl fisheries, and seabird captures in surface longline fisheries. There were no observed captures of marine mammals in surface longline fisheries in this period, or of other protected species in either trawl or surface longline fisheries.

## 2. METHODS

### 2.1 Data sources

Ministry of Fisheries observers on commercial fishing boats record captures of protected species, including seabirds and marine mammals. The capture events are recorded on paper forms by the observers and entered into a database maintained by the National Institute of Water and Atmospheric Research (NIWA) on behalf of the Ministry of Fisheries. Currently, data are entered into the Centralised Observer Database (COD). The following protected species bycatch information from COD was used:

Species	The species identified by the observer. This may either be a species level or a more general classification if the observer was unable to identify the animal to species level.
Capture method	A code indicating where the animal was captured. For example, in the net, on the warps, or tangled in line. Additional information from the observer's comments has also been used to identify the capture method.
Life status	Observers record whether the animal was alive, dead, killed by the crew, or decomposed (long dead).
Station details	Trip number, station number and date at beginning of the tow or set. This information is obtained for all observed stations, including those where there were no protected species bycatch.

In addition to the observer data, fishing effort data were required. Commercial fishing boats return a record of all fishing effort on each trip to the Ministry of Fisheries. Depending on which fishery they are fishing in, skippers complete either a Trawl Catch Effort Processing Return (TCEPR), Trawl Catch Effort Return (TCER), Tuna Longline Catch Effort Return (TLCER), Catch Effort Landing Return (CELR), Lining Catch Effort Return (LCER), or Lining Trip Catch Effort Return (LTCER) form. The effort data are stored in databases administered by the Ministry of Fisheries (Ministry of Fisheries 2008). In this report, information on station date, position and effort (either number of trawls or number of hooks) is used.

The observer station and capture data are currently being moved into COD from the older *obs\_lfs*, *obs* and *l\_line* databases. Data were requested from COD from the beginning of the 2006–07 fishing year to allow a comparison of the new data extract with data from the older databases. In the new extract, there was only one difference between capture data from the 2006–07 and 2007–08 fishing years; an additional fur seal was caught in the southern blue-whiting fishery in August 2007. The surface longline data are not yet integrated with COD and were provided directly from the *l\_line* database.

Over the last year, inshore trawl fisheries have moved to reporting fishing effort on TCER forms, rather than CELR forms. The TCER form locates effort at a latitude and longitude, rather than the general statistical area field of the CELR form. This allows a more accurate understanding of where fishing effort is occurring and how spatially representative the observer coverage is.

Grooming has been applied where there are clearly mistakes in the data (Abraham & Thompson 2009a). There were no changes made to the observer records in the six month period 1 October 2007 to 31 March 2008. In the trawl effort data, 39 records had the start position changed due to unreasonable vessel speeds, and two records had the effort number for a CELR added where it was missing.

### 2.1.1 Necropsy information

Observers retain some animals for necropsy. When the capture data were supplied, the necropsy information had not been integrated back into the observer database. The seabird necropsy data were obtained directly from David Thompson (NIWA) and merged with the observer records. Where the observer had incorrectly identified a species, or had only provided a general classification, the records were updated to the species identified by necropsy. The necropsied animals are listed in Table 1 with both the observer and necropsy identifications. White-chinned petrel (*Procellaria aequinoctialis*) were frequently not identified by the observer, and the most frequent mis-identification was identifying flesh-footed shearwater (*Puffinus carneipes*) as sooty shearwater (*Procellaria griseus*).

Six black petrels were reported captured and released alive on three tows between 17 and 21 March 2008. Unfortunately, black petrel is used by some observers as a descriptive term, and applied to other black

**Table 1: Necropsied seabirds returned by the Ministry of Fisheries observer programme from 1 October 2007 to 31 March 2008, with the species identified by the observer and the species identified by necropsy. The codes are those used by the Ministry of Fisheries for non-fish catch.**

Necropsied species		Observed species		
Common name	Scientific name	Code	Species name	Number
Sooty shearwater	<i>Puffinus griseus</i>	XSH	Sooty shearwater	44
White-chinned petrel	<i>Procellaria aequinoctialis</i>	XWC	White-chinned petrel	19
White-capped albatross	<i>Thalassarche steadi</i>	XWM	White-capped albatross	17
White-chinned petrel	<i>Procellaria aequinoctialis</i>	XPE	Petrel (unidentified)	7
Flesh-footed shearwater	<i>Puffinus carneipes</i>	XSH	Sooty shearwater	7
White-chinned petrel	<i>Procellaria aequinoctialis</i>	XBP	Black petrel	3
Salvin's albatross	<i>Thalassarche salvini</i>	XSA	Salvin's albatross	3
White-capped albatross	<i>Thalassarche steadi</i>	XAL	Albatross (unidentified)	2
Sooty shearwater	<i>Puffinus griseus</i>	XPE	Petrel (unidentified)	2
Campbell albatross	<i>Thalassarche impavida</i>	XKM	Black-browed albatross	1
Sooty shearwater	<i>Puffinus griseus</i>	XWM	White-capped albatross	1
Sooty shearwater	<i>Puffinus griseus</i>	XBP	Black petrel	1
Fairy prion	<i>Pachyptila turtur</i>	XFP	Fairy prion	1
Southern royal albatross	<i>Diomedea epomophora</i>	XMM	Albatross	1
Black petrel	<i>Procellaria parkinsoni</i>	XSH	Sooty shearwater	1
White-capped albatross	<i>Thalassarche steadi</i>	XSH	Sooty shearwater	1

coloured petrels. It should strictly only be used for *Procellaria parkinsoni*, also known as Parkinson's petrel. The observer species were changed to unidentified petrels because the captures occurred near the Auckland Islands, well outside of the black petrel range (Brooke 2004). One of the six birds was returned for necropsy from the trip and was identified as a flesh-footed shearwater.

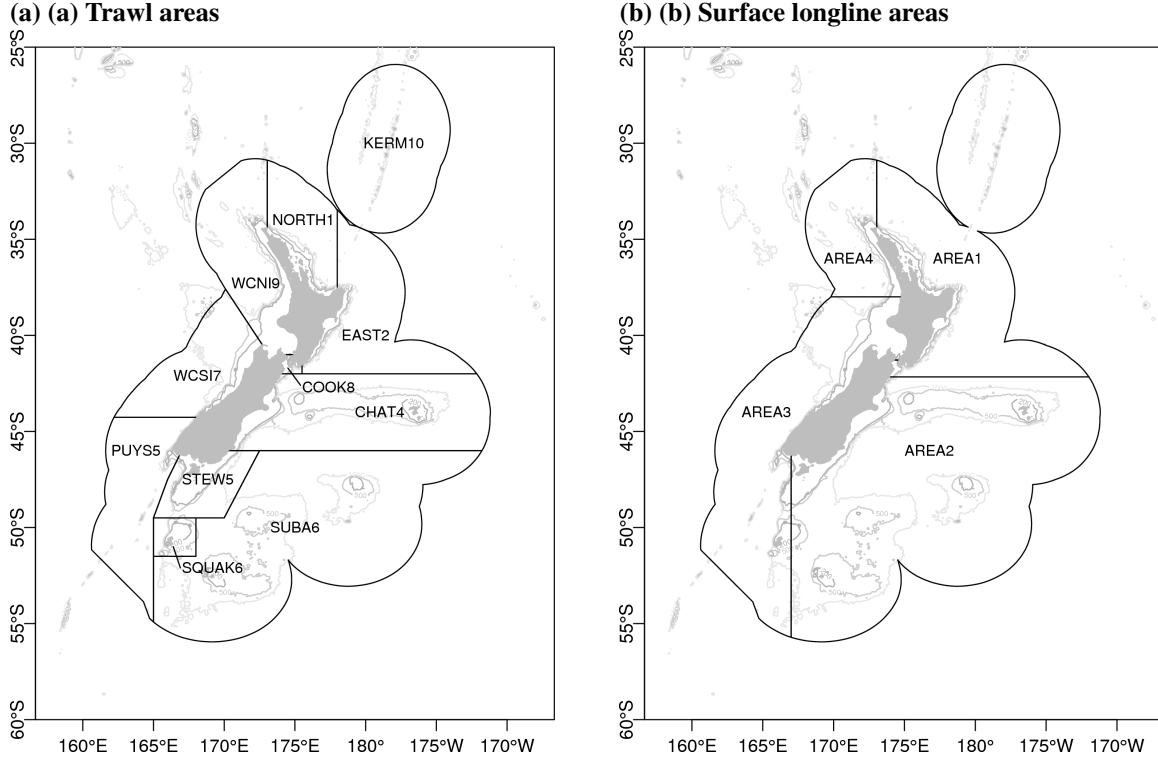
The necropsy data provide an independent check on the completeness of the observer non-fish bycatch record. When they are caught, the animals are tagged by the observer with trip, station and specimen numbers, and a species code. This information is also written on the non-fish bycatch form and entered into the observer databases, and the two data sources should reconcile. A cross-check of the necropsy information against the COD data extract showed that there were non-fish bycatch records missing from ten observed trawl trips. Photocopies of non-fish bycatch forms from these trips were provided by Ministry of Fisheries Research Data Management (RDM) to complete the dataset.

## 2.2 Excluded captures

Animals that land on the deck or collide with the vessel's superstructure are not considered to be fishing related bycatch. The capture method code and observer comments were used to identify deck captures, and they were excluded from the data. In addition, decomposing animals are assumed to have died of causes unrelated to the fishing effort and are excluded. In total, 50 bird captures were excluded, mainly because of deck landings. One fur seal capture was also excluded, as it had climbed on board the vessel, and one whale skull was excluded.

## 2.3 Fishery and area classification

Trawl fishing events were assigned to fisheries on the basis of the species targeted by the fishing effort, following the classification used in Abraham & Thompson (2009a). Deepwater and middle depths trawl fisheries include squid, hoki, hake, ling, southern blue-whiting, other deep water fish (orange roughy,



**Figure 1: Reporting areas for trawl and surface longline**

oreos, patagonian toothfish, and cardinal fish), and scampi. Pelagic trawl includes effort targeting jack and blue mackerel. Other middle depths trawl includes effort targeting barracouta, ribaldo, rubyfish, alfonsino, bluenose, frostfish, ghost shark, gem fish, spiny dogfish, sea perch, and warehou. All inshore target species are reported as inshore trawl.

The surface longline effort was sorted into three groups by vessel registration type. Domestic surface longline includes all vessels registered in New Zealand. Australian chartered vessels form a category of their own as they are small vessels (less than 30m) whereas the rest of the charter surface longline fleet are over 50m long. The remaining vessels are grouped together as charter surface longline.

Captures in all fisheries, apart from surface longline, are reported for the areas shown in Figure 1a (Abraham & Thompson 2009a). These have been chosen to surround the prominent bathymetric features that are the focus of fishing effort. These areas include the Cook Strait, Stewart-Snares shelf and Auckland Islands areas used in previous reports of protected species bycatch (e.g., Baird & Smith 2007, 2008). Away from these areas, the boundaries have been chosen to avoid cutting through fishing grounds, and have been aligned with the boundaries of the Fisheries Management Areas where possible. The areas used for reporting surface longline effort follow those defined previously (e.g., Baird & Smith 2007, 2008) and are shown in Figure 1b.

## 2.4 Estimation of total captures

The estimated total number of captures in a fishery is

$$N_t = N_o + N_e \quad , \quad (1)$$

where  $N_o$  are the observed captures and  $N_e$  are the estimated captures during unobserved fishing. The unobserved captures are estimated using a ratio method. Data are stratified by fishery and by area, following the definitions given above, with independent estimates being made for each fishing half year.

Within each stratum,  $s$ , the observed bycatch is  $n_s$ . In trawl fisheries, the effort is determined by the number of tows and in longline fisheries effort is determined by the number of hooks in the set. If the total effort in a stratum is  $e_s$  and the observed effort is  $o_s$ , then the unobserved captures,  $N_e$ , are estimated by the product of the sum over strata of the observed catch rate,  $n_s/o_s$ , with the unobserved effort,

$$N_e = \sum_s \left( \frac{n_s}{o_s} (e_s - o_s) \right) \quad . \quad (2)$$

The sum over strata in equation (2) is restricted to strata  $s$  where there was sufficient observer coverage. We do not include strata where less than 100 tows (10 000 hooks), or less than 1% of the total effort, was observed. Where the estimates are presented, the percentage of effort included in the estimate is also given,

$$f = (O + \sum_s (e_s - o_s)) / E \quad , \quad (3)$$

where  $E$  is the total effort and  $O$  is the total observed effort in the given fishery. This percentage indicates how much of the effort was observed at a level sufficient for making the estimate. If all strata are included in the estimate of  $N_e$  then  $f = 1$ . At the other extreme, if no strata are sufficiently observed to be included in the estimate of  $N_e$ , then  $N_t = N_o$  and  $f = O/E$ . The strata,  $s$ , which were included in the calculation of  $N_t$ , and the fraction of the total effort in the included strata ( $\sum_s e_s / E$ ) are given in Tables 2 and 3 for each half year and fishery. It is not possible to simply scale up the total estimated captures to account for effort in strata that have not been included. The problem is that bycatch rates may vary greatly between strata, and this scaling up is best carried out within the framework of a statistical model. No unobserved effort from the inshore, hake, southern blue whiting or other middle depths trawl fisheries is included in the estimation. The strata included in the estimation in the first half of 2006–07 and 2007–08 are the same for the squid, hoki and pelagic fisheries. The STEW5 area stratum is dropped from the deep-water fishery in 2007–08. The total effort in this stratum was 106 tows. The NORTH1 scampi fishery and the STEW5 ling fishery strata are included in the 2007–08 estimates, the total effort in these strata was 631 and 500 tows respectively. The change in effort from a change in these strata is approximately an additional 1000 tows, compared with a total of 12 000 tows which are used for the estimation. In surface longline fisheries, the charter and Australian charter fisheries are not included in the estimation, as there was no effort in these fisheries. Estimates of catches in domestic surface longline in the first half of 2006–07 and 2007–08 are both restricted to effort in AREA1. The estimates of captures in the surface longline fishery from the two periods are therefore directly comparable.

The uncertainty in the total captures,  $N_t$ , is estimated by stratified bootstrap resampling (e.g., Davison & Hinkley 1997). The observed fishing events are resampled 5000 times, preserving the number of observations within each stratum, and the total bycatch is recalculated for each sample from equations (1, 2). The 95% confidence interval in the estimate is calculated from the 2.5% and 97.5% quantiles in the distribution of the resampled total catch.

### 3. RESULTS

#### 3.1 Data summaries

Summaries of the protected species are presented in tabular and graphical form: for seabirds in trawl fisheries in section 3.5; for New Zealand fur seals in trawl fisheries in section 3.6; for New Zealand sea lions in trawl fisheries in section 3.7; for dolphins in trawl fisheries in section 3.8; and for seabirds in surface longline fisheries in section 3.9. Within each section are tables summarising the effort, the observer coverage, the observed captures, and the estimated captures. Data is given for the three half year periods: summer 2006–07, winter 2007 and summer 2006–07. The information is also broken into selected fisheries, and maps of the effort, observations and captures are given. Only effort which has



**Table 2: Effort included in ratio estimates for trawl fisheries.**

	Inshore	Deep	Hoki	Hake	Ling	Squid	Scampi	SBW	Pelagic	Other
2007–08, October to March										
Effort (tows)	27 749	4 045	3 583	444	1 512	3 249	2 526	2	1 522	3 630
% observed	0.3	31.5	18.4	11.5	14.4	36.7	11.6	100.0	33.6	3.5
% eff. in est.	0.0	71.7	77.0	0.0	41.7	90.1	19.8	0.0	95.8	0.0
Areas in est.		CHAT4 SUBA6	CHAT4 STEW5		STEW5	SQUAK6 STEW5	NORTH1		WCNI9	
2006–07, April to September										
Effort (tows)	27 362	3 207	6 391	1 225	806	1 572	2 681	615	1 176	3 834
% observed	0.4	42.1	17.4	14.2	10.9	13.6	6.0	34.8	33.2	5.9
% eff. in est.	0.0	71.5	91.6	85.6	0.0	53.4	0.0	100.0	89.4	0.0
Areas in est.		CHAT4 NORTH1 SUBA6 WCNI9	CHAT4 COOK8 WCSI7	WCSI7		STEW5		SUBA6	WCNI9 WCSI7	
2006–07, October to March										
Effort (tows)	32 176	4 181	4 217	381	853	4 338	2 457	17	1 535	4 360
% observed	0.6	23.3	15.3	32.0	8.1	24.8	9.3	58.8	26.8	3.8
% eff. in est.	0.0	80.3	83.5	0.0	0.0	75.6	0.0	0.0	93.3	0.0
Areas in est.		CHAT4 STEW5 SUBA6	CHAT4 STEW5			SQUAK6 STEW5			WCNI9	

**Table 3: Effort included in ratio estimates for surface longline fisheries.**

	Domestic longline	Charter longline	Australian longline
2007–08, October to March			
Effort (hooks)	630 052	0	0
% observed	3.4	-	-
% eff. in est.	93.9	-	-
Areas in est.	AREA 1		
2006–07, April to September			
Effort (hooks)	1 453 017	1 328 730	36 040
% observed	8.8	53.1	34.9
% eff. in est.	99.4	100.0	100.0
Areas in est.	AREA 1 AREA 4	AREA 1 AREA 3	AREA 1
2006–07, October to March			
Effort (hooks)	800 185	52 480	48 780
% observed	5.2	95.0	37.7
% eff. in est.	93.8	100.0	100.0
Areas in est.	AREA 1	AREA 3	AREA 1

latitude and longitude is displayed, and in particular, data collected on CELR forms is not shown. The caption gives the percentage of the total effort which is included. In order to meet Ministry of Fisheries data confidentiality requirements, the effort and observations are plotted on a 0.2° grid, and the positions of the captures are jittered by a random uniform number between  $\pm 0.1^\circ$ . The colour of a grid cell indicates the number of tows or hooks within that cell. The number of observations is shown by a black dot, with the size of the dot increasing as the number of observations increases. Unobserved or poorly observed effort is seen in cells which are coloured, but which do not have black dot. Maps are presented for both summer 2006–07 and summer 2007–08, allowing a comparison to be made. The same colour scales and axes limits are used in both figures.

Maps of the trawl effort and observer tows show gaps in the observer coverage (Figure 3). There are very few observations (97 tows or 0.3% of the fishery) in any inshore trawl fisheries. Most of the effort surrounding the South Island was unobserved, with a small number of observations being made on the

**Table 4: All non-fish captures in trawl fisheries recorded by the Ministry of Fisheries observer programme from 1 October 2007 to 31 March 2008, showing the number of captures, the total number of records including decomposing animals and deck landings, the number reported alive, dead or decomposing, the number returned and necropsied, and the number of animals caught in the net, on the warp or elsewhere.**

Species	Captures	Total	Alive status			Nec.	Capture location		
			Alive	Dead	Deco.		Net	Warp	Other
Sooty shearwater	64	92	38	54	-	52	62	2	28
White-chinned petrel	45	46	9	34	3	36	44	-	2
White-capped albatross	31	38	8	27	3	31	20	9	9
New Zealand fur seal	25	26	7	19	-	-	24	-	2
Common dolphin	20	20	-	20	-	-	20	-	-
Salvin's albatross	8	11	4	7	-	3	1	6	4
Petrel (unidentified)	8	10	10	-	-	-	4	1	5
New Zealand sea lion	7	7	-	7	-	-	7	-	-
Flesh-footed shearwater	4	4	-	4	-	4	1	-	3
Buller's albatross	2	4	2	2	-	1	2	-	2
Southern royal albatross	2	2	-	2	-	2	2	-	-
Seabird small	2	2	2	-	-	-	2	-	-
Albatross (unidentified)	1	8	6	1	1	2	2	-	6
Cape pigeon	1	2	2	-	-	-	-	1	1
Black petrel	1	2	1	1	-	1	1	-	1
Black-browed albatross	1	1	-	1	-	-	-	-	1
Grey petrel	1	1	1	-	-	-	-	-	1
Campbell albatross	1	1	-	1	-	1	1	-	-
Storm petrels	-	3	3	-	-	-	-	-	3
Fairy prion	-	2	1	1	-	1	-	-	2
Dolphins and toothed whales	-	1	-	-	1	-	1	-	-
Westland petrel	-	1	1	-	-	-	-	-	1
White-faced storm petrel	-	1	1	-	-	-	-	-	1
Prion (unidentified)	-	1	1	-	-	-	-	-	1
Grey-backed storm petrel	-	1	1	-	-	-	-	-	1

West Coast and to the western end of the Chatham Rise. The widespread use of the TCER forms has allowed the distribution of trawl effort to be plotted in detail. In the first half of 2006–07, only the 49% of fishing effort is plotted (Figure 2) as the remaining effort was only given to a statistical area. In many places there is a halo around the coast. By contrast, Figure 3 shows 98% of fishing effort and the inshore gaps have been filled in.

### 3.2 Seabird captures in trawl fisheries

A list of all observed captures in trawl fisheries in the first half of 2007–08 is given in Table 4, in order of decreasing numbers of captures. Of the birds, the most frequently caught species were sooty shearwater, white-chinned petrel and white-capped albatross (*Thalassarche steadi*). Together, these three species account for 77% of all seabird captures over this period. The majority of these birds were caught on the Stewart-Snares shelf and near the Auckland Islands (Figure 3), a very similar pattern to the previous summer (Figure 2). The captures are also shown in Table 5, grouped by fishery. Target fisheries which had no observed captures are not shown in this table. There were two birds caught in inshore trawl fisheries, a cape pigeon (*Daption capense*) caught on a tarakihi target trawl on the northern West Coast of the South Island and a white-capped albatross caught on a red cod target trawl in Pegasus Bay.

Observers on trawlers recorded 177 bird captures in the first half of 2007–08, an increase from 124 bird

**Table 5: Non-fish captures in trawl fisheries by species group and target species in first half of 2007–08, from 1 October 2006 to 31 March 2008. The fisheries are presented in decreasing order of the total captures (seabirds and mammals).**

		Effort (tows or hooks)	% observed	Sooty shearwater	White-capped albatross	Other albatross	White-chinned petrel	Other bird	All birds	Fur seal	New Zealand sea lion	Common dolphin	All mammals
Trawl													
Arrow squid	SQU	3 249	36.6	60	27	3	37	8	<b>135</b>	5	4	-	<b>9</b>
Jack mackerel	JMA	1 518	33.5	-	-	-	-	-	-	-	-	20	<b>20</b>
Hoki	HOK	3 582	19.8	1	2	1	3	1	<b>8</b>	8	-	-	<b>8</b>
Scampi	SCI	2 526	11.6	2	-	4	-	8	<b>14</b>	1	-	-	<b>1</b>
Ling	LIN	1 510	14.3	-	1	2	3	2	<b>8</b>	4	-	-	<b>4</b>
Southern blue whiting	SBW	2	100.0	-	-	1	-	-	<b>1</b>	4	3	-	<b>7</b>
Black oreo	BOE	364	46.4	-	-	1	-	2	<b>3</b>	2	-	-	<b>2</b>
Hake	HAK	444	11.0	3	-	-	-	-	<b>3</b>	1	-	-	<b>1</b>
Barracouta	BAR	1 648	2.2	-	-	-	2	-	<b>2</b>	-	-	-	-
Red cod	RCO	1 639	0.4	-	-	1	-	-	<b>1</b>	-	-	-	-
Spiny dogfish	SPD	120	5.0	-	-	1	-	-	<b>1</b>	-	-	-	-
Tarakihi	TAR	5 484	0.5	-	-	-	-	1	<b>1</b>	-	-	-	-

captures in the first half of 2006–07. The observed seabird catch rate increased to 3.99 captures per one hundred tows in the first half of 2007–08, from 3.19 captures per one hundred tows in the first half of 2006–07. Despite the total trawl effort decreasing from 54 515 to 48 262 tows, the estimated total bird captures increased to 436 in the first half of 2007–08 (95% c.i.: 371 to 513, based on 25.3% of effort) from 378 in the first half of 2006–07 (95% c.i.: 316 to 446, based on 23.1% of effort). The estimated seabird captures only include approximately one quarter of the trawl effort, largely due to insufficient coverage in the inshore trawl fishery (Table 6).

Most seabirds were caught by trawlers targeting squid, with the scampi trawl fishery being the only other fishery where more than ten birds were observed caught. The squid fishery was well observed, but coverage of the scampi fishery was relatively low, with only 11.6% of tows being observed. Although the number of squid tows decreased markedly, to 3200 from 4300, the estimated number of seabird captures increased to 335 (95% c.i.: 282 to 400, based on 90.1% of effort) in the first half of 2007–08, from 278 in the first half of 2006–07 (95% c.i.: 228 to 334, based on 76.0% of effort).

Captures of white-capped albatross decreased to 30 in the first half of 2007–08, from 42 in the first half of 2006–07. This continues a trend of decreasing white-capped albatross captures since 2004–05 (Abraham & Thompson 2009a). The estimate of total white-capped albatross captures in trawl fisheries decreased to 70 in the first half of 2007–08 (95% c.i.: 52 to 90, based on 25.4% of effort) from 127 in the first half of 2006–07 (95% c.i.: 98 to 158, based on 23.1% of effort). The breakdown of seabird captures by capture location (Table 4) shows that there were relatively few warp captures of white-capped albatross (8) compared with net captures (21). This is consistent with the use of mitigation devices in trawl fisheries which deter the birds from entering the region between the stern of the vessel and the warps. The use of tori lines in the squid fishery is associated with a decrease in the warp strike rate and in the numbers of warp captures (Abraham & Thompson 2009b).

Other albatross species were caught south of 40°, in a range of trawl fisheries. Eight Salvin's albatross (*Thalassarche salvini*) and three Buller's albatross (*Thalassarche bulleri*) were caught, along with

single captures of Campbell albatross (*Thalassarche impavida*), southern royal albatross (*Diomedea epomophora*) and black-browed albatross (*Thalassarche melanophrys*). The identity of the black-browed albatross was not confirmed by autopsy, and it may have been a Campbell albatross, as many observers do not distinguish these two species. The number of estimated captures of albatross species other than white-capped albatross has decreased to 22 in the first half of 2007–08 (95% c.i.: 15 to 31, based on 25.4% of effort) from 42 in the first half of 2006–07 (95% c.i.: 21 to 67, based on 23.1% of effort).

Petrel captures were dominated by sooty shearwaters and white-chinned petrels. The estimated number of sooty shearwater captures increased to 147 in the first half of 2007–08 (95% c.i.: 99 to 210, based on 25.4% of effort) from 124 in the first half of 2006–07 (95% c.i.: 81 to 178, based on 23.1% of effort). Similarly, estimated captures of white-chinned petrels increased to 94 in the first half of 2007–08 (95% c.i.: 74 to 118, based on 25.4% of effort) from 76 in the first half of 2006–07 (95% c.i.: 53 to 100, based on 23.1% of effort). There were 17 other observed petrel captures in the first half of 2007–08, an increase from nine observed captures in the first half of 2006–07. The identifications of seven flesh-footed shearwaters (*Puffinus carneipes*), one fairy prion (*Pachyptila turtur*), and one black petrel (*Procellaria parkinsoni*) were confirmed by necropsy. The black petrel was caught in the scampi fishery north of the North Island.

### 3.3 Marine mammal captures in trawl fisheries

A summary of the fur seal captures is given in section 3.6. Although trawl effort has decreased, the number of fur seals caught increased to 25 in the first half of 2007–08, from 17 in the first half of 2006–07. Of these animals, 21 were caught south of 48° south, on the Stewart-Snares shelf and in the Subantarctic. The remaining four were caught on the Chatham Rise, near Banks Peninsula. There were no captures in the Cook Strait or on the West Coast. This is not unexpected, as trawl effort and fur seal captures in these two areas is higher in the second half of the fishing year. The total estimate of fur seal captures increased to 76 in the first half of 2007–08 (95% c.i.: 50 to 108, based on 25.3% of effort) from 49 in the first half of 2006–07 (95% c.i.: 29 to 73, based on 23.1% of effort).

Sea lions are caught most frequently in the Auckland Islands squid fishery. The six month period from October to March includes approximately half of the Auckland Islands squid trawl season, although the timing varies from season to season. The effort in this fishery was markedly reduced, from 1191 tows in the first half of 2006–07 to 748 tows in the first half of 2007–08. Four sea lions were caught in this fishery, a catch rate of 0.98 sea lions per hundred tows. There were three other observed captures to the east of Campbell Island in the southern blue-whiting fishery. These three animals were caught on the only two southern blue whiting trawls in the first half of the 2007–08 fishing year. The season finishes at the beginning of October, and there were only two tows in October 2007. The ratio estimate of total sea lion captures in all trawl fisheries in the first half of 2007–08 was 10 (95% c.i.: 8 to 14, based on 25.3% of effort). This is approximately half of the estimated captures in the corresponding period in 2006–07. This is an estimate of the landed captures, and does not include animals that passed through a sea lion exclusion device (SLED).

There was an increase in observed captures of dolphins to 20 in the first half of 2007–08 from six in the first half of 2006–07 (section 3.8). All these dolphins were identified by the observers as common dolphin (*Delphinus delphis*). There were no observed captures of Hector's dolphin (*Cephalorhynchus hectori*) or Maui's dolphin (*Cephalorhynchus hectori maui*), although there was very little observer coverage in the coastal zone where these animals live. All 20 dolphins were caught by three vessels targeting jack mackerel off the west coast of the North Island. Dolphins are often caught together and the animals were caught in just five of over 500 observed trawls, with nine being caught on a single trawl. The total estimate of dolphin captures in the pelagic trawl has increased to 57 in the first half of 2007–08 (95%

c.i.: 24 to 105, based on 95.8% of effort) from 21 in the first half of 2006–07 (95% c.i.: 9 to 39, based on 93.8% of effort).

### 3.4 Surface longline fisheries

Data on surface longline captures is given in section 3.9. There were seven birds observed caught in surface longline fisheries, compared with 85 in the first half of 2006–07. All birds were caught by domestic vessels. The species caught were two flesh-footed shearwaters, two Buller's albatross, one Salvin's albatross, one Gibson's albatross (*Diomedea gibsoni*) and one unidentified petrel. The identity of the Salvin's and Gibson's albatrosses were confirmed by autopsy. The unidentified petrel was caught while the vessel was targeting swordfish, the other birds were all caught while big-eye tuna was being targeted. No marine mammals or turtles were caught during this period.

The charter surface longline fleet does not usually operate in the first half of the fishing year and there was no charter surface longline effort in the 2007–08 summer. The first half of the 2006–07 fishing year was unusual because of the relatively large amount of charter surface longline activity. In particular, an Australian vessel in 2006–07 had a very high catch rate. This was not repeated in the 2007–08 summer. There has been a decrease in domestic surface longline effort from 800 185 to 630 052 hooks. The estimated total seabird captures in the domestic surface longline fishery has also decreased, to 217 in the first half of 2007–08 (95% c.i.: 67 to 392, based on 94.5% of effort) from 305 in the first half of 2006–07 (95% c.i.: 141 to 505, based on 94.4% of effort). The decrease is not significant as the uncertainty on the estimate is high, due to the low observer coverage in this fishery, only 3.4% of all hooks.

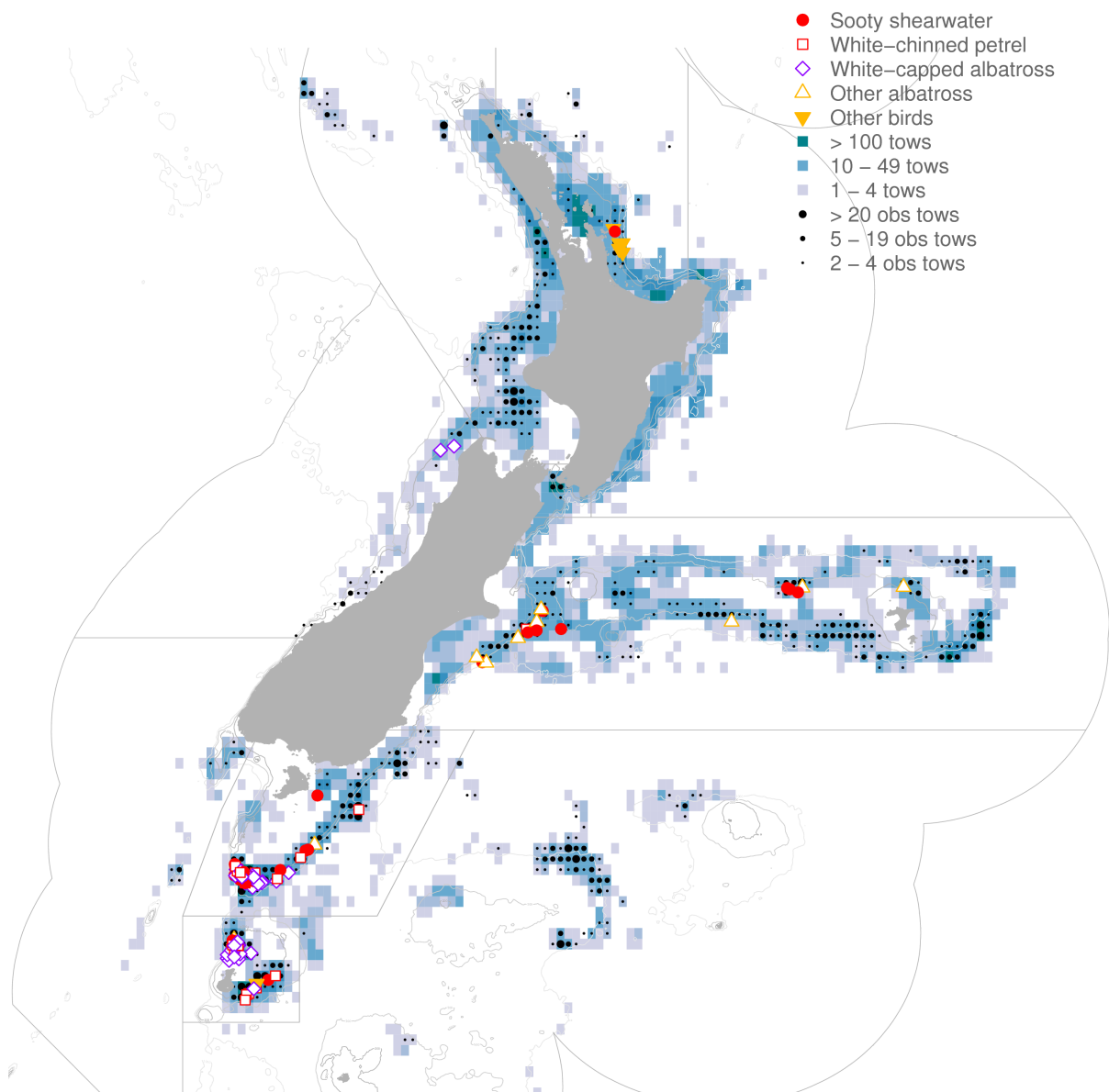
### 3.5 Trawl fisheries, all bird captures

**Table 6: Summary by half year with number of tows, number of tows observed, percentage of tows observed, number of observed captures, capture rate per 100 tows, total estimated captures with 95% confidence intervals, and percentage of tows included in the estimate.**

	Tows	No. obs	% obs	Captures	Rate	Estimated captures	% eff. in est.
2007–08, October to March							
Squid trawl	3 249	1 194	36.7	136	11.39	335 (282 - 400)	90.1
Hoki trawl	3 583	667	18.6	7	1.05	25 (11 - 44)	80.2
Hake trawl	444	51	11.5	3	5.88	3 (3 - 3)	11.5
Deepwater trawl	4 045	1 273	31.5	3	0.24	10 (3 - 19)	81.3
Ling trawl	1 512	218	14.4	8	3.67	15 (8 - 26)	47.2
SBW trawl	2	2	100.0	1	50.00	1 (1 - 1)	100.0
Scampi trawl	2 526	294	11.6	14	4.76	42 (17 - 81)	26.2
Pelagic trawl	1 522	512	33.6	0	0.00	0	95.8
Other trawl	3 630	128	3.5	3	2.34	3 (3 - 3)	3.5
Inshore trawl	27 749	97	0.3	2	2.06	2 (2 - 2)	0.3
<b>Total</b>	<b>48 262</b>	<b>4 436</b>	<b>9.2</b>	<b>177</b>	<b>3.99</b>	<b>436 (371 - 513)</b>	<b>25.3</b>
2006–07, April to September							
Squid trawl	1 572	214	13.6	38	17.76	154 (114 - 203)	57.4
Hoki trawl	6 391	1 112	17.4	10	0.90	37 (19 - 58)	92.8
Hake trawl	1 225	174	14.2	3	1.72	20 (3 - 42)	86.7
Deepwater trawl	3 207	1 349	42.1	1	0.07	3 (1 - 7)	72.3
Ling trawl	806	88	10.9	0	0.00	0	10.9
SBW trawl	615	214	34.8	3	1.40	9 (3 - 18)	100.0
Scampi trawl	2 681	160	6.0	14	8.75	14 (14 - 14)	6.0
Pelagic trawl	1 176	390	33.2	1	0.26	2 (1 - 4)	90.2
Other trawl	3 834	226	5.9	10	4.42	10 (10 - 10)	5.9
Inshore trawl	27 362	111	0.4	8	7.21	8 (8 - 8)	0.4
<b>Total</b>	<b>48 869</b>	<b>4 038</b>	<b>8.3</b>	<b>88</b>	<b>2.18</b>	<b>256 (205 - 314)</b>	<b>25.5</b>
2006–07, October to March							
Squid trawl	4 338	1 075	24.8	89	8.28	278 (228 - 334)	76.0
Hoki trawl	4 217	646	15.3	13	2.01	79 (44 - 120)	84.8
Hake trawl	381	122	32.0	5	4.10	5 (5 - 5)	32.0
Deepwater trawl	4 181	973	23.3	0	0.00	0	83.5
Ling trawl	853	69	8.1	2	2.90	2 (2 - 2)	8.1
SBW trawl	17	10	58.8	0	0.00	0	58.8
Scampi trawl	2 457	229	9.3	11	4.80	11 (11 - 11)	9.3
Pelagic trawl	1 535	412	26.8	0	0.00	0	93.8
Other trawl	4 360	167	3.8	2	1.20	2 (2 - 2)	3.8
Inshore trawl	32 176	181	0.6	2	1.10	2 (2 - 2)	0.6
<b>Total</b>	<b>54 515</b>	<b>3 884</b>	<b>7.1</b>	<b>124</b>	<b>3.19</b>	<b>378 (316 - 446)</b>	<b>23.1</b>

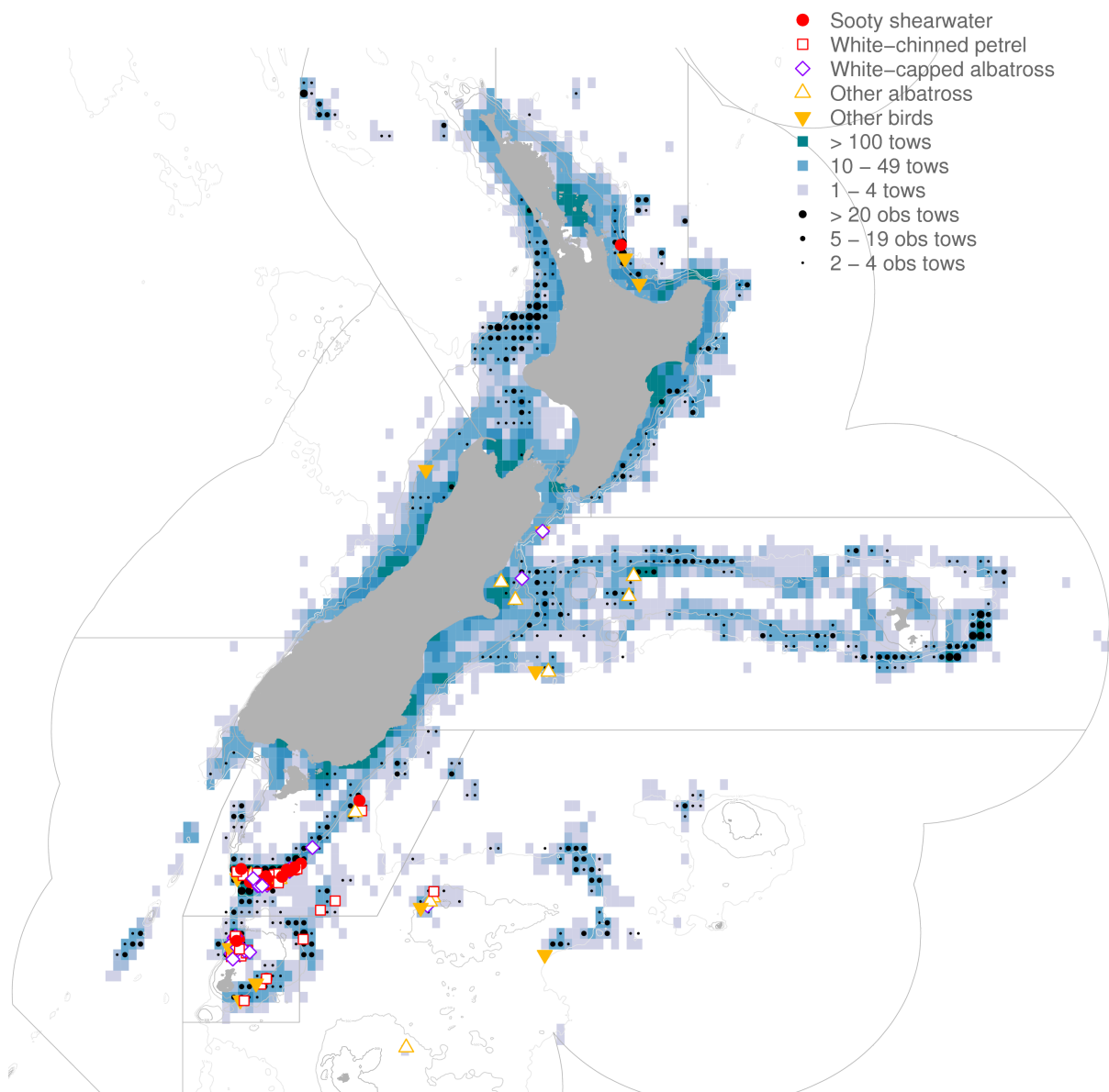
**Table 7: Species caught by area in trawl fisheries with numbers of animals captured, dead and necropsied.**

	STEW5			SQUAK6			CHAT4			Other areas		
	c.	d.	n.	c.	d.	n.	c.	d.	n.	c.	d.	n.
2007–08, October to March												
Sooty shearwater	57	46	42	7	7	6	-	-	-	2	2	0
White-chinned petrel	27	22	20	16	13	7	-	-	-	2	2	2
White-capped albatross	13	13	9	14	13	11	2	0	0	1	0	0
Petrel (unidentified)	1	0	0	6	0	0	2	0	0	-	-	-
Salvin's albatross	-	-	-	-	-	-	7	7	3	1	0	0
Flesh-footed shearwater	-	-	-	-	-	-	-	-	-	7	7	7
Buller's albatross	3	2	0	-	-	-	-	-	-	-	-	-
Seabird small	1	0	0	-	-	-	-	-	-	1	0	0
Black-browed albatross	-	-	-	-	-	-	-	-	-	1	1	0
Southern royal albatross	1	1	1	-	-	-	-	-	-	-	-	-
Black petrel	-	-	-	-	-	-	-	-	-	1	1	1
Campbell albatross	-	-	-	-	-	-	-	-	-	1	1	1
Cape pigeon	-	-	-	-	-	-	-	-	-	1	1	0
Fairy prion	1	1	1	-	-	-	-	-	-	-	-	-
Grey petrel	-	-	-	-	-	-	-	-	-	1	0	0
2006–07, April to September												
Sooty shearwater	26	20	20	15	15	15	6	5	5	-	-	-
White-capped albatross	3	1	1	2	1	1	2	2	1	7	7	6
White-chinned petrel	2	1	1	3	0	0	-	-	-	-	-	-
Buller's albatross	1	1	1	-	-	-	1	1	1	3	3	3
Grey petrel	-	-	-	-	-	-	1	1	1	2	2	2
Salvin's albatross	-	-	-	-	-	-	2	2	1	-	-	-
Cape pigeon	1	1	0	-	-	-	-	-	-	1	0	0
Seabird small	-	-	-	-	-	-	-	-	-	1	0	0
Seabird large	-	-	-	-	-	-	-	-	-	1	0	0
Northern giant petrel	-	-	-	-	-	-	-	-	-	1	1	1
Giant petrels (unidentified)	-	-	-	-	-	-	-	-	-	1	1	0
Black petrel	-	-	-	-	-	-	-	-	-	1	1	1
Albatross (unidentified)	-	-	-	-	-	-	1	1	0	-	-	-
Gibson's albatross	-	-	-	-	-	-	1	1	1	-	-	-
Common diving petrel	-	-	-	-	-	-	-	-	-	1	0	0
Southern cape pigeon	-	-	-	-	-	-	-	-	-	1	1	1
Flesh-footed shearwater	-	-	-	-	-	-	-	-	-	1	1	1
2006–07, October to March												
White-capped albatross	23	22	20	16	16	14	-	-	-	2	2	2
Sooty shearwater	23	20	21	2	2	2	10	6	6	1	1	1
White-chinned petrel	10	9	8	14	8	8	1	1	1	-	-	-
Salvin's albatross	-	-	-	-	-	-	9	7	4	-	-	-
Flesh-footed shearwater	-	-	-	-	-	-	-	-	-	6	5	5
Petrel (unidentified)	-	-	-	1	0	0	-	-	-	1	1	0
Northern giant petrel	-	-	-	1	1	1	-	-	-	-	-	-
Black-browed albatross	1	0	0	-	-	-	-	-	-	-	-	-
Shy albatross	-	-	-	1	0	0	-	-	-	-	-	-
Buller's albatross	-	-	-	1	1	1	-	-	-	-	-	-
Albatross (unidentified)	-	-	-	-	-	-	1	1	1	-	-	-



**Figure 2: Mapped effort and bird captures in trawl fisheries from 1 October 2006 to 31 March 2007, with 49% of trawl effort shown. Bird captures are divided into five categories: sooty shearwaters, white-capped albatross, white-chinned petrels, other albatross and other birds.**





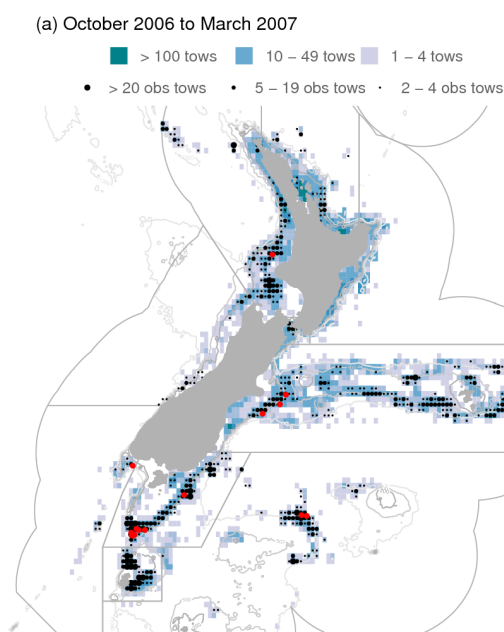
**Figure 3: Mapped effort and bird captures in trawl fisheries from 1 October 2007 to 31 March 2008, with 98% of trawl effort shown. Bird captures are divided into five categories: sooty shearwaters, white-capped albatross, white-chinned petrels, other albatross and other birds.**

### 3.6 Trawl fisheries, fur seal captures

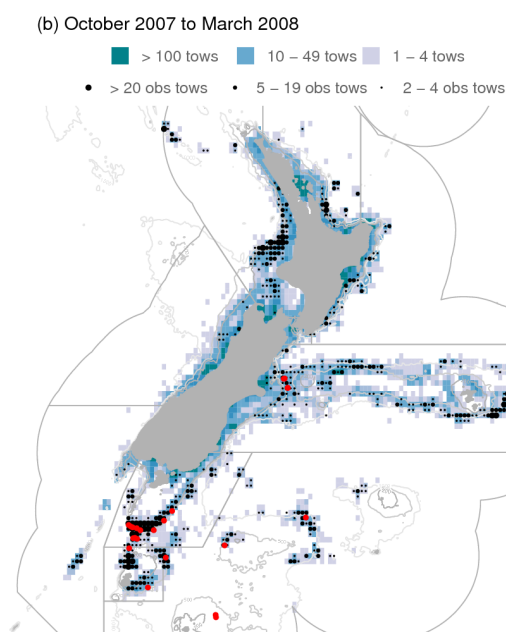
**Table 8: Summary by half year with number of tows, number of tows observed, percentage of tows observed, number of observed captures, capture rate per 100 tows, total estimated captures with 95% confidence intervals, and percentage of tows included in the estimate.**

	Tows	No. obs	% obs	Captures	Rate	Estimated captures	% eff. in est.
2007–08, October to March							
Trawl, COOK8	1 247	5	0.4	0	0.00	0	0.4
Trawl, WCSI7	4 071	41	1.0	0	0.00	0	1.0
Trawl, Other areas	42 944	4 390	10.2	25	0.57	76 (50 - 107)	28.3
<b>Total</b>	<b>48 262</b>	<b>4 436</b>	<b>9.2</b>	<b>25</b>	<b>0.56</b>	<b>76 (50 - 108)</b>	<b>25.3</b>
2006–07, April to September							
Trawl, COOK8	2 558	178	7.0	23	12.92	206 (127 - 302)	62.2
Trawl, WCSI7	8 589	879	10.2	5	0.57	28 (11 - 51)	40.9
Trawl, Other areas	37 722	2 981	7.9	27	0.91	70 (48 - 95)	19.5
<b>Total</b>	<b>48 869</b>	<b>4 038</b>	<b>8.3</b>	<b>55</b>	<b>1.36</b>	<b>304 (216 - 404)</b>	<b>25.5</b>
2006–07, October to March							
Trawl, COOK8	1 678	50	3.0	0	0.00	0	3.0
Trawl, WCSI7	4 517	71	1.6	0	0.00	0	1.6
Trawl, Other areas	48 320	3 765	7.8	17	0.45	49 (29 - 74)	25.8
<b>Total</b>	<b>54 515</b>	<b>3 884</b>	<b>7.1</b>	<b>17</b>	<b>0.44</b>	<b>49 (29 - 73)</b>	<b>23.1</b>

(a)



(b)



**Figure 4: Fur seal captures in trawl fisheries from 1 October 2006 to 31 March 2008. (a) Captures for the 2006–07 fishing year, with 49% of effort mapped. (b) Captures for the first half of the 2007–08 fishing year, with 98% of effort mapped.**

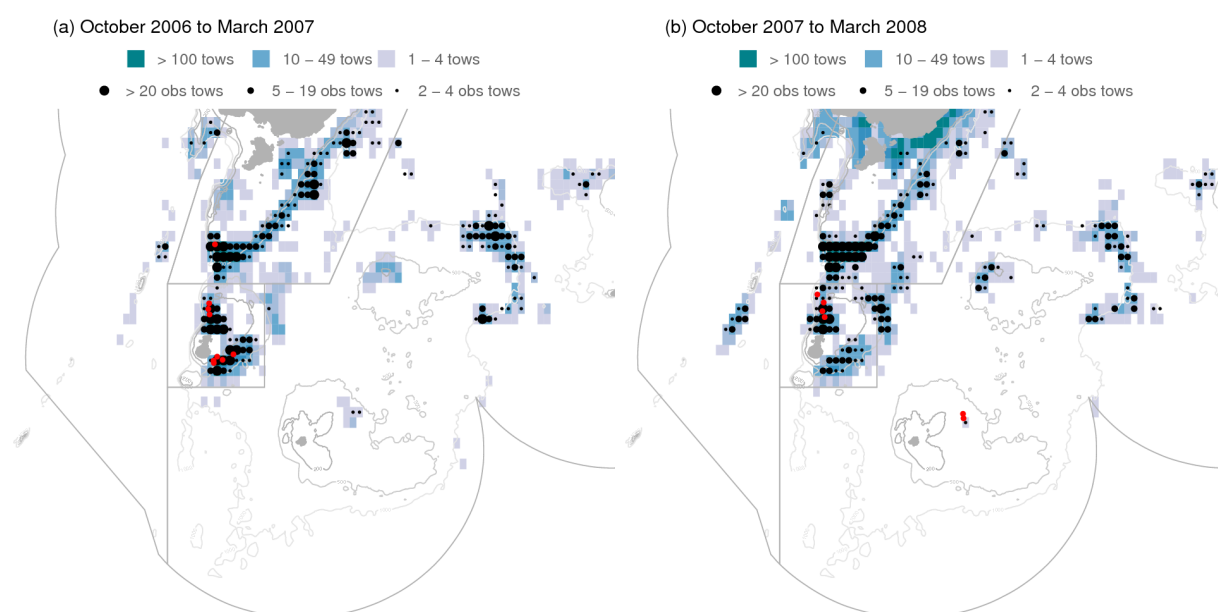
### 3.7 Trawl fisheries, sea lion captures

**Table 9: Summary by half year with number of tows, number of tows observed, percentage of tows observed, number of observed captures, capture rate per 100 tows, total estimated captures with 95% confidence intervals, and percentage of tows included in the estimate.**

	Tows	No. obs	% obs	Captures	Rate	Estimated captures	% eff. in est.
2007–08, October to March							
Squid, SQUAK6	748	407	54.4	4	0.98	7 (5 - 11)	100.0
Other trawl	47 514	4 029	8.5	3	0.07	3 (3 - 3)	24.1
<b>Total</b>	<b>48 262</b>	<b>4 436</b>	<b>9.2</b>	<b>7</b>	<b>0.16</b>	<b>10 (8 - 14)</b>	<b>25.3</b>
2006–07, April to September							
Squid, SQUAK6	126	34	27.0	0	0.00	0	27.0
Other trawl	48 743	4 004	8.2	3	0.07	9 (3 - 18)	25.5
<b>Total</b>	<b>48 869</b>	<b>4 038</b>	<b>8.3</b>	<b>3</b>	<b>0.07</b>	<b>9 (3 - 18)</b>	<b>25.5</b>
2006–07, October to March							
Squid, SQUAK6	1 191	504	42.3	7	1.39	16 (11 - 25)	100.0
Other trawl	53 324	3 382	6.3	2	0.06	5 (2 - 10)	21.4
<b>Total</b>	<b>54 515</b>	<b>3 884</b>	<b>7.1</b>	<b>9</b>	<b>0.23</b>	<b>21 (13 - 31)</b>	<b>23.1</b>

(a)

(b)

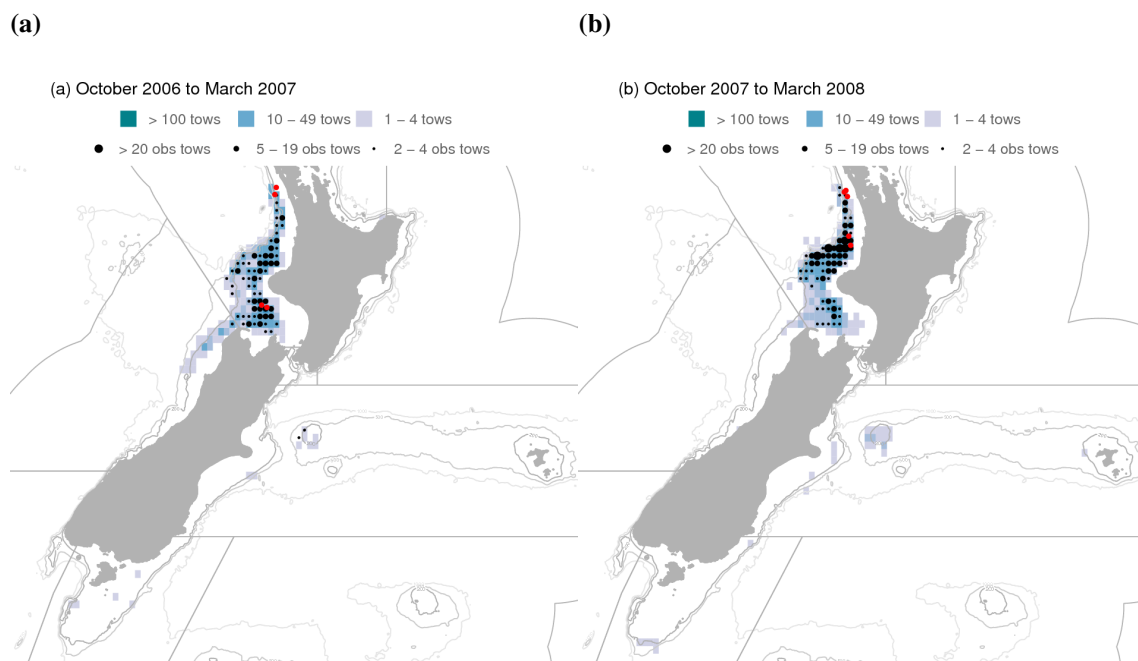


**Figure 5: Sea lion captures in trawl fisheries from 1 October 2006 to 31 March 2008. (a) Captures for the 2006–07 fishing year, with 49% of effort mapped. (b) Captures for the first half of the 2007–08 fishing year, with 98% of effort mapped.**

### 3.8 Pelagic trawl fisheries, common dolphin captures

**Table 10: Summary by half year with number of tows, number of tows observed, percentage of tows observed, number of observed captures, capture rate per 100 tows, total estimated captures with 95% confidence intervals, and percentage of tows included in the estimate.**

	Tows	No. obs	% obs	Captures	Rate	Estimated captures	% eff. in est.
2007–08, Oct to Mar	1 522	512	33.6	20	3.91	57 (24 - 105)	95.8
2006–07, Apr to Sep	1 176	390	33.2	5	1.28	18 (5 - 44)	90.2
2006–07, Oct to Mar	1 535	412	26.8	6	1.46	21 (9 - 39)	93.8



**Figure 7: Common dolphin captures in pelagic trawl fisheries from 1 October 2006 to 31 March 2008. (a) Captures for the 2006–07 fishing year, with 100% of effort mapped. (b) Captures for the first half of the 2007–08 fishing year, with 100% of effort mapped.**

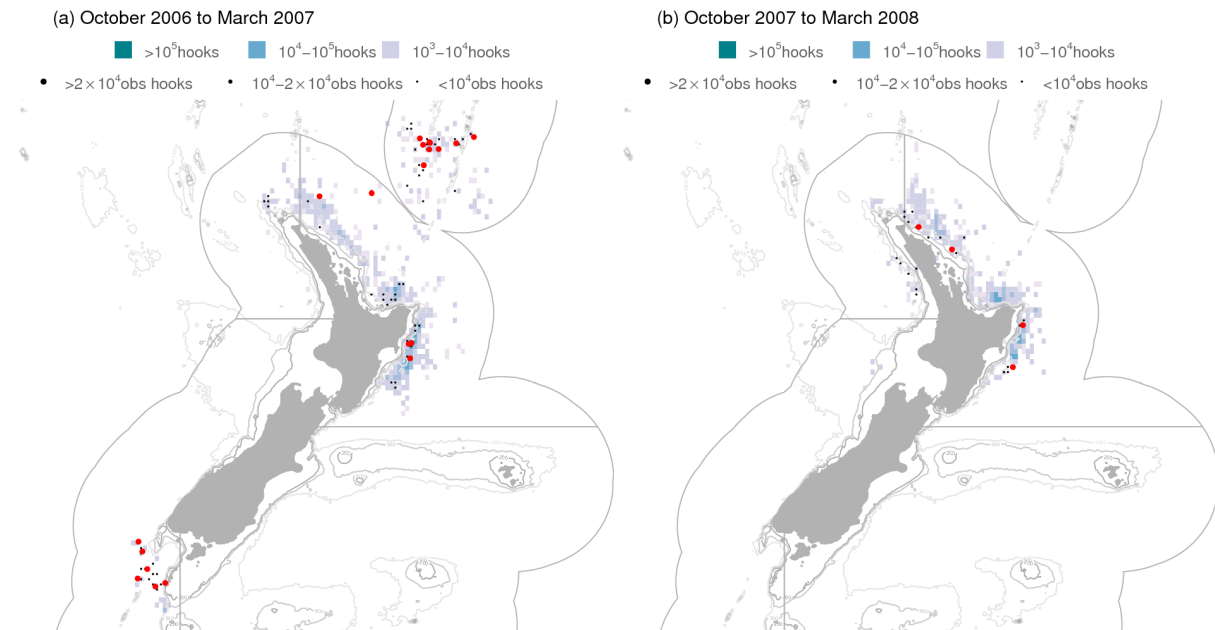
### 3.9 Surface longline, all bird captures

**Table 11: Summary by half year with number of hooks, number of hooks observed, percentage of hooks observed, number of observed captures, capture rate per 1000 hooks, total estimated captures with 95% confidence intervals, and percentage of hooks included in the estimate.**

	Hooks	No. obs	% obs	Captures	Rate	Estimated captures		% eff. in est.
2007–08, October to March								
Domestic longline	630 052	21 605	3.4	7	3.24	233	(39 - 452)	94.5
Charter longline	0							
Australian charter longline	0							
<b>Total</b>	<b>630 052</b>	<b>21 605</b>	<b>3.4</b>	<b>7</b>	<b>3.24</b>	<b>233</b>	<b>(41 - 457)</b>	<b>94.5</b>
2006–07, April to September								
Domestic longline	1 453 017	127 680	8.8	15	1.17	172	(93 - 261)	99.4
Charter longline	1 328 730	705 487	53.1	87	1.23	166	(135 - 201)	100.0
Australian charter longline	36 040	12 586	34.9	0	0.00	0		100.0
<b>Total</b>	<b>2 817 787</b>	<b>845 753</b>	<b>30.0</b>	<b>102</b>	<b>1.21</b>	<b>338</b>	<b>(252 - 430)</b>	<b>99.7</b>
2006–07, October to March								
Domestic longline	800 185	41 912	5.2	16	3.82	326	(107 - 610)	94.4
Charter longline	52 480	49 855	95.0	11	2.21	12	(11 - 12)	100.0
Australian charter longline	48 780	18 399	37.7	58	31.52	154	(82 - 241)	100.0
<b>Total</b>	<b>901 445</b>	<b>110 166</b>	<b>12.2</b>	<b>85</b>	<b>7.72</b>	<b>491</b>	<b>(257 - 788)</b>	<b>95.1</b>

(a)

(b)



**Figure 8: Bird captures in surface longline fisheries from 1 October 2006 to 31 March 2008. (a) Captures for the 2006–07 fishing year, with 100% of effort mapped. (b) Captures for the first half of the 2007–08 fishing year, with 100% of effort mapped.**

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