Identification of seabirds captured in New Zealand fisheries: 1 July 2012 – 30 June 2013

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Abstract:

New Zealand waters support a diverse range of seabird species, but much of the commercial fishing activity in the region overlaps with their ranges. The accurate identification of seabirds captured in New Zealand fisheries is vital for determining the potential impact of fisheries on these populations. Between 1 July 2012 and 30 June 2013 a total of 431 seabirds comprising 17 taxa were incidentally killed as bycatch and returned for autopsy by onboard New Zealand Government observers. Birds were returned from longline (*n* = 30) and trawl (*n* = 146) vessels, and were dominated numerically by four species (white-chinned petrel *Procellaria aequinoctialis*, New Zealand white-capped albatross *Thalassarche steadi*, Buller's albatross *Thalassarche bulleri bulleri* and sooty shearwater *Puffinus griseus*). All birds returned from longline fisheries had injuries consistent with being hooked or entangled in the bill or throat. In contrast, most birds (79.9%) returned from trawl fisheries were killed through entanglement in the net or cod-end, with the remaining 20.1% likely to have been killed by warp interaction. Two birds were killed by striking the deck. Birds had similar mean fat scores as in the previous fishing year, and discards, including offal, appear to continue to be an attractant for many seabirds. Out of 138 records of seabird captures on fishing vessels, photographs were taken of 52 seabirds consisting of 13 eleven taxa. Image quality varied widely, with poor images being particularly common for birds that were alive and seen onboard for short periods. Recommendations are made to improve photo-identifications in the future.

Keywords: commercial fishing, seabirds, autopsy, photo-identification, incidental mortality, longline, trawl

1. Introduction

New Zealand waters support a large and diverse range of seabird species. However, much of the commercial fishing activity within New Zealand waters overlaps with the ranges of these seabirds (Robertson *et al.* 2003). Therefore, the accurate identification of seabirds captured in commercial fisheries operations is vital for determining the potential impact of fisheries on these seabird populations.

New Zealand Government observers have been placed on commercial vessels since 1998 to investigate interactions between fisheries and seabird species, but are not always able to accurately identify seabirds at sea. Consequently, an autopsy programme has been in place since 1998 to accurately determine the taxon (and age, sex, diet and provenance) of specimens recovered dead by observers. Observers present on fishing trips within New Zealand's Exclusive Economic Zone (EEZ) are generally required to return all seabirds caught and killed as incidental bycatch during fishing operations for autopsy. Additional information such as vessel name, location of capture (latitude and longitude) and date of capture is also recorded. Specific catch locations and vessel names have not been provided in this report on the grounds of commercial sensitivity. All autopsies were performed for the Department of Conservation (DOC) as part of Conservation Services Programme (CSP) project INT2010/02.

In the past, identification of seabirds released alive were often of unknown accuracy and were not confirmed by an expert. Consequently, a photography programme was developed to enable observers to record and return images of birds interacting with vessels (whether alive or dead), enabling the identification to be checked and verified.

This report provides a summary of the species of seabird identified as being captured in New Zealand fisheries between 1 July 2012 and 30 June 2013. Identifications were based on dead birds caught and returned and/or photographs.

1.1 Objectives

The overall objective of the observer programme is to determine which seabird species are captured in New Zealand commercial fisheries and the mode of capture.

The specific objectives are to:

1. Determine the taxon, sex and, where possible, age class and provenance of seabirds killed in New Zealand fisheries (for returned dead specimens).
2. Describe the injuries, body condition and stomach contents and, where possible, the likely cause of mortality (for returned dead specimens).
3. Report any changes in the protocol used for autopsy of seabirds (for returned dead specimens).
4. Determine the taxon and, where possible, sex, age-class and provenance of seabirds captured in New Zealand fisheries through examination of photographs (for live captures or dead specimens discarded at sea).

2. METHODS

2.1 Autopsy

The autopsy methods followed those described by Bartle (2000) and used in autopsies in subsequent fishing years (Robertson 2000; Robertson & Bell 2002a, b; Robertson *et al.* 2003, 2004; Conservation Services Programme 2008; Thompson 2009, 2010a, b).

Common and scientific names of all species caught and returned are provided in Table 1. Nomenclature generally follows Marchant & Higgins (1990), but for the albatrosses for which current taxonomy and nomenclature is in a state of flux, it is based on a combination of Nunn *et al*. (1996) and Robertson & Nunn (1998), and is consistent with the taxonomy recognised by the Agreement on the Conservation of Albatrosses and Petrels (ACAP 2010).

Table 1. Common and scientific names of seabirds captured and returned or photographed from New Zealand fisheries between 1 July 2012 and 30 June 2013.

COMMON NAME	SCIENTIFIC NAME	AUTOPSY	PHOTO
Albatross (unidentified)	Diomedeidae (Family)		✓
Antipodean albatross	*Diomedea antipodensis antipodensis*	✓	✓
Black petrel	*Procellaria parkinsoni*	✓	
Black-backed gull	*Larus dominicanus*	✓	
Black-bellied storm petrel	*Fregetta tropica*		✓
Black-browed albatross (unidentified)	*Thalassarche* spp.		✓
Buller's albatross	*Thalassarche bulleri bulleri*	✓	✓
Campbell albatross	*Thalassarche impavida*	✓	✓
Cape petrels (unidentified)	*Daption* spp.		✓
Chatham Island albatross	*Thalassarche eremita*	✓	
Common diving petrel	*Pelecanoides urinatrix*	✓	✓
Fairy Prion	*Pachyptila turtur*	✓	✓
Flesh-footed shearwater	*Puffinus carneipes*	✓	
Giant petrels (Unidentified)	*Macronectes* spp.		✓
Gibson's albatross	*Diomedea antipodensis gibsoni*	✓	✓
Great albatross (unidentified)	*Diomedea* spp.		✓
Grey petrel	*Procellaria cinerea*	✓	✓
New Zealand White-capped albatross	*Thalassarche steadi*	✓	✓
Petrel (unidentified)	*Procellaria* spp.	✓	✓
Petrels, Prions and Shearwaters (unidentified)	Hydrobatidae, Procellariidae & Pelecanoididae (Families)		✓
Prion (unidentified)	*Pachyptila* spp.		✓
Procellaria petrel (unidentified)	*Procellaria* spp.		✓
Salvin's albatross	*Thalassarche salvini*	✓	✓
Shy albatross (unidentified)	*Thalassarche* spp.		✓
Small albatross (unidentified)	*Thalassarche* spp.		✓
Snares cape pigeon	*Daption capense australe*		✓
Sooty shearwater	*Puffinus griseus*	✓	✓
Southern Royal albatross	*Diomedea epomophora*	✓	✓
Storm petrels (unidentified)	Hydrobatidae (Family)		✓
Wandering albatross (unidentified)	*Diomedea exulans* spp.		✓
Westland petrel	*Procellaria westlandica*	✓	✓
White-chinned petrel	*Procellaria aequinoctialis*	✓	✓
White-faced storm petrel	*Pelagodroma marina*		✓
White-headed petrel	*Pterodroma lessonii*		✓

During autopsy, all birds were sexed by internal examination, with the exception of birds that had been damaged by fishing gear, machinery or sea lice. Feather moult and the condition of the brood patch were also recorded. Birds were characterised as either adult, breeding adult, non-breeding adult, sub-adult (pre-breeder), immature or juvenile based on a combination of plumage, morphological (such as bill size and colour), gonadal and brood patch characteristics.

- Adults – adult morphology (e.g. body size, bill size, bill colour, plumage colour), but active breeding could not be confirmed
- Breeding adults - considered to be actively breeding at the time of capture (e.g. bare brood patch, swollen ovaries or testes)
- Non-breeding adults - identified by feather moult (e.g. downy brood patch, body moult, wing moult) and gonadal evidence (i.e. regressed or small ovaries and testes)
- Sub-adults (pre-breeders) – non-adult or near-adult plumage and/or morphology (e.g. bill colour), but no gonadal evidence that they had obtained breeding condition
- Juveniles - juvenile plumage and/or morphology (e.g. bill colour, bill size, leg and foot colour)

Body condition was determined by assigning a fat score based on the relative amount of subcutaneous fat and fat on and around organs: '1' = no fat, to '5' = extremely fat (where internal examination becomes difficult). In instances where the birds have been damaged by sea lice, the fat score was listed as unknown.

For each bird, any injuries were recorded, and this information, together with observer comments on the autopsy label, was used to determine the likely cause of death.

Stomach and gizzard contents were identified to broad dietary groupings (i.e. squid, fish, crustaceans, etc.) and any hard parts (squid beaks, otoliths) were retained for future identification where possible. In addition, any bait material, offal or discarded material, plastic, stones, algae and goose barnacle plates were recorded. Photographs were taken of plastic debris in the gizzard or stomach.

Each specimen was allocated a unique autopsy number and photographed. This number, along with the information on the observer specimen tag and all other information collected during autopsy was entered into an Access database. Details relating to each specimen are available on request from the Manager, Marine Conservation Services, DOC (email: csp@doc.govt.nz).

2.2 Photo-identification

The photographs used in this analysis were of seabird captures for which the records indicated that only observer identification had been made, rather than a confirmed identification following autopsy. This covered live captures, mortalities where a specimen was not returned for autopsy (for whatever reason), images of birds that had no associated observer data (i.e. missing from Ministry of Primary Industries (MPI) Central Observer Database ('COD') extracts) and reported interactions in the MPI COD extract with no corresponding image and may include non-capture interactions. Photographs were provided in electronic format with associated observer extracted information (vessel name, type of fishery, date of capture, time of capture etc.) in an Excel

spreadsheet. Common and scientific names of all species caught and photographed are provided in Table 1.

Dead specimens were generally photographed with a label that bore the trip, station and sample number making it easy to correlate to the MPI COD extract. However, photographs of live captures often contained no information on station or sample number, making it difficult to match the specimen to the extract unless the time and date stamp on the camera had been set correctly.

All photographed seabirds were identified to the lowest possible taxon. Various seabird reference books (including Marchant & Higgins 1990; Bartle 2000; Shirihai 2002; Onley & Scofield 2007) were used to confirm identification when necessary. Bill and head morphology and colour were usually sufficient to allow the identification of albatrosses and larger petrels to species, but other key features (such as size, shape, foot colour and wing markings) were needed to identify smaller species. If key features were not visible in the photograph or the image was out of focus, identification to species was not possible.

Where possible, the age, sex and provenance of the photographed seabirds were also determined.

Each Individual seabird was allocated a unique number. The photograph (or photographs), the information from the observers and any other information observed in the photograph or the MPI COD extract were entered into an Access database.

3. Results

3.1 Autopsy

3.1.1 Returned seabirds

A total of 431 seabirds comprising 17 taxa were returned from 38 vessels between 1 July 2012 and 30 June 2013 (Table 2, Fig 1). Seabirds returned were dominated by four species: white-chinned petrel (*n* = 169, 39.2%), NZ white-capped albatross (*n* = 92, 21.3%), sooty shearwater (*n* = 79, 18.3%) and Buller's albatross (*n* = 48, 11.1%) (Table 2). These four species, together with Salvin's albatross (*n* = 20, 4.6%) accounted for 94.5% of all returns (Table 2). Of the remaining twelve taxa, five had only single captures, six had two captures and flesh-footed shearwater and Campbell albatross both had three captures (Table 2).

Table 2. Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2012 and 30 June 2013, by month of capture.

SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Antipodean albatross					1								1	0.2
Black petrel				2									2	0.5
Black-backed gull	1										1		2	0.5
Buller's albatross			3	10	9	19	6		1				48	11.1
Campbell albatross							2		1				3	0.7
Chatham Island albatross									1				1	0.2
Common diving petrel			1							1			2	0.5
Fairy prion		1	1										2	0.5
Flesh-footed shearwater	1										1	1	3	0.7
Gibson's albatross						1							1	0.2
Grey petrel							1		1				2	0.5
NZ white-capped albatross	8	21	17	4	10	15	5		2			10	92	21.3
Petrel (unidentified)											1		1	0.2
Salvin's albatross		1					1		6	5	7		20	4.6
Sooty shearwater	4	11	8	33	11					9	3		79	18.3
Southern royal albatross						1						1	2	0.5
Westland petrel									1				1	0.2
White-chinned petrel	5	68	51	30	2					1	3	9	169	39.2
TOTAL	**19**	**102**	**81**	**79**	**33**	**36**	**15**	**0**	**13**	**16**	**16**	**21**	**431**	
% TOTAL	**4.4**	**23.7**	**18.8**	**18.3**	**7.7**	**8.4**	**3.5**	**0**	**3.0**	**3.7**	**3.7**	**4.9**		

One Chatham albatross had a uniquely numbered metal band and darvic band, having been banded in 2008 as an adult on The Pyramid, Chatham Islands (band number O33866 on the right leg and white darvic number B97 on the left leg). One Buller's albatross had a uniquely numbered metal band (M89162), having been banded in 2012 as an adult on North East Island, The Snares. Banded specimens provide valuable longevity, survival and at-sea distribution data. Specimens still need to be checked for PIT tags.

The majority of birds returned were males (*n* = 316, 73.3%); however, both Campbell albatross (*n* = 2, 66.6%) and southern royal albatross returns had more females (*n* = 2, 100%) than males (Table 3). Also, most birds returned were adults (*n* = 421, 97.7%). Of the 421 adults, 281 (65.2%) were breeding, 137 (31.8%) were non-breeding and 6 (1.4%) could not have the breeding status confirmed due to damage. Of all the birds returned, 7 (1.6%) were pre-breeders (Table 3).

Table 3 Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2012 and 30 June 2013, by sex (M = male, F = female, U = unknown), age (A = adult, SA = sub-adult, I = immature, J = juvenile, U = unknown) and breeding status (B = breeding, N = non-breeding, PB =pre-breeding, U = unknown).

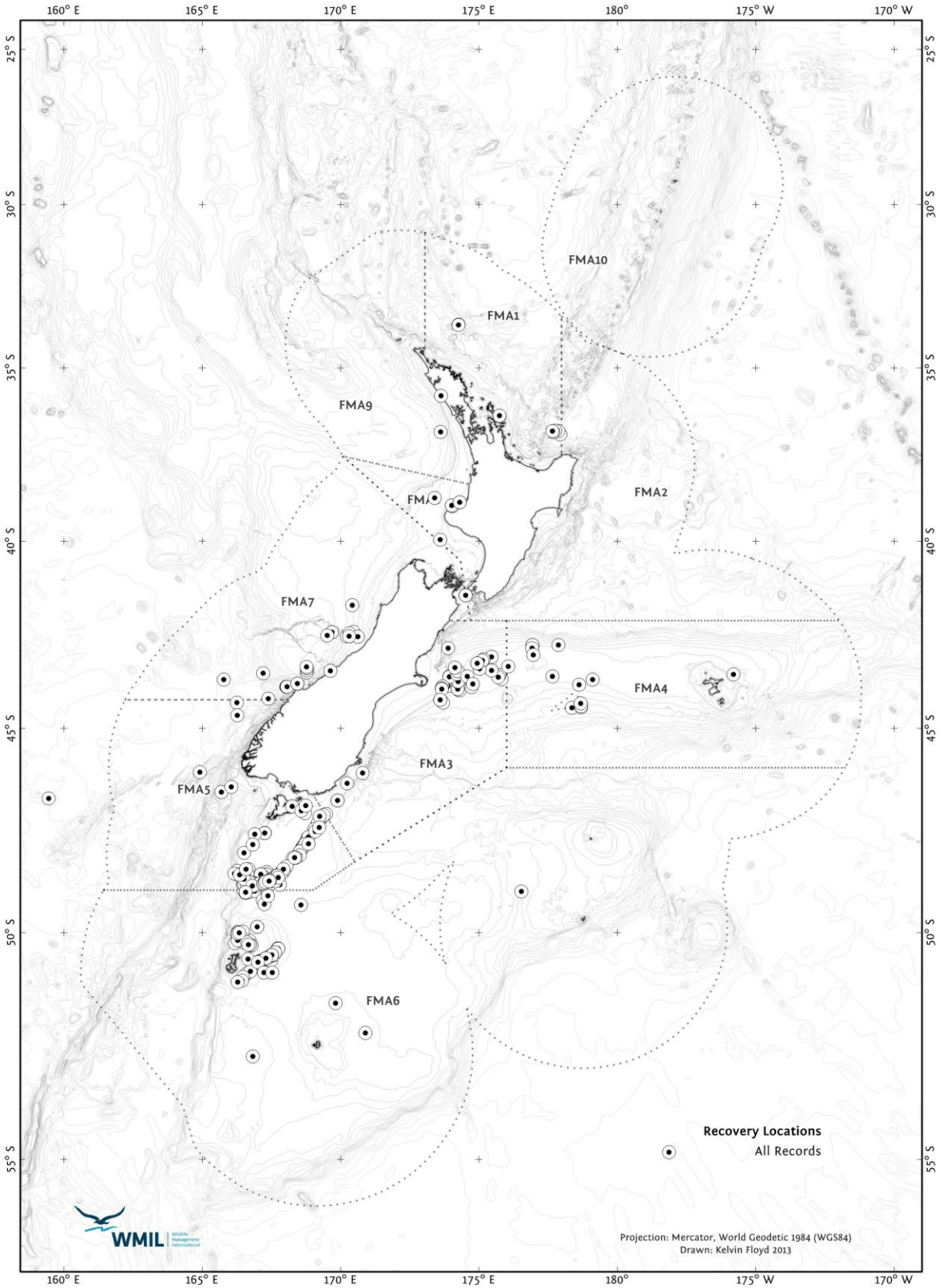
SPECIES	SEX			AGE					BREEDING STATUS				TOTAL	% TOTAL
	M	F	U	A	SA	I	J	U	B	NB	PB	U		
Antipodean albatross		1		1					1				1	0.2
Black petrel	2			2					2				2	0.5
Black-backed gull	1	1			1	1					2		2	0.5
Buller's albatross	28	20		48					42	6			48	11.1
Campbell albatross	1	2		3					1	2			3	0.7
Chatham Island albatross		1		1					1				1	0.2
Common diving petrel	1	1		2					1	1			2	0.5
Fairy prion	2			2					1	1			2	0.5
Flesh-footed shearwater	3			3					1	2			3	0.7
Gibson's albatross	1			1					1				1	0.2
Grey petrel	1	1		2						2			2	0.5
NZ white-capped albatross	57	28	7	85	5			2	63	20	5	4	92	21.3
Petrel (unidentified)			1					1				1	1	0.2
Salvin's albatross	12	8		20					12	8			20	4.6
Sooty shearwater	74	4	1	79					61	18			79	18.3
Southern royal albatross		2		2					2				2	0.5
Westland petrel	1			1						1			1	0.2
White-chinned petrel	132	36	1	169					92	76		1	169	39.2
TOTAL	**316**	**105**	**10**	**421**	**6**	**1**	**0**	**3**	**281**	**137**	**7**	**6**	**431**	
% TOTAL	**73.3**	**33.2**	**9.5**	**97.7**	**1.4**	**0.2**	**0**	**0.7**	**65.2**	**31.8**	**1.6**	**1.4**		

The monthly distribution of returned specimens was not evenly spread across the fishing year with most birds returned being caught in February (*n* = 102, 23.7%), March (*n* = 81, 18.8%) or April (*n* = 79, 18.3%) (Table 2). This pattern reflects the timing of seabird breeding, presence within the New Zealand EEZ, timing and location of fisheries, and observer coverage.

3.1.2 Target vessel and fishery

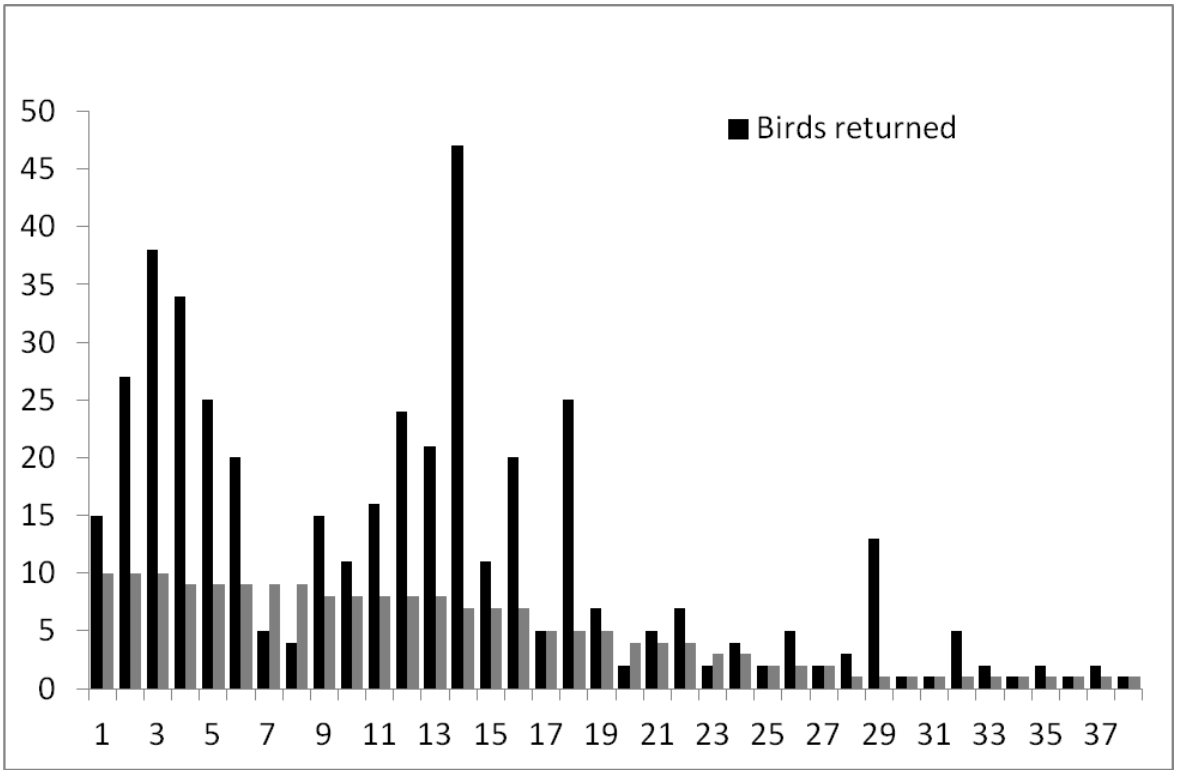
The seabirds killed and returned were caught in a range of Fishing Management Areas (FMA 1, 2, 3, 4, 5, 6, 7, 8 and 9) and general positions are show in Fig 1. Additional figures showing general capture positions for each species, and by fishery target species and method are provided in Appendix 1 (Figures A1.1-A1.10).

Figure 1. Catch locations of all A. small petrels and B. albatrosses killed and returned from New Zealand fisheries for autopsy between 1 July 2011 and 30 June 2012. Note: some catch locations may be obscured by overlying symbols (e.g. where several individuals were captured from the same tow or set, each bird will have the same catch location and appear on the map as a single symbol).



For the fishing period 1 July 2012 to 30 June 2013, there were 272 observed trips on 98 vessels (Kris Ramm, CSP DOC, pers. comm.), and 38 (38.8%) of these vessels returned birds during this period. Half the vessels returned relatively low numbers of birds (< 5 birds caught and returned; *n* = 19, 50.0%) (Fig. 2). On average, there were 11.3 birds (± 1.9) caught and returned from 4.9 trips (± 0.6) per vessel. Eight vessels caught over 20 birds as shown in Fig. 2.

Figure 2. The number of birds killed and returned, and the number of trips for each observed vessel between 1 July 2012 and 30 June 2013.



Bottom and surface longline fisheries returned a total of 40 birds (9.3% of total returns), with vessels targeting tuna (*Thunnus* spp.) accounting for 80% (*n* = 32) of longline specimens and the remainder targeting 'other' species (mainly hoki *Macruronus novaezelandiae* or snapper *Centroberyx affinis*) (Table 4). Bottom and midwater trawl

fisheries combined returned 390 birds (90.5% of total returns), with trawlers targeting squid (*Nototodarus* spp.) accounting for 22.6% (*n* = 88) of all trawl returns, trawlers targeting hoki (*Macruronus novaezelandiae*) accounting for 14.6% (*n* = 57), trawlers targeting scampi (*Metanephrops challengeri*) accounting for 0.5% (*n* = 2) and trawlers targeting 'other' species accounting for 56.1% (*n* = 242) (Table 4). The 'other' species included barracouta (*Thyrsites atun)*, hake (*Merluccius australis*), jack mackerel (*Trachurus* spp.), silver warehou (*Seriolella punctata*), and white warehou (*S. caerulea*).

Table 4 Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2012 and 30 June 2013, by fisheries type.

Species	Trawl					Set Net	Longline				Total
	Bottom						Surface		Bottom		
	Scampi	Squid	Hoki	Ling	Other		Tuna	Other	Tuna	Other	
Antipodean albatross								1			**1**
Black petrel										2	**2**
Black-backed gull										2	**2**
Buller's albatross		4	5		27		6	6			**48**
Campbell albatross					1		2				**3**
Chatham Island albatross			1								**1**
Common diving petrel		1			1						**2**
Fairy prion					2						**2**
Flesh-footed shearwater						1				2	**3**
Gibson's albatross							1				**1**
Grey petrel					1		1				**2**
NZ white-capped albatross		30	7		44		7	4			**92**
Petrel (unidentified)					1						**1**
Salvin's albatross	2		10	1	6		1				**20**
Sooty shearwater		9	16		52			2			**79**
Southern royal albatross					1		1				**2**
Westland petrel								1			**1**
White-chinned petrel		44	18		106			1			**169**
Total	2	88	57	1	242	1	19	15	0	6	**431**
	390					**1**	**40**				

3.1.3 Injuries of returned birds and likely cause of death

The condition of the returned birds ranged from 'no obvious injury' to 'mangled'. Of the birds caught and returned from longline vessels, 31 had hook injuries and 18 of these still had hooks still present (7 swallowed, 3 in the wing and 8 in the bill) (Table 5).

As in previous years (Robertson *et al*. 2004; Conservations Services Programme 2008; Thompson 2010 a, b), birds caught and returned from trawl fisheries had different injuries from those caught by longline vessels. Most birds had been caught in the trawl nets or recovered in the pound or cod ends (i.e. had drowned, *n* = 270, 69.2%) and were very wet and sandy with crush injuries (broken wings, broken chest, crushed organs etc.) (Table 5). Other birds had injuries suggesting entanglement and crush injuries from the trawl warp and blocks (*n* = 195), many with grease covering part or all of the body and multiple fractures or missing body parts. Non-albatross taxa were mostly recovered from the net (78%) while albatross taxa were predominately affected by warp strikes (50.0%) exhibiting serious wing injuries or lacerations.

Table 5 Number of seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2012 and 30 June 2013, by likely cause of death. The proportion of albatross and non-albatross taxa returned is also presented.

Species	Longline				Trawl			Tangled	Vessel strike	Total
	Bill or Throat	Wing	Legs or Feet	Not obvious	Warp	Net	Pound or Cod-end			
Antipodean albatross				1						**1**
Black petrel		2								**2**
Black-backed gull	1			1						**2**
Buller's albatross	7			3	18	16	3	1		**48**
Campbell albatross	1			1	1					**3**
Chatham Island albatross						1				**1**
Common diving petrel					1				1	**2**
Fairy prion							1		1	**2**
Flesh-footed shearwater	1			1		1				**3**
Gibson's albatross						1				**1**
Grey petrel				1		1				**2**
NZ white-capped albatross	4	1		3	47	29	7	1		**92**
Petrel (unidentified)						1				**1**
Salvin's albatross				1	3	16				**20**
Sooty shearwater						70	7	1	1	**79**
Southern royal albatross	1						1			**2**
Westland petrel						1				**1**
White-chinned petrel	1			3		151	14			**169**
Total	**16**	**3**	**0**	**15**	**70**	**287**	**33**	**3**	**3**	**431**
% of total longline or trawl	47.1	8.8	0	44.1	17.9	73.6	8.5			
Albatrosses (%)	81.25	33.3	0	56.25	98.6	22.0	33.3	66.7		
Non-albatross (%)	18.75	66.7	0	43.75	1.4	78.0	66.7	33.3	100	

3.1.4 Body condition

Between 1 July 2012 and 30 June 2013, 71.7% of returned birds had fat scores of less than 3, 13.9% of birds had fat scores of 3 and 12.5% of birds (1 Chatham Island albatross, 4 Buller's albatross, 1 fairy prion, 2 flesh-footed shearwater, 17 NZ white-capped albatross, 9 Salvin's albatross, 12 sooty shearwater, 1 southern royal albatross and 7 white-chinned petrels) had fat scores over 3 (Table 6). This suggests that the mean fat scores of returned birds between 1 July 2012 and 30 June 2013 (mean (± SE) = 2.1 ± 0.1) were similar to the last fishing year (the mean fat score (± SE) of all returned birds from the 2011/12 fishing year = 2.0 ± 0.1%; Bell, *in press*). Eight birds (1.9%) could not have their fat scores confirmed due to damage.

Table 6 Fat scores of seabirds killed and returned from fishing vessels between 1 July 2012 and 30 June 2013 (1= no fat, to 5 = extremely fat; U = unknown).

SPECIES	FAT SCORE						TOTAL	MEAN (±SE)
	1	2	3	4	5	U		
Antipodean albatross		1					**1**	2.0 ± 0.0
Black petrel	1	1					**2**	1.5 ± 0.5
Black-backed gull	1		1				**2**	2 ± 1.0
Buller's albatross	22	19	3	4			**48**	1.8 ± 0.1
Campbell albatross	1		2				**3**	2.3 ± 0.7
Chatham Island albatross				1			**1**	4.0 ± 0.0
Common diving petrel	2						**2**	1.0 ± 0.0
Fairy prion		1			1		**2**	3.5 ± 1.5
Flesh-footed shearwater			1	2			**3**	3.7 ± 0.3
Gibson's albatross		1					**1**	2.0 ± 0.0
Grey petrel	1	1					**2**	1.5 ± 0.5
NZ white-capped albatross	23	30	16	11	6	6	**92**	2.4 ± 0.1
Petrel (unidentified)						1	**1**	
Salvin's albatross	2	4	5	4	5		**20**	3.3 ± 0.3
Sooty shearwater	24	28	15	11	1		**79**	2.2 ± 0.1
Southern royal albatross		1			1		**2**	3.5 ± 1.5
Westland petrel	1						**1**	1.0 ± 0.0
White-chinned petrel	78	66	17	5	2	1	**169**	1.7 ± 0.1
TOTAL	**156**	**153**	**60**	**38**	**16**	**8**	**431**	**2.1 ± 0.1**
% TOTAL	**36.2**	**35.5**	**13.9**	**8.8**	**3.7**	**1.9**		

3.1.5 Stomach and gizzard content

Stomach contents were identified to main groups following a similar method to that used by Thompson (2009, 2010a, b). In total, 273 birds (63.3%) had offal or discards in their stomachs, and five birds has bait in its stomach (1.2%) (Table 7). In addition, 157 birds (36.4%) had empty stomachs.

Table 7 Stomach contents of seabirds killed and returned from fishing vessels between 1 July 2012 and 30 June 2013.
Note: Birds can have multiple items in the stomachs resulting in higher stomach content figures than the total number of seabirds killed and returned (*n* = 431).

SPECIES	EMPTY	GONE[1]	BAIT[2]	OFFAL (OR DISCARDS)[3]	NATURAL [4]	SLUDGE [5]	PROVENTRICULAR OIL
Antipodean albatross	1						
Black petrel			1	1			
Black-backed gull					1	1	
Buller's albatross	17	2		44	8		7
Campbell albatross	2				1		
Chatham Island albatross				1			
Common diving petrel	1				2		
Fairy prion	1				1		
Flesh-footed shearwater	3						
Gibson's albatross	1						
Grey petrel				1	1		1
NZ white-capped albatross	29	5	1	82	10	7	2
Petrel (unidentified)		1					
Salvin's albatross	4			25	6		
Sooty shearwater	26	4		42	3	25	8
Southern royal albatross				3	1		
Westland petrel					2		
White-chinned petrel	72	2	3	74	23	30	11
TOTAL	**157**	**14**	**5**	**273**	**59**	**63**	**29**
% TOTAL	**36.4**	**3.2**	**1.2**	**63.3**	**13.7**	**14.6**	**6.7**

[1] Stomach missing or damaged by sea lice.
[2] Identifiable (regularly sized) pieces of fish or squid.
[3] Whole fish (usually small bycatch fish); fish heads, fillets, vertebrae and skin; or squid tentacles, heads and beaks.
[4] Identifiable prey fish or squid (whole or parts), salps and krill.
[5] Usually fish sludge (minced fish or squid); could be offal or discards, or natural.

Most of the gizzard contents were natural food items (squid beaks, fish bones and eyeballs and otoliths), but 7.9% of the birds returned had also ingested plastic or string and 3.9% had ingested stones or seeds (Table 8). In addition, 73 birds (16.9%) had empty stomachs. Samples (e.g. squid beaks and otoliths) have been collected for detailed identification to species if required.

Table 8 Gizzard contents of seabirds killed and returned from fishing vessels between 1 July 2012 and 30 June 2013.
Note: Birds can have multiple items in the gizzard resulting in higher figures than the total number of seabirds killed and returned (*n* = 431).

SPECIES	EMPTY	GONE	SQUID BEAKS	OTOLITHS	FISH OR SQUID EYEBALLS	FISH BONES OR SKIN	PLASTIC OR STRING	SEEDS OR STONE	WORMS	BARNACLES OR SEAWEED
Antipodean albatross			1							
Black petrel			2		1					
Black-backed gull										2
Buller's albatross	17	2	7	9	12	21			2	2
Campbell albatross	1		1		1	2				1
Chatham Island albatross			1			1				
Common diving petrel	1					1				1
Fairy prion	1					1				1
Flesh-footed shearwater			2				4	2		
Gibson's albatross		1								
Grey petrel			2			1				
NZ white-capped albatross	26	6	15	9	25	50			4	1
Petrel (unidentified)		1								
Salvin's albatross	9		6	1	4	6		1		5
Sooty shearwater	15		35	15	1	40	22	9	7	
Southern royal albatross			1	1		1				
Westland petrel			1							
White-chinned petrel	3		165	9		31	8	5	24	1
TOTAL	**73**	**10**	**240**	**44**	**44**	**155**	**34**	**17**	**37**	**14**
% TOTAL	**16.9**	**2.3**	**55.7**	**10.2**	**10.2**	**36.0**	**7.9**	**3.9**	**8.6**	**3.2**

3.1.6 Seabird identification

Autopsy confirmed that the majority (79.4%) of the seabirds returned between 1 July 2012 and 30 June 2013 were identified correctly by the observers (based on the information provided by observers on the specimen tags) (Table 9). Twenty-seven (6.3%) were identified to the correct group or size class, but were given the wrong species code (although this may relate to changes in the coding system), which included Antipodean albatross, Campbell albatross, Gibson's albatross, NZ white-capped albatross, sooty shearwater, southern royal albatross, Westland petrel and white-chinned petrel. A further 39 (9.0%) were identified incorrectly including the following species: black-backed gull, Buller's albatross, fairy prion, NZ white-capped albatross, Salvin's albatross, sooty shearwater, southern royal albatross and white-chinned petrel. Twenty-three birds (5.3%) did not have an observer identification code on the return label (Table 9).

Table 9 Comparison of identifications (ID) recorded by on-board observers at sea compared with autopsy identification for seabirds killed and returned from observed fishing boats between 1 July 2012 and 30 June 2013.

Species	ID correct	ID'd to correct 'species' group*	ID'd as seabird large or albatross*	ID'd as petrel unidentified*	ID wrong	ID not on label	**Total**
Antipodean albatross			1				**1**
Black petrel	2						**2**
Black-backed gull	1				1		**2**
Buller's albatross	39				3	6	**48**
Campbell albatross		2				1	**3**
Chatham Island albatross	1						**1**
Common diving petrel	2						**2**
Fairy prion	1				1		**2**
Flesh-footed shearwater	3						**3**
Gibson's albatross		1					**1**
Grey petrel	2						**2**
NZ white-capped albatross	74	4	2		5	7	**92**
Petrel (unidentified)						1	**1**
Salvin's albatross	18				1	1	**20**
Sooty shearwater	54	2		2	19	2	**79**
Southern royal albatross		1			1		**2**
Westland petrel		1					**1**
White-chinned petrel	145	2		9	8	5	**169**
Total	**342**	**13**	**3**	**11**	**39**	**23**	**431**
% total	**79.4**	**3.0**	**0.7**	**2.6**	**9.0**	**5.3**	

* Identified to correct group or size class, but given the wrong species code.

3.2 Photographs

In total, 378 birds were reported as captured in extracts of seabird captures from the MPI COD or were photographed interacting with fishing vessels (this number may include some non-capture interactions) between 1 July 2012 and 30 June 2013; over two-thirds of these represented live bird interactions (*n* = 262, 69.3%) (Table 10). There were also 251 observed seabird captures for which no photographs had been taken (a mixture of birds that were either released alive or discarded dead by the crew) and 34 photographed birds with no corresponding information in the MPI COD extract (Table 10).

Table 10 Number of seabirds of each species reported as captured or photographed as interacting with fishing vessels between 1 July 2012 and 30 June 2013.

Species	Photographed & listed as captured in COD extract	Photographed, but not listed in COD extract	No photograph, but listed in COD extract	Total
Albatross (unidentified)			3	3
Antipodean albatross	2			2
Black-bellied storm petrel	1		1	2
Black-browed albatross (unidentified)			1	1
Buller's albatross	9	3	17	29
Campbell albatross	2			2
Cape petrels			4	4
Common diving petrel	4	1	4	9
Fairy prion	2	4	1	7
Giant petrel (unidentified)			1	1
Gibson's albatross	1			1
Great albatross (unidentified)			4	4
Grey petrel	12			12
New Zealand white-capped albatross	14	12	31	57
Petrel (unidentified)			28	28
Petrels, prion and shearwaters (unidentified)			19	19
Prion (unidentified)			5	5
Procellaria petrel (unidentified)			2	2
Salvin's albatross	6	1	15	22
Shy albatross			1	1
Small albatross (unidentified)			2	2
Snares Cape petrel	28			28
Sooty shearwater	4	6	21	31
Southern royal albatross	1		1	2
Storm petrel (unidentified)			5	5
Unknown[6]			6	6
Wandering albatross (unidentified)			1	1
Westland petrel			1	1
White-chinned petrel	6	5	76	87
White-faced storm petrel	1		1	2
White-headed petrel		3		3
Total	**93**	**34**	**251**	**378**
Dead	**73**	**32**	**11**	**116**
Alive	**20**	**2**	**240**	**262**

[6] These birds are listed as Unknown, as the observer used an incorrect code (XSW), but from other records in the Observer Log Book it appears these are likely to be sooty shearwater.

Examination of 93 photographs confirmed that observers had accurately identified 40.9% (*n* = 38) of seabirds (Table 11). It should be noted that the majority of specimens were cape petrels, New Zealand white-capped albatross and white-chinned petrels, which are relatively simple to identify (although several observers failed to identify cape petrels to species and these birds were recorded as 'seabird'; this may have been due to time constraints when recording the large number of bird interactions at the time); other species, such as storm petrels and larger albatrosses, were harder to identify (Table 11).

Table 11 Comparison of 93 observer identifications with expert photograph identifications for observed captures listed in COD from fishing vessels between 1 July 2012 and 30 June 2013, by species. 'Confirmed' = photograph identification confirmed the observer identification; 'new, consistent' = photograph identification was to a lower taxonomic group, but consistent with the observer identification; and 'new, not consistent' = photograph identification was not consistent with the observer identification.

Species	Confirmed	New, consistent	New, not consistent	**Total**
Antipodean albatross		2		**2**
Black-bellied storm petrel			1	**1**
Buller's albatross	6		3	**9**
Campbell albatross		2		**2**
Common diving petrel	1		3	**4**
Fairy prion	1		1	**2**
Gibson's albatross		1		**1**
Grey petrel	1		11	**12**
NZ white-capped albatross	14			**14**
Salvin's albatross	5		1	**6**
Snares cape petrel		1	27	**28**
Sooty shearwater	3		1	**4**
Southern Royal albatross	1			**1**
White-chinned petrel	6		1	**7**
Total	**38**	**6**	**49**	**93**
Live	**26**	**1**	**46**	**73**
Dead	**12**	**5**	**3**	**20**

3.2.1 Quality and number of photographs

The quality of the images obtained by observers continued to vary widely. Issues included only one photograph for some seabirds, not all key features were photographed, poor focus, and under- or over-exposure. Poor images were particularly common for birds that were alive and seen onboard for short periods (when photographs were taken from a long distance).

3.2.2 Recommendations for photo-identification

It is recommended that:

1. Wherever possible, all seabird interactions are photographed and recorded. If possible, haul and sample information should be included in the image.
2. Images (with scale if possible) include the head and bill from the side and above, body (full body and side shots), wings (above and below) and shots of the feet whenever possible.
3. Photo logs are completed for all images (which can be correlated to date and time stamps from the camera). Descriptions of the interaction would also help with the identification and matching of images.
4. Photograph numbers are recorded on the observer non-fish bycatch form.
5. Photographs (and extracts from the MPI observer log books) are provided regularly throughout the fishing year for photo-identification.
6. Training and instruction on the use of the cameras and on how to take suitable photographs for identification use is provided (i.e. number of images, type of images, date and time stamps etc.) is provided for all observers.

4. Acknowledgements

This work was funded through the Conservation Services Programme (INT2010/02), Department of Conservation. This autopsy and photo-identification work would not have been possible without the dedication of Ministry of Primary Industries observers who retained the birds for autopsy, took the photographs, and completed log books (which contain important information on cause of death and other aspects of the interaction onboard). Kristopher Ramm provided the link between Wildlife Management International Ltd, the Department of Conservation and the Ministry of Primary Industries Observer Programme, and helped provide clarification on any discrepancies with autopsy tag data and photograph records. Kelvin Floyd (WMIL) developed the WMIL autopsy and photo-identification database and produced all maps.

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Appendix 1

Catch locations of seabirds killed and returned from New Zealand fisheries for autopsy between 1 July 2012 and 30 June 2013, by species, fishery target species and method

Note: some catch locations may be obscured by overlying symbols (e.g. where several individuals were captured from the same tow or set, each bird will have the same catch location and appear on the maps as a single symbol).

Figure A1.1. Antipodean albatross, Gibson's albatross and Southern royal albatross.

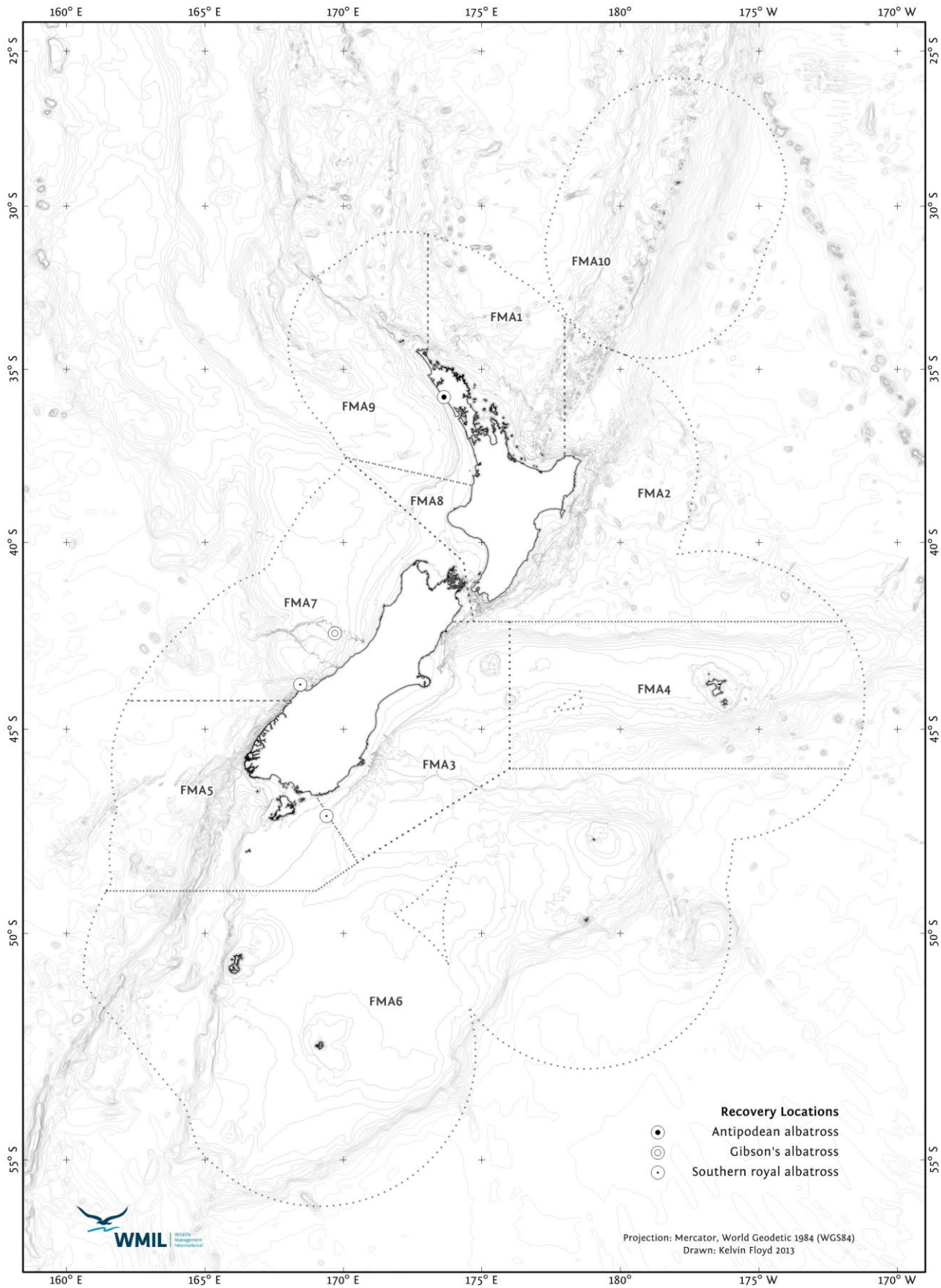

Figure A1.2. Buller's albatross, Chatham Island albatross and Campbell albatross.

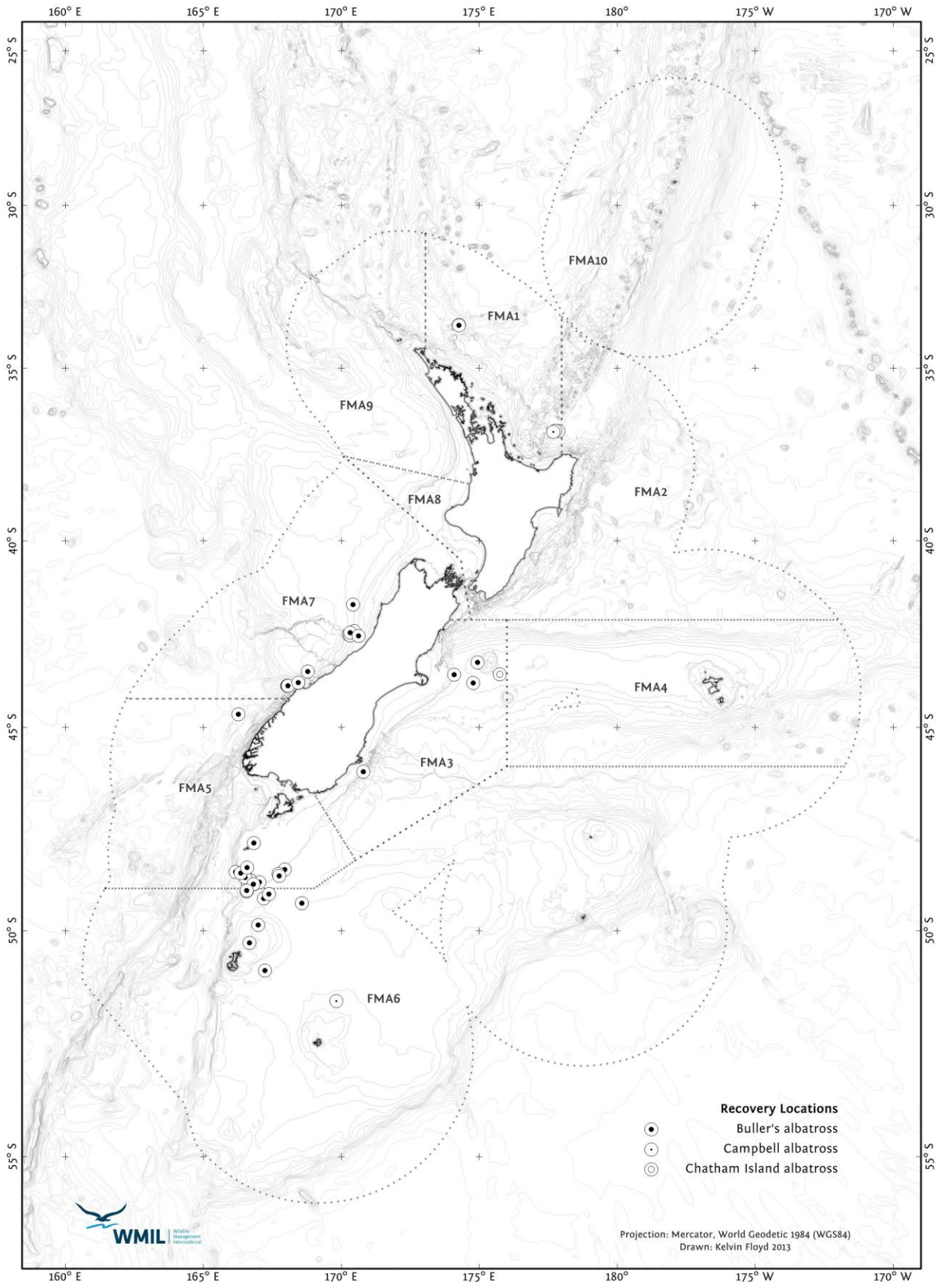

Figure A1.3. New Zealand white-capped albatross and Salvin's albatross.

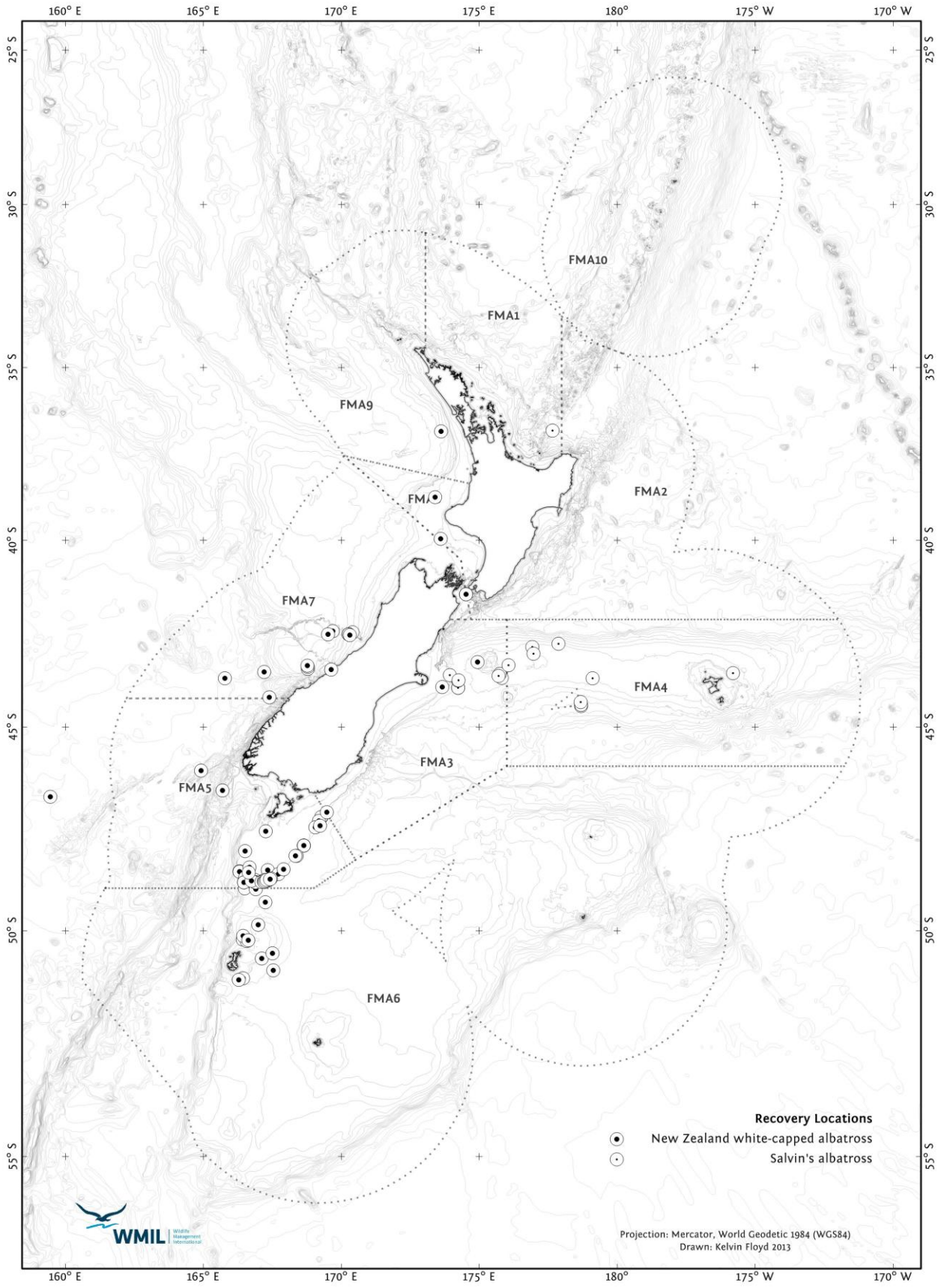

Figure A1.4. *Procellaria* petrels.

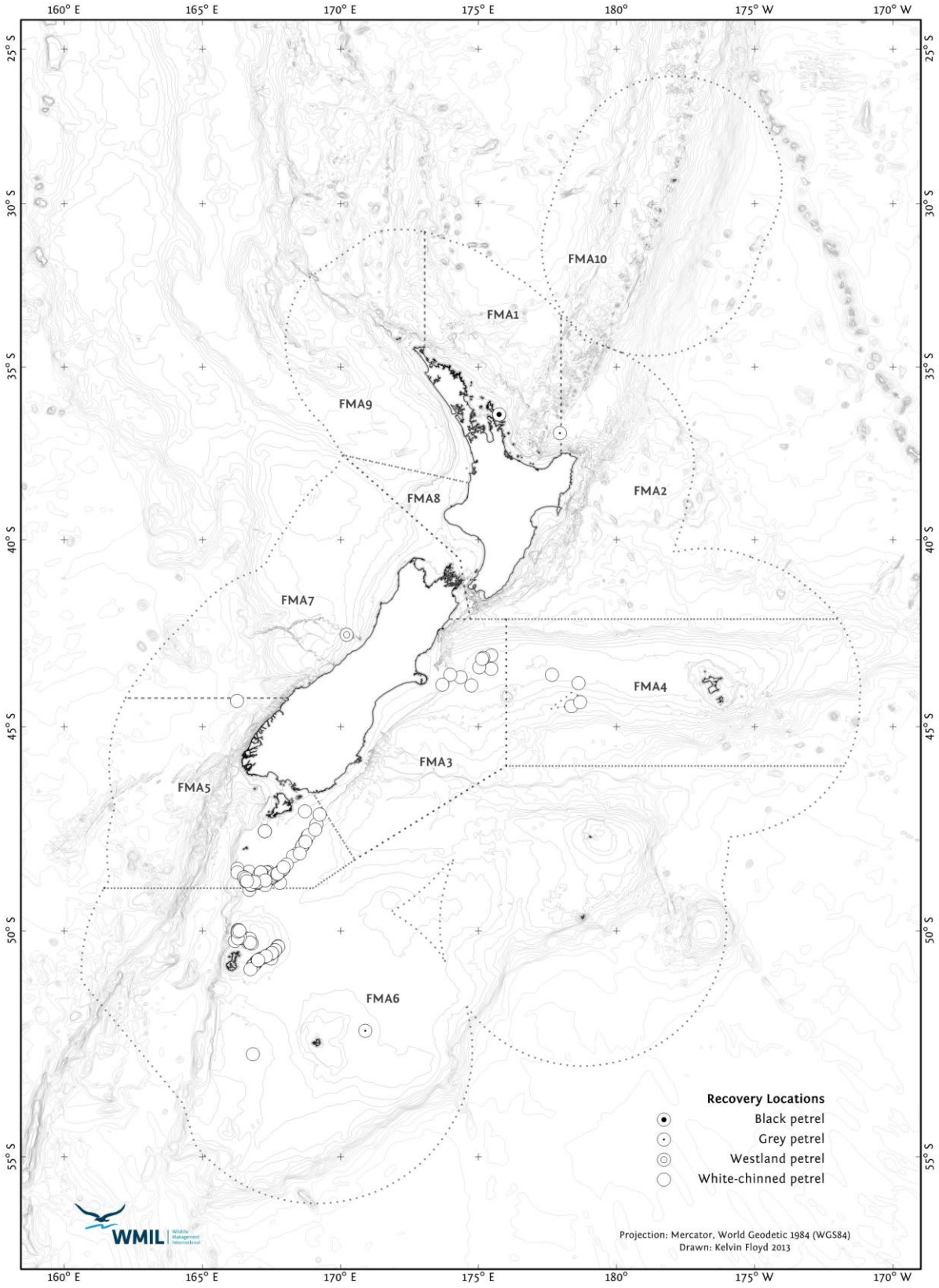

Figure A1.5. Sooty shearwaters and flesh-footed shearwaters

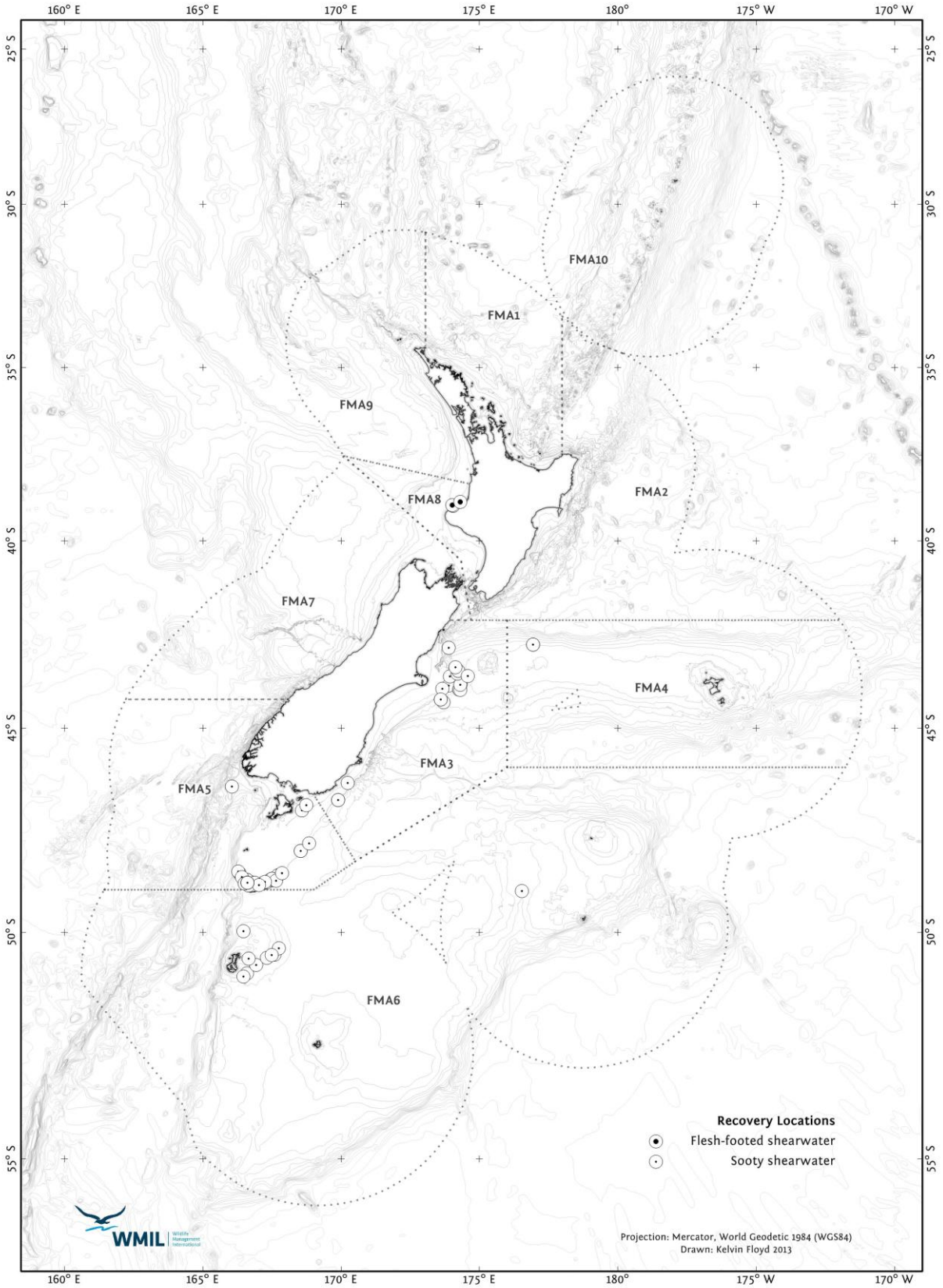

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Figure A1.6. Buller's albatross, split by fisheries target species and method.

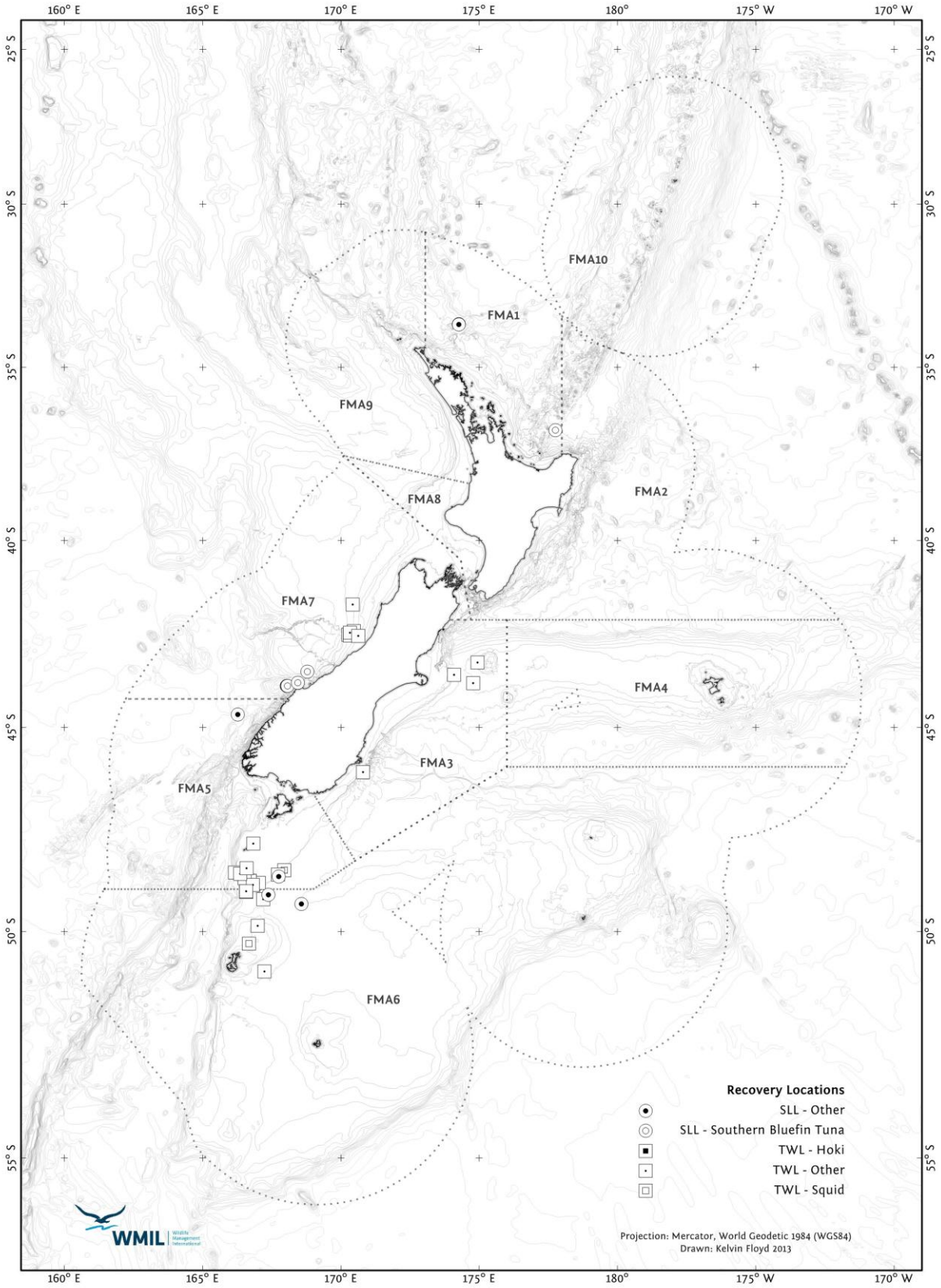

Figure A1.7. New Zealand white-capped albatross, split by fisheries target species and method.

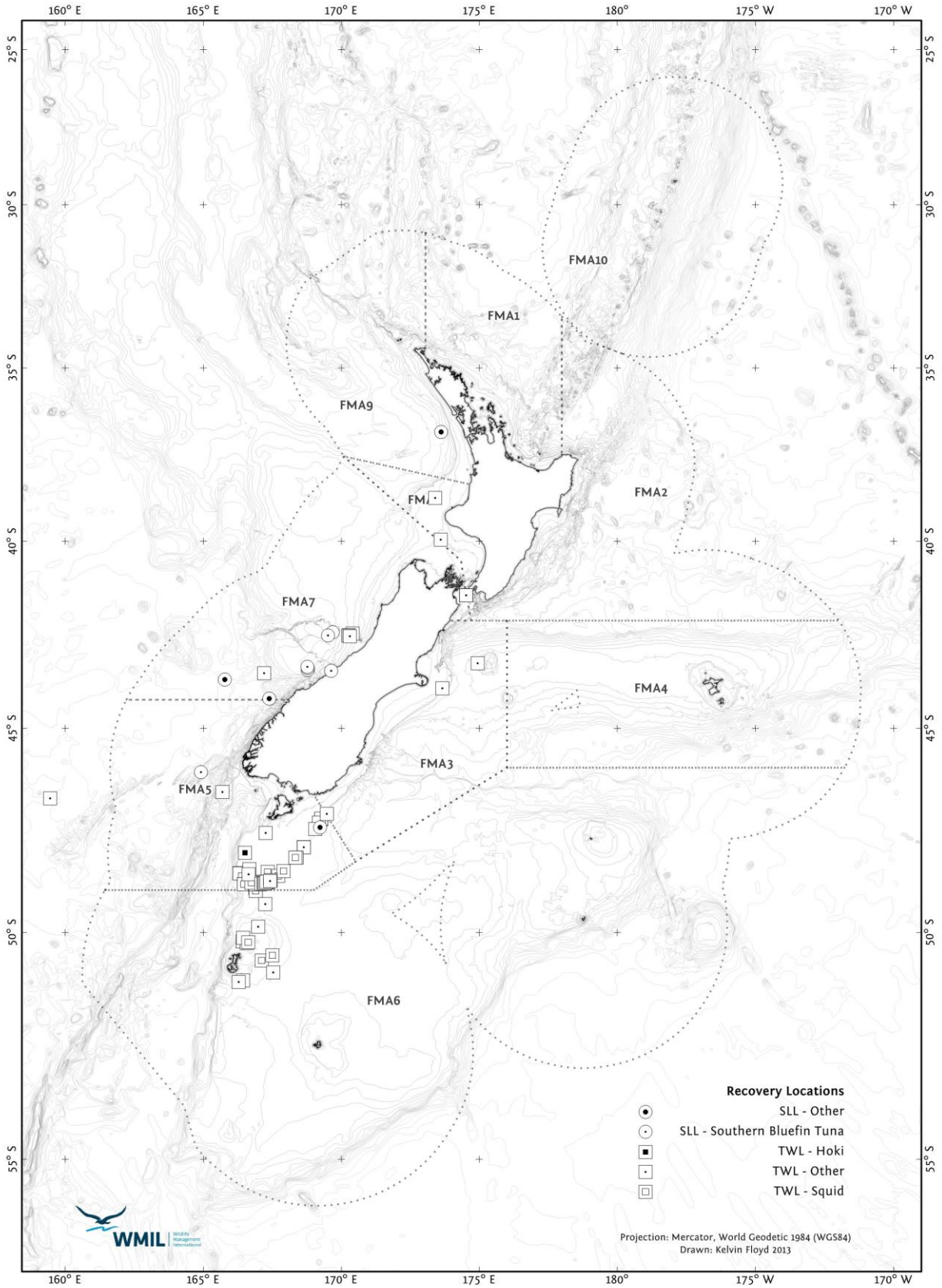

Figure A1.8. Salvin's albatross, split by fisheries target species and method.

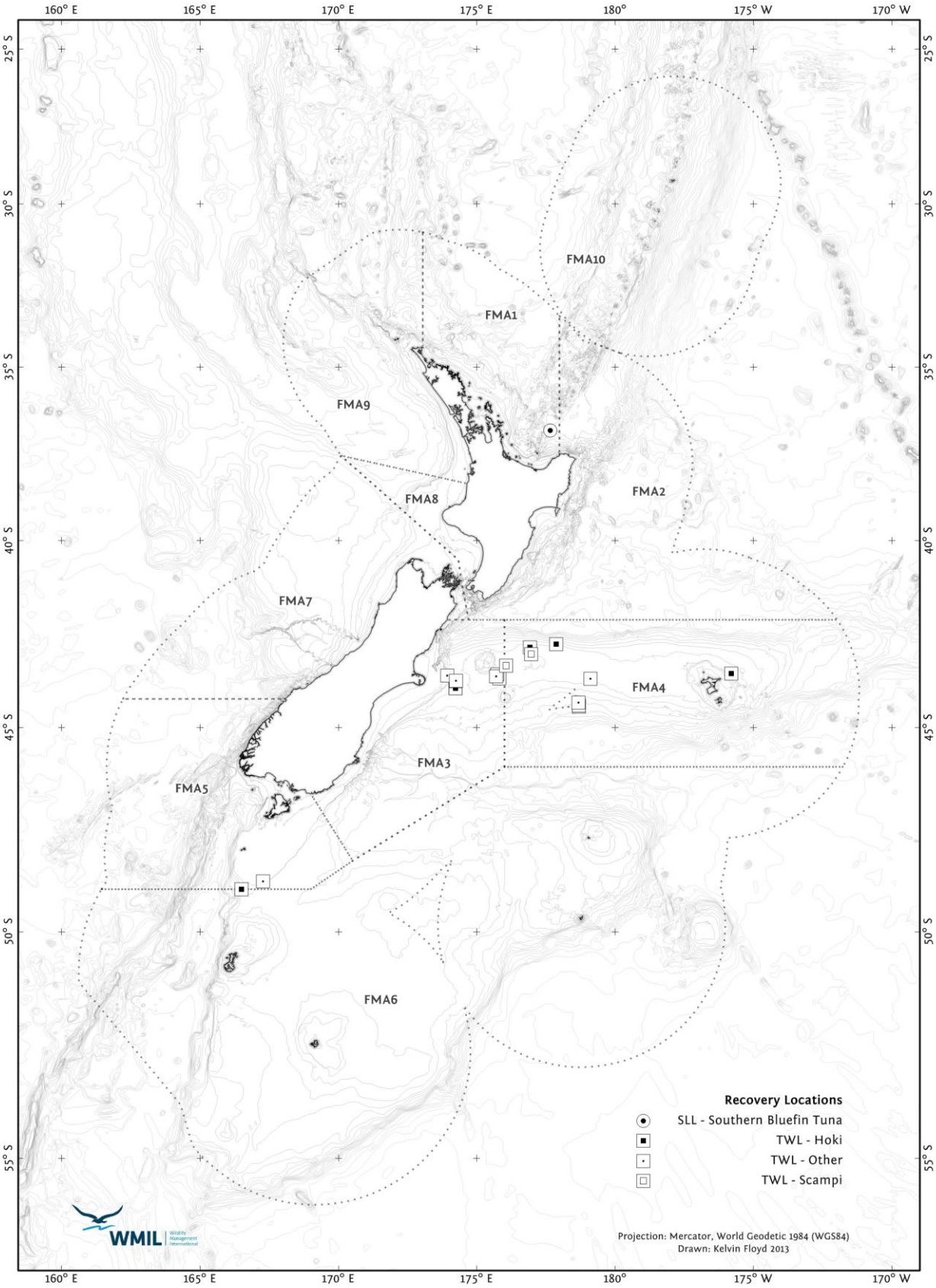

Figure A1.9. White-chinned petrel, split by fisheries target species and method.

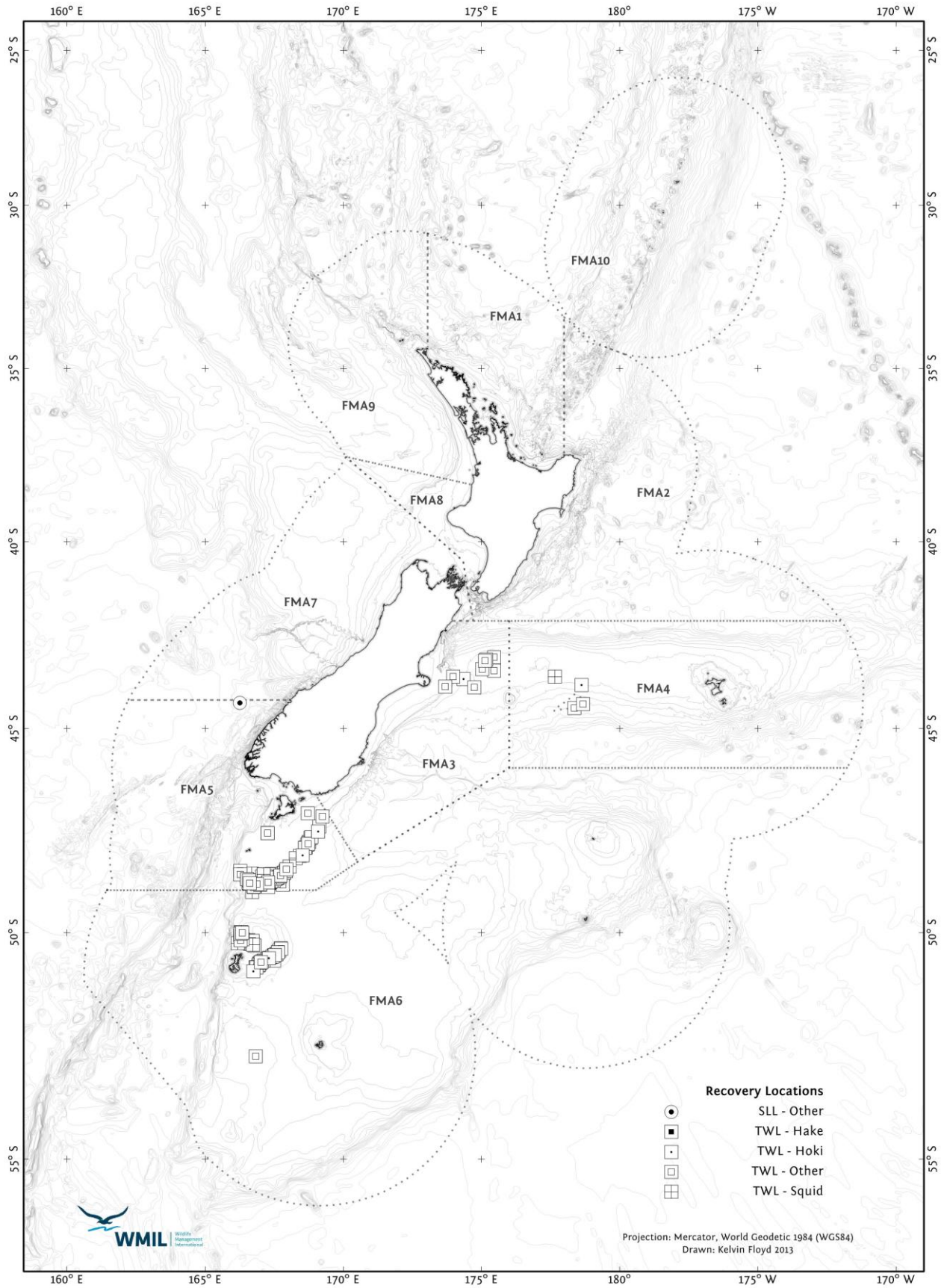

Figure A1.10. Sooty shearwater, split by fisheries target species and method.