INT 2016-02 IDENTIFICATION OF SEABIRDS CAPTURED IN NEW ZEALAND FISHERIES:

1 July 2017 to 30 June 2018

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INT2016-02 Identification of seabirds captured in New Zealand fisheries: 1 July 2017 to 30 June 2018

Elizabeth Bell and Mike Bell

Wildlife Management International Ltd
PO Box 607
Blenheim 7240
New Zealand
www.wmil.co.nz
biz@wmil.co.nz

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Cover image: Image of white-chinned petrel interaction (deck landing) provided by Steve Hornby (MPI/DOC Government Observer), 29 October 2017.

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 2017 and 30 June 2018, a total of 251 seabirds comprising 22 taxa were incidentally killed as bycatch and returned for autopsy by on-board New Zealand Government observers. Birds were returned from 17 longline (n = 97 birds), 30 trawl (n = 143 birds) and 5 set net (n = 11 birds) vessels and were dominated numerically by six species (flesh-footed shearwater *Puffinus carneipes*, Salvin's albatross *Thalassarche salvini*, sooty shearwater *Puffinus griseus*, Buller's albatross *Thalassarche bulleri bulleri*, white-chinned petrel *Procellaria aequinoctialis* and New Zealand white-capped albatross *Thalassarche steadi*. All birds returned from longline fisheries had injuries consistent with being hooked or entangled in the bill, throat or wing. In contrast, most birds (79.7%) returned from trawl fisheries were killed through entanglement in the net, cod-end or pound, with 10.4% likely to have been killed by warp interaction or entanglement. Four birds were killed by striking the deck of the trawl vessel. Birds had slightly higher mean fat scores in comparison to birds from the last fishing year, and discards, including offal, appear to continue to be an attractant for many seabirds. In addition to the seabirds that were returned for autopsy, examination of the Ministry for Primary Industries Central Observer Database (COD) and images provided by Government observers gave a total of a further 540 seabirds that were reported as interactions or photographed (as dead or alive captures) aboard 57 fishing vessels (and may include some non-capture interactions). Two-thirds (66.5%) of the seabirds reported in these interactions were released alive. Out of these 540 records of seabird interactions, photographs were taken of 232 seabirds consisting of 17 taxa. Image quality varied widely, with poor images being particularly common for birds that were alive and seen on-board for short periods. Images of dead birds have improved with multiple images taken for each specimen. Recommendations are made to improve photo-identifications in the future.

There are 4 photographs for this period (1 July 2017 to 30 June 2018) still to be provided; these species will be confirmed when the images and updated COD extract has been received.

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 (as well as 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 INT2016-02.

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 2017 and 30 June 2018. Identifications were based on dead birds caught and returned and/or photographs or videos of live or dead birds.

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, 2002b; Robertson, *et al*., 2003, 2004; Conservation Services Programme, 2008; Thompson, 2009, 2010a, 2010b; Bell, 2011, 2012, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017). 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 & Petrels (ACAP 2010).

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.

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.

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.

Table 1 Common and scientific names of seabirds captured and returned, photographed or reported as an interaction from New Zealand fisheries between 1 July 2017 and 30 June 2018.

COMMON NAME	SCIENTIFIC NAME	AUTOPSY	PHOTO (P) OR EXTRACT REPORT (E)
Albatross (unidentified)			E
Antarctic prion	*Pachyptila desolata*		P
Black (Parkinson's) petrel	*Procellaria parkinsoni*	✓	P & E
Black-bellied storm petrel	*Fregetta tropica*	✓	
Buller's albatross	*Thalassarche bulleri bulleri*	✓	E
Buller's or Pacific albatross (unidentified)	*Thalassarche spp.*		E
Buller's shearwater	*Puffinus bulleri*		E
Campbell albatross	*Thalassarche impavida*	✓	P
Cape petrel	*Daption capense*	✓	
Cape petrels (unidentified)	*Daption spp.*		E
Common diving petrel	*Pelecanoides urinatrix*	✓	P & E
Erect-crested penguin	*Eudyptes sclateri*	✓	
Fairy prion	*Pachyptila turtur*		P & E
Fiordland crested penguin	*Eudyptes pachyrhynchus*	✓	
Flesh-footed shearwater	*Puffinus carneipes*	✓	P & E
Fluttering shearwater	*Puffinus gavia*		E
Great albatross (unidentified)	*Diomedea* spp.		E
Great-winged (grey-faced) petrel	*Pterodroma macroptera*	✓	P & E
Grey petrel	*Procellaria cinerea*	✓	
Grey-backed storm petrel	*Garrodia nereis*		P & E
Kerguelen petrel	*Aphrodroma brevirostris*		P
Mid-sized petrel and shearwater (unidentified)			P & E

COMMON NAME	SCIENTIFIC NAME	AUTOPSY	PHOTO (P) OR EXTRACT REPORT (E)
Mottled petrel	*Pterodroma inexpectata*		P
New Zealand white-capped albatross	*Thalassarche steadi*	✓	P & E
Northern giant petrel	*Macronectes halli*		E
Northern royal albatross	*Diomedea sanfordi*	✓	
Pacific albatross	*Thalassarche bulleri platei*		E
Penguin (unidentified)			P & E
Petrel (unidentified)			E
Petrels, prion and shearwaters (unidentified)			E
Prion (unidentified)	*Pachyptila* spp.		E
Procellaria petrel (unidentified)	*Procellaria* spp.		P & E
Pterodroma petrel (unidentified)	*Pterodroma* spp.		E
Salvin's albatross	*Thalassarche salvini*	✓	P & E
Seabird (small)			E
Shearwater (unidentified)			E
Shy albatross	*Thalassarche cauta*		E
Small albatross (unidentified)	*Thalassarche* spp.		E
Sooty shearwater	*Puffinus griseus*	✓	P & E
Southern royal albatross	*Diomedea epomophora*	✓	P
Spotted shag	*Phalacrocorax punctatus*	✓	E
Storm petrel (unidentified)			P & E
Wandering albatross (unidentified)	*Diomedea exulans* spp.		E
Westland petrel	*Procellaria westlandica*	✓	E
White-chinned petrel	*Procellaria aequinoctialis*	✓	P & E
White-faced storm petrel	*Pelagodroma marina*	✓	P & E
White-headed petrel	*Pterodroma lessonii*		P & E
Yellow-eyed penguin	*Megadytes antipodes*	✓	

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, Conservation Services Programme, 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 for 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.

Each bird or interaction was separated as follows:

- *Photo (Photo and Extract)*: seabird photographed by observer, image provided, and interaction recorded in MPI COD
- *Photo (Image not received to date)*: seabird apparently photographed by observer but not received to date and interaction recorded in MPI COD
- *Photo (Not in extract to date)*: image of seabird received but interaction not listed in MPI COD to date

- *Interaction*: seabird interaction with vessel (i.e. live or dead capture, warp or deck strike, etc.) listed in MPI COD, but no image taken by observer

Photographs were provided in electronic format with associated observer MPI COD 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, photographed or recorded in the COD extract 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 251 seabirds comprising 21 taxa were returned from 53 vessels between 1 July 2017 and 30 June 2018 (Table 2, Figure 1).

Seabirds returned were dominated by six species: flesh-footed shearwater (n = 12, 4.8%), Salvin's albatross (n = 14, 5.6%), sooty shearwater (n = 23, 9.2%), Buller's albatross (n = 28, 11.2%), white-chinned petrel (n =65, 25.9%) and New Zealand white-capped albatross (n = 68, 27.1%) (Table 2). These six species accounted for 83.7% of all returns. Of the remaining 15 taxa, eight had only single captures, four had three captures, one had five captures and two had eight captures (Table 2).

There was one banded bird within those captured and returned between 1 July 2017 and 30 June 2018. One female Buller's albatross had a uniquely numbered metal band (M74157) and had been banded as a chick on North East Island at The Snares on 6 July 1999. Banded specimens provide valuable longevity and survival data.

The monthly distribution of returned specimens was not evenly spread across the fishing year with most birds returned being caught in March 2018 (n = 39, 15.5%), May 2018 (n = 34, 13.5%), April 2018 (n = 33, 13.1%) and February 2018 (n = 32, 12.7%) (Table 2). This pattern reflects the timing of seabird breeding, presence within the New Zealand EEZ, timing and location of all observed fisheries, and observer coverage.

Table 2. Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2017 and 30 June 2018, by month of capture.

SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Black (Parkinson's) petrel	1			1								6	8	3.2%
Black-bellied storm petrel					1								1	0.4%
Buller's albatross				5	8	9	4					2	28	11.2%
Campbell albatross							1		1		1		3	1.2%
Cape petrel										1			1	0.4%
Common diving petrel			3										3	1.2%
Erect-crested penguin			1										1	0.4%
Fiordland crested penguin												1	1	0.4%
Flesh-footed shearwater			1	4				1		5	1		12	4.8%
Great-winged (grey-faced) petrel												1	1	0.4%
Grey petrel							2	1	2				5	2.0%
NZ white-capped albatross	4	7	8	13	19	8	2				3	4	68	27.1%
Northern royal albatross												1	1	0.4%
Salvin's albatross	2	2	1							4	4	1	14	5.6%
Sooty shearwater	1	5	9	3	2					2	1		23	9.2%
Southern royal albatross				2					1				3	1.2%
Spotted shag		1											1	0.4%
Westland petrel					2	4				1	1		8	3.2%
White-chinned petrel	7	16	15	5	1					1	9	11	65	25.9%
White-faced storm petrel		1											1	0.4%
Yellow-eyed penguin	1		1		1								3	1.2%
TOTAL	**16**	**32**	**39**	**33**	**34**	**21**	**9**	**2**	**4**	**14**	**20**	**27**	**251**	
% TOTAL	**6.4%**	**12.7%**	**15.5%**	**13.1%**	**13.5%**	**8.4%**	**3.6%**	**0.8%**	**1.6%**	**5.6%**	**8.0%**	**10.8%**		

Table 3 Species and numbers of seabirds killed and returned form observed fishing vessels between 1 July 2017 and 30 June 2018, by sex (M = male, F = female, U = unknown) and age (A = adult, BA = breeding adult, N = non-breeding adult, SA = sub-adult, I = immature and J = juvenile, U = unknown).

SPECIES	SEX			AGE							TOTAL	% TOTAL
	M	F	U	A	BA	N	SA	I	J	U		
Black (Parkinson's) petrel	7	1		8	5						**8**	**3.2%**
Black-bellied storm petrel	1			1	1						**1**	**0.4%**
Buller's albatross	14	13	1	28	14						**28**	**11.2%**
Campbell albatross	3			2		1	1				**3**	**1.2%**
Cape petrel	1			1							**1**	**0.4%**
Common diving petrel	2	1		3							**3**	**1.2%**
Erect-crested penguin			1	1							**1**	**0.4%**
Fiordland crested penguin		1		1							**1**	**0.4%**
Flesh-footed shearwater	4	8		12							**12**	**4.8%**
Great-winged (grey-faced) petrel	1			1							**1**	**0.4%**
Grey petrel	2	1	2	5	3						**5**	**2.0%**
NZ white-capped albatross	29	35	4	55	14		6	6		1	**68**	**27.1%**
Northern royal albatross		1					1				**1**	**0.4%**
Salvin's albatross	7	7		12	5		1	1			**14**	**5.6%**
Sooty shearwater	19	4		22	4		1				**23**	**9.2%**
Southern royal albatross		3		3	1						**3**	**1.2%**
Spotted shag		1		1							**1**	**0.4%**
Westland petrel	3	5		8	4	1					**8**	**3.2%**
White-chinned petrel	48	11	6	61	25	1		3		1	**65**	**25.9%**
White-faced storm petrel		1		1	1						**1**	**0.4%**
Yellow-eyed penguin	1	1	1	2	1					1	**3**	**1.2%**
TOTAL	**142**	**94**	**15**	**228**	**78**	**3**	**10**	**10**	**0**	**3**	**251**	
% TOTAL	**56.6%**	**37.5%**	**6.0%**	**90.8%**	**31.1%**	**1.2%**	**4.0%**	**4.0%**	**0**	**1.2%**		

The majority of birds were males (n = 142, 56.6%, Table 3). Black-bellied storm petrel, Campbell albatross, cape petrel and great-winged (grey-faced) petrel returned only males. However, Fiordland crested penguin, flesh-footed shearwater, New Zealand white-capped albatross, northern royal albatross, southern royal albatross, spotted shag, Westland petrel and white-faced storm petrel had either more female or only female returns. Most birds were adults (n = 228, 90.8%) (Table 3). Of these adults, 78 (31.1%) were breeding and 3 (1.2%) were non-breeding (Table 3). Twenty birds (8.0%) were pre-breeders (i.e. either sub-adult, immature or juvenile birds) (Table 3).

3.1.2 Target vessel and fishery of necropsy seabirds

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 Figures 1 and 2.

For the fishing period 1 July 2017 to 30 June 2018, there were 308 observed trips on 127 vessels (Shannon Weaver, CSP DOC, pers. comm.). Fifty-two vessels (40.9%) returned birds during this period. Over half of these 52 vessels returned relatively low numbers of birds (< 5 birds caught and returned; n = 30, 57.7%) (Figure 3). Five vessels caught 10 or more birds (Figure 3). Of these five vessels, one surface longliner caught and returned 32 birds from one observed trip, another surface longliner caught and returned 11 birds from one observed trip, one bottom longliner caught and returned 12 birds from one out of two observed trips, one trawler caught and returned 11 birds from two out of five observed trips and another trawler caught and returned 19 birds from three out of five observed trips as shown in Figure 3.

Seventy-five vessels did not return any birds from 143 observed trips during this fishing year (Shannon Weaver, CSP DOC, pers. comm.). From 52 vessels that did catch and return birds, the average was 4.8 birds (± 0.75) caught and returned from 3.2 trips (± 0.4) per vessel.

Of the 52 vessels that caught and returned seabirds, 17 were longliners (32.7%; bottom = 7 or surface = 10), five were set-netters (9.6%) and 30 were trawlers (57.7%) (Table 4).

Bottom and surface longline fisheries returned a total of 97 birds (38.7% of total returns; bottom longliner n = 25, 10% and surface longliner n= 72, 28.7%), with vessels targeting tuna *Thunnu*s spp. accounting for 54.6% of longline specimens (n = 53) and those targeting snapper *Centroberyx affinis* accounting for 25.8% of longline specimens (n = 25) and the remainder targeting 'other' species (mainly ling *Genypterus blacodes*, swordfish *Xiphias gladius* or bluenose *Hyperoglyphe antarctica*) accounting for 19.6% of longline specimens (n = 19) (Table 4).

Bottom and midwater trawl fisheries combined returned 143 birds (57.0% of total returns), with trawlers targeting squid *Nototodarus* spp. accounting for 43.4% (n = 62) of all trawl returns, trawlers targeting hoki *Macruronus novaezelandiae* accounting for 25.2% (n = 36), trawlers targeting ling accounting for 4.2% (n = 6), trawlers targeting scampi *Metanephrops challengeri* accounting for 5.6% (n = 8) and trawlers targeting 'other' species accounting for 23.8% (n = 34) (Table 4). The 'other' species included barracouta *Thyrsites atun*, orange roughy *Hoplostethus atlanticus*, jack mackerel *Trachurus* spp., trevally *Pseudocaranx georgianus*, silver warehou *Seriolella punctata* and southern blue whiting *Micromesistius australis*.

Eleven seabirds were caught and killed on set net vessels (4.4% of total returns), with vessels targeting school sharks (*Galeorhinus galeus*) accounting for 18.2% of all set-net returns (n = 2), those targeting rig (*Mustelus lenticulatus*) accounting for 45.5% of all set-net returns (n = 5) and those targeting 'other' species (mainly butterfish *Odax pullus* or elephant fish *Callorhinchus milii*) accounting for 36.4% of all set-net returns (n = 4) (Table 4).

Figure 1 Individual catch locations of all seabirds killed and returned in New Zealand fisheries for necropsy between 1 July 2017 and 30 June 2018.

Note: catch location symbols 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.

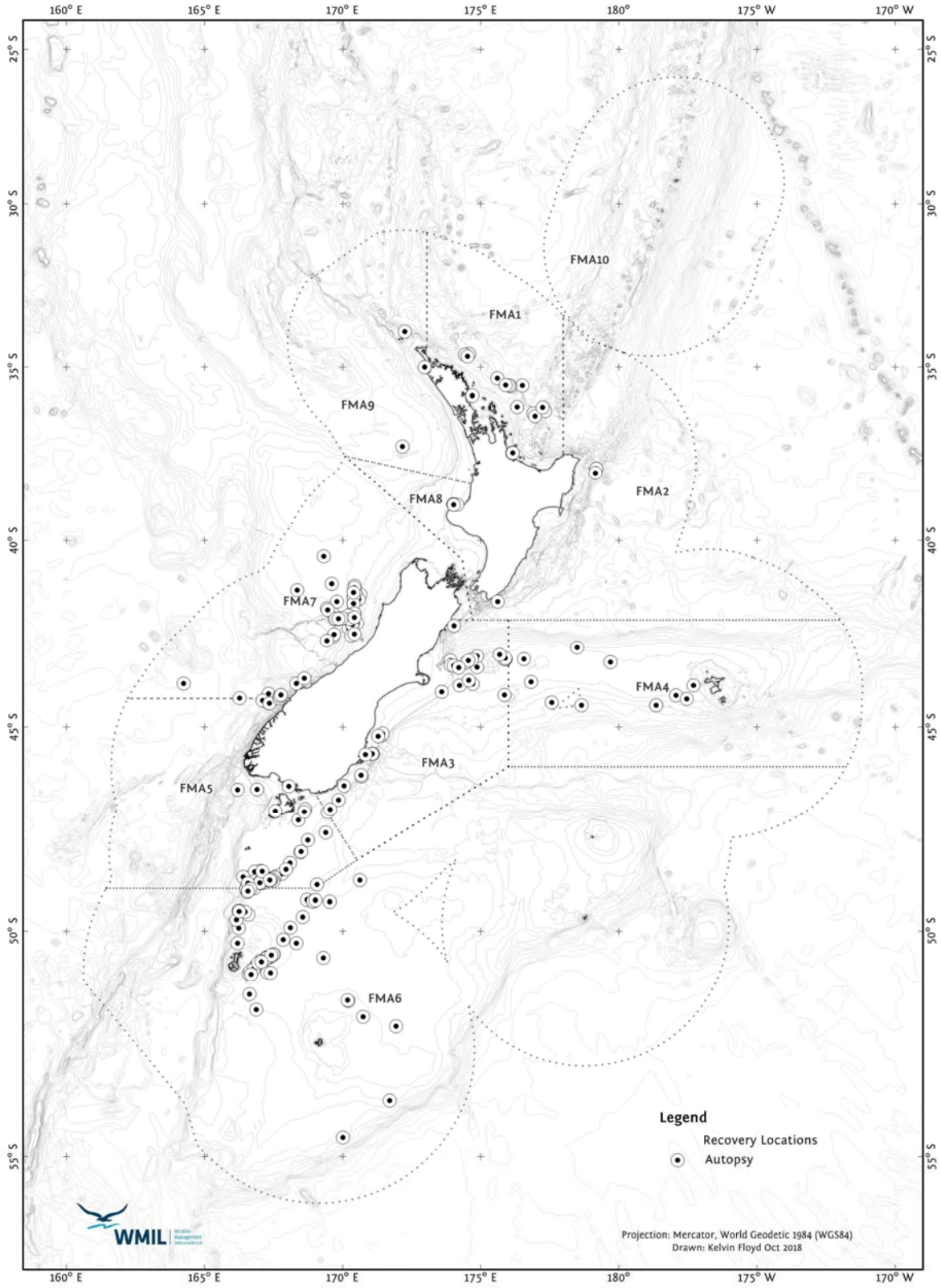


Figure 2 Grouped catch locations of all seabirds killed and returned in New Zealand fisheries for necropsy between 1 July 2017 and 30 June 2018.

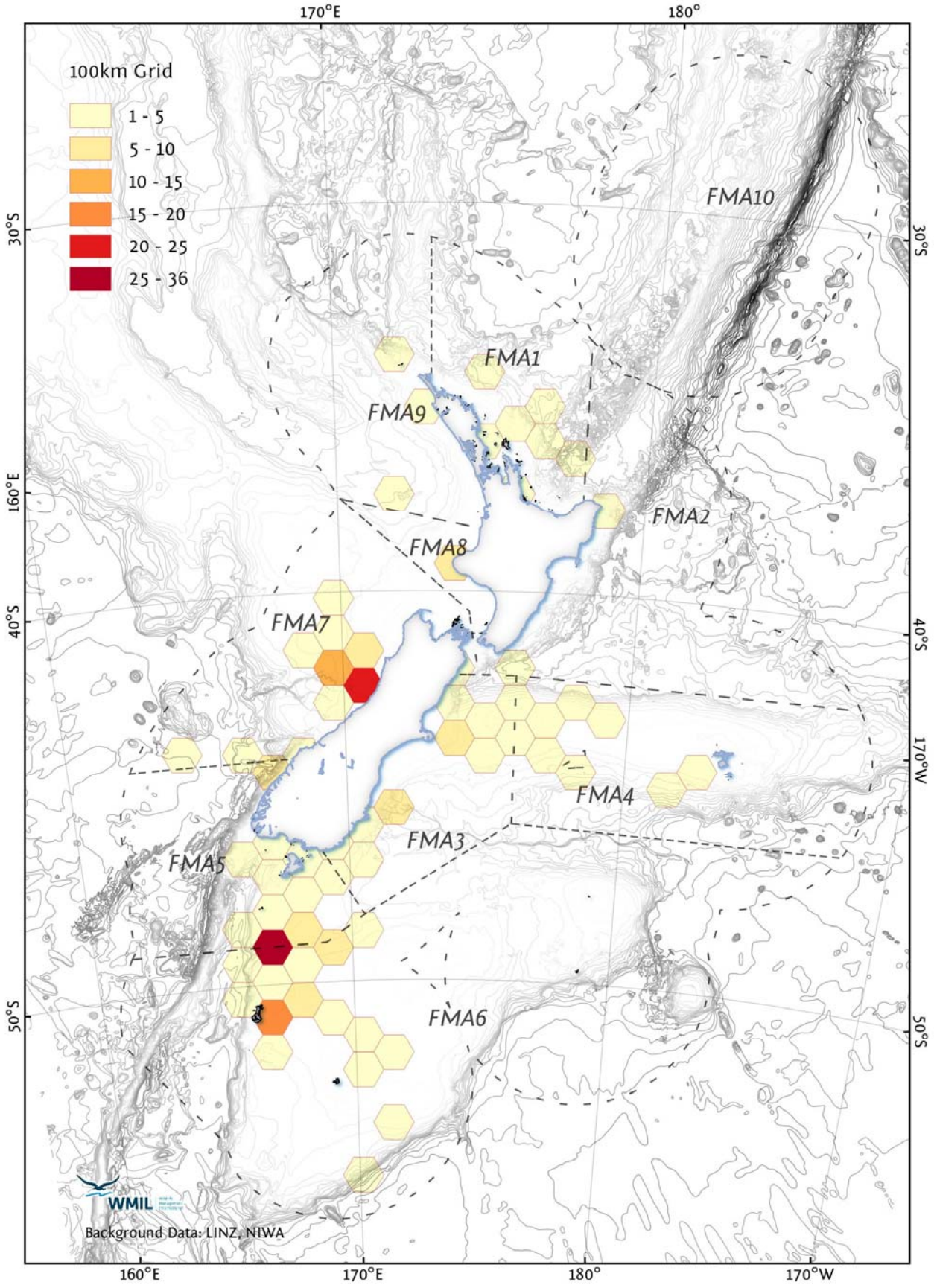


Figure 3 The number of seabirds killed and returned in New Zealand fisheries, and the number of trips for each observed vessel between 1 July 2017 and 30 June 2018.

Where ● is the number of observed trips by a trawl vessel, ● is the number of observed trips by a longline vessel and ● is the number of observed trips by a set net vessel and ● is the total number of seabirds caught and returned by that vessel in all observed trips combined.

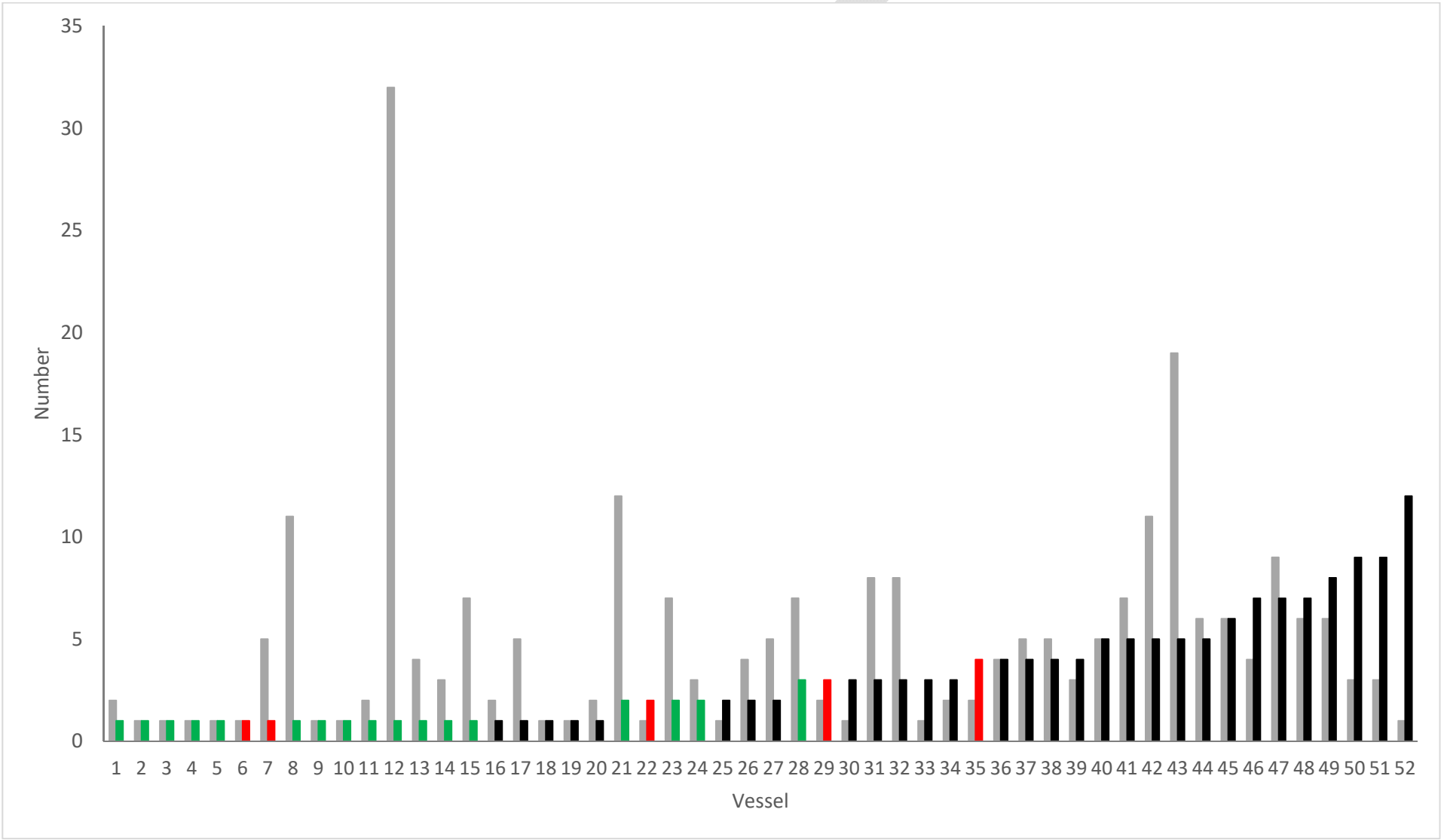


Table 4 Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2017 and 30 June 2018, by fisheries type.

Species	Trawl (Bottom/Midwater)					Longline (Surface/Bottom)				Setnet	Total
	Scampi	Squid	Hoki	Ling	Other	Tuna	Snapper	Ling	Other		
Black (Parkinson's) petrel						5			3		**8**
Black-bellied storm petrel			1								**1**
Buller's albatross	6		8		2	9	2		1		**28**
Campbell albatross			1		1	1					**3**
Cape petrel							1				**1**
Common diving petrel		2	1								**3**
Erect-crested penguin		1									**1**
Fiordland crested penguin										1	**1**
Flesh-footed shearwater						2	9		1		**12**
Great-winged (grey-faced) petrel						1					**1**
Grey petrel	1				3	1					**5**
NZ white-capped albatross		15	8	3	6	27	9				**68**
Northern royal albatross						1					**1**
Salvin's albatross		3	6		4				1		**14**
Sooty shearwater		11	4	1	6					1	**23**
Southern royal albatross					1	2					**3**
Spotted shag										1	**1**
Westland petrel			1			2	4	1			**8**
White-chinned petrel	1	30	6	2	7	2		12		5	**65**
White-faced storm petrel					1						**1**
Yellow-eyed penguin										3	**3**
TOTAL	**8**	**62**	**36**	**6**	**34**	**53**	**25**	**13**	**6**	**11**	**251**
	5.6%	**43.4%**	**25.2%**	**4.2%**	**23.8%**	**%**	**%**	**%**	**%**		
	143					**97**					
% TOTAL	**57.0%**					**38.6%**				**4.4%**	

Table 5 Number of seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2017 and 30 June 2018, by likely cause of death. The proportion of albatross and non-albatross taxa returned is also presented.

Species	Longline						Trawl					Setnet	Total
	Bill, neck or throat	Wing	Legs or feet	Not obvious	Tangled	Vessel strike	Warp	Net	Pound or Cod-end	Other	Vessel strike		
Black (Parkinson's) petrel	2	1		4	1								**8**
Black-bellied storm petrel								1					**1**
Buller's albatross	4	1		7			3	7	4	2			**28**
Campbell albatross					1		1			1			**3**
Cape petrel				1									**1**
Common diving petrel									1		2		**3**
Erect-crested penguin									1				**1**
Fiordland crested penguin												1	**1**
Flesh-footed shearwater	2	2	1	7									**12**
Great-winged (grey-faced) petrel	1												**1**
Grey petrel	1							1	1	2			**5**
NZ white-capped albatross	8	4		24			15	14	2	1			**68**
Northern royal albatross				1									**1**
Salvin's albatross				1			5	6	1		1		**14**
Sooty shearwater								11	6	4	1	1	**23**
Southern royal albatross	1			1						1			**3**
Spotted shag												1	**1**
Westland petrel	1	1		5			1						**8**
White-chinned petrel	3			11				40	4	2		5	**65**
White-faced storm petrel								1					**1**
Yellow-eyed penguin												3	**3**
Total	**23**	**9**	**1**	**62**	**2**	**0**	**25**	**81**	**20**	**13**	**4**	**11**	**251**
Total (each type)	**97**						**143**					**11**	
% of total longline or trawl	**23.7%**	**9.3%**	**1.0%**	**63.9%**	**2.1%**		**17.5%**	**56.6%**	**14.0%**	**9.1%**	**2.8%**		
Albatrosses (%)	**56.5%**	**55.6%**		**54.8%**	**50.0%**		**96.0%**	**33.3%**	**35.0%**	**38.5%**	**25.0%**		
Non-albatross (%)	**43.5%**	**44.4%**	**100.0%**	**45.2%**	**50.0%**		**4.0%**	**66.7%**	**65.0%**	**61.5%**	**75.0%**	**100.0%**	

Table 6 Types of injuries recorded on seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2017 and 30 June 2018. The proportion of albatross and non-albatross taxa returned is also presented.

Note: Birds can have multiple injuries resulting in higher figures than the total number of seabirds killed and returned (*n* = 251).

	No visible injuries	Waterlogged	Broken wing	Broken neck	Broken legs or feet	Broken bill	Hook in bill or throat (including swallowed hook)	Hook in wing	Hook in leg or feet	Open wound	Crushed or more than 3 injuries	Greased	Liced
Black (Parkinson's) petrel	1	2			1		3	2					
Black-bellied storm petrel										1			
Buller's albatross	4	16	5		2	1	5	1		6	6	1	
Campbell albatross	1		3								1		
Cape petrel	1												
Common diving petrel	3	1											
Erect-crested penguin													1
Fiordland crested penguin			1										
Flesh-footed shearwater	6	5	1				1	1	5				
Great-winged (grey-faced) petrel							1						
Grey petrel	1	3			1	1	1			1	1		
NZ white-capped albatross	13	22	16		2	2	9			20	14	7	1
Northern royal albatross			1				1			1			
Salvin's albatross	4	9	4			1				1	2	1	
Sooty shearwater	9	14	1	1	8	3				2			
Southern royal albatross		2	2							2			
Spotted shag	1	1											
Westland petrel	4	3			1	1		1		1	1		
White-chinned petrel	28	50	3		6	5	5			6	1		4
White-faced storm petrel		1											
Yellow-eyed penguin	2	1								1			
Total	**78**	**131**	**37**	**1**	**21**	**14**	**26**	**5**	**1**	**42**	**26**	**9**	**6**
% Total	**31.1%**	**52.2%**	**14.7%**	**0.4%**	**8.4%**	**5.6%**	**10.4%**	**2.0%**	**0.4%**	**16.7%**	**10.4%**	**3.6%**	**2.4%**
Albatrosses (%)	28.2%	37.4%	83.8%	0.0%	19.0%	28.6%	57.7%	20.0%	0.0%	71.4%	88.5%	100.0%	16.7%
Non-albatross (%)	71.8%	62.6%	16.2%	100.0%	81.0%	71.4%	42.3%	80.0%	100.0%	28.6%	11.5%	0.0%	83.3%

3.1.3 Injuries and likely cause of death of necropsy seabirds

The condition of the returned birds ranged from 'no obvious injury', 'waterlogged', 'greased' or 'hook present' to 'crushed'. As in previous years (Robertson, *et al*., 2004; Conservations Services Programme, 2008; Thompson, 2010a, 2010b; Bell, 2011, 2012, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017), birds caught and returned from trawl fisheries had different injuries from those caught by longline vessels.

Of the 97 birds from longline vessels, most were waterlogged and had hook injuries (Tables 5 and 6). Of these, 33 (34.0%) still had hooks present (23 in the bill, throat or neck, 9 in the wing and one in the foot) (Tables 5 and 6).

Of the 143 birds from trawl vessels, most had been caught in the net or recovered in the pound or cod end (i.e. had drowned, n = 114, 79.7%) and were very wet and sandy with crush injuries (broken wings, broken chest, crushed organs etc.) (Tables 5 and 6). Other birds had injuries suggesting entanglement and crush injuries from the trawl warp and blocks (n = 26, 10.4%), 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 (66.7%) while almost only albatross taxa were affected by warp strikes (960%) exhibiting serious wing injuries or lacerations (Tables 5 and 6). There were four seabirds returned that had been killed by impacting the trawl vessel (1.6%) (Tables 5 and 6).

All 11 setnet birds were caught in the net with occasional damage to legs or bills (Table 5).

3.1.4 Body condition of necropsy seabirds

Between 1 July 2017 and 30 June 2018, 73.7% of returned birds had fat scores of less than 3, 14.3% of birds had fat scores of 3 and only 4.8% of birds had fat scores over 3 (Table 7).

Table 7 Fat scores of seabirds killed and returned from fishing vessels between 1 July 2017 and 30 June 2018 (1= no fat, to 5 = extremely fat; U = unknown).

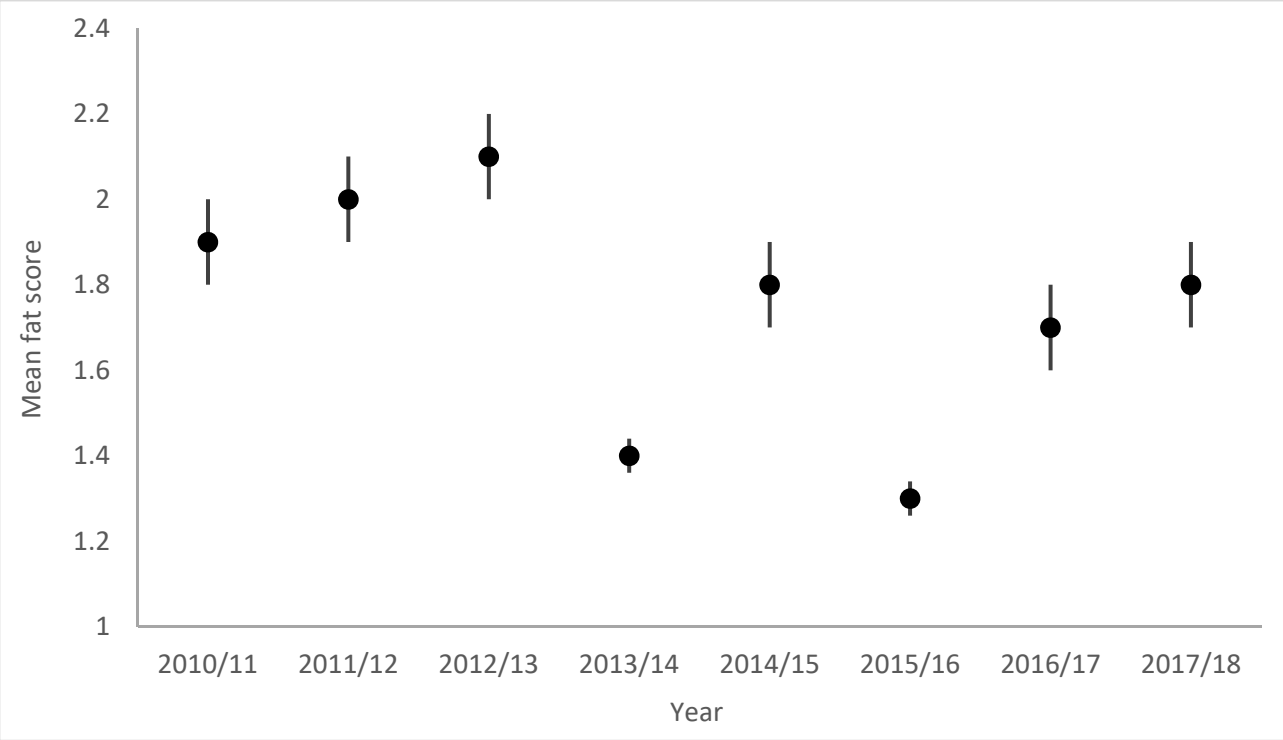
SPECIES	FAT SCORE						TOTAL	MEAN (±SE)
	1	2	3	4	5	U		
Black (Parkinson's) petrel	8						**8**	1.0 ± 0.0
Black-bellied storm petrel			1				**1**	3.0 ± 0.0
Buller's albatross	11	11	3	1	1	1	**28**	1.9 ± 0.2
Campbell albatross	1	2					**3**	1.7 ± 0.3
Cape petrel	1						**1**	1.0 ± 0.0
Common diving petrel	1	1	1				**3**	2.0 ± 0.6
Erect-crested penguin						1	**1**	
Fiordland crested penguin	1						**1**	1.0 ± 0.0
Flesh-footed shearwater	7	5					**12**	1.4 ± 0.2
Great-winged petrel	1						**1**	1.0 ± 0.0
Grey petrel	3					2	**5**	1.0 ± 0.0
NZ white-capped albatross	28	20	7	6		7	**68**	1.9 ± 0.1
Northern royal albatross	1						**1**	1.0 ± 0.0
Salvin's albatross	4	3	6	1			**14**	2.3 ± 0.3
Sooty shearwater	11	8	3		1		**23**	1.8 ± 0.2
Southern royal albatross	1	1	1				**3**	2.0 ± 0.6
Spotted shag	1						**1**	1.0 ± 0.0
Westland petrel	5	1	2				**8**	1.6 ± 0.3
White-chinned petrel	24	21	12	1	1	6	**65**	1.9 ± 0.1
White-faced storm petrel		1					**1**	2.0 ± 0.0
Yellow-eyed penguin	1	1				1	**3**	1.5 ± 0.5
TOTAL	**110**	**75**	**36**	**9**	**3**	**18**	**251**	**1.8 ± 0.1**
% TOTAL	**43.8%**	**29.9%**	**14.3%**	**3.6%**	**1.2%**	**7.2%**		

Eighteen birds (7.2%) could not have their fat scores confirmed due to damage (Table 7).

This suggests that the mean fat scores of returned birds between 1 July 2017 and 30 June 2018 (mean (± SE) = 1.8 ± 0.1) was slightly higher than the last two fishing years (2016/17 = 1.7 ± 0.1; 2015/16 = 1.3 ± 0.04) and the same as the 2014/15 fishing year (1.8 ± 0.1) (Bell, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017).

The mean fat score has fluctuated over the past eight years, mean fat scores steadily increased until 2012/13 and then have alternated between low and higher mean fat scores over the past five fishing years (Bell, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017; Figure 3).

Figure 4 The mean fat scores for all seabirds killed and returned in New Zealand fisheries, per fishing year, between 1 October 2010 and 30 June 2018.



3.1.5 Stomach and gizzard contents

Stomach contents were identified to main groups following a similar method to that used since 2009 (Thompson, 2009, 2010a, 2010b; Bell, 2011, 2012, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017).

In total, 65 birds (25.9%) had offal or discards in their stomachs and 20 birds (8.0%) had bait in their stomach (Table 8). In addition, 115 birds (45.8%) had empty stomachs. A further six birds (2.4%) had missing stomachs due to interaction with fishing gear or damage due to sea lice. The white-faced storm petrel had plastic in its stomach (listed as 'Other' in Table 8).

Most of the gizzard contents were natural food items (squid beaks 49.4%, fish bones and skin 27.9%, squid or fish eyeballs 13.1% and otoliths 18.3%), but 12.4% of the birds returned had also ingested plastic, metal or string and 2.4% had ingested stones or seeds (Table 9).

In addition, 39 birds (15.5%) had empty stomachs and five birds (2.0%) had missing gizzards due to damage by fishing gear or sea lice. Samples (e.g. squid beaks and otoliths) have been collected for detailed identification to species if required.

Photographs and samples of plastic content were also taken.

Table 8 Stomach contents of seabirds killed and returned from fishing vessels between 1 July 2017 and 30 June 2018.

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* = 251).

SPECIES	EMPTY	GONE[1]	BAIT[2]	OFFAL/DISCARDS[3]	NATURAL[4]	SLUDGE[5]	PROVENTRICULAR OIL	OTHER[6]
Black (Parkinson's) petrel	5		1		2			
Black-bellied storm petrel	1							
Buller's albatross	10		5	10	2	2	1	
Campbell albatross	1			2	1			
Cape petrel	1							
Common diving petrel	3					1		
Erect-crested penguin		1						
Fiordland crested penguin	1							
Flesh-footed shearwater	9		2			2		
Great-winged (grey-faced) petrel					1			
Grey petrel	1			3	3	1	3	1
NZ white-capped albatross	42	5	4	11	3	3		
Northern royal albatross						1		
Salvin's albatross	1			12	3	6		2
Sooty shearwater	9			8	3	6		
Southern royal albatross	1			2			1	
Spotted shag					1			
Westland petrel	1		2	2	4			
White-chinned petrel	28	1	6	15	6	13	3	2
White-faced storm petrel								1
Yellow-eyed penguin	2					1		
TOTAL	**115**	**6**	**20**	**65**	**29**	**36**	**8**	**6**
% TOTAL	**45.8%**	**2.4%**	**8.0%**	**25.9%**	**11.6%**	**14.3%**	**3.2%**	**2.4%**

[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.
[6] Seaweed, goose barnacles, plastic, worms or nylon cord

Table 9 Gizzard contents of seabirds killed and returned from fishing vessels between 1 July 2017 and 30 June 2018.
Note: Birds can have multiple items in the gizzard resulting in higher figures than the total number of seabirds killed and returned (*n* = 251).

SPECIES	EMPTY	GONE	SQUID BEAKS	OTOLITHS	FISH OR SQUID EYEBALLS	FISH BONES OR SKIN	PLASTIC, METAL OR STRING	SEEDS, STONES OR SHELL	WORMS	KRILL, FEATHERS, BARNACLES OR SEAWEED
Black (Parkinson's) petrel			7		1					
Black-bellied storm petrel						2				
Buller's albatross	7		4	5	7	16				2
Campbell albatross			1		1	1				
Cape petrel										1
Common diving petrel	3									
Erect-crested penguin										
Fiordland crested penguin										
Flesh-footed shearwater			9	2	1	1	10			
Great-winged (grey-faced) petrel			1							
Grey petrel			4	1	1				2	1
NZ white-capped albatross	21	4	17	10	13	19	2		1	1
Northern royal albatross			1	1	1					
Salvin's albatross			3	7	4	9				1
Sooty shearwater	6		8	5	3	2	7	1	1	
Southern royal albatross			3					2		
Spotted shag										
Westland petrel			8	3		4	3		1	
White-chinned petrel	2	1	58	12	1	14	8	3	4	2
White-faced storm petrel							1			
Yellow-eyed penguin						1				
TOTAL	**39**	**5**	**124**	**46**	**33**	**70**	**31**	**6**	**9**	**8**
% TOTAL	**15.5%**	**2.0%**	**49.4%**	**18.3%**	**13.1%**	**27.9%**	**12.4%**	**2.4%**	**3.6%**	**3.2%**

3.1.6 Identification of necropsy birds

Autopsy confirmed that the majority (82.5%) of the seabirds returned between 1 July 2017 and 30 June 2018 were identified correctly by the observers (based on the information provided by observers on the specimen tags) (Table 10).

Table 10 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 2017 and 30 June 2018.

Species	ID correct	ID wrong	ID to correct species group*	ID as seabird large or albatross*	ID as petrel or *Procellaria* unidentified*	ID not on label or code didn't exist	Total
Black (Parkinson's) petrel	7				1		**8**
Black-bellied storm petrel	1						**1**
Buller's albatross	19	1	8				**28**
Campbell albatross	2	1					**3**
Cape petrel			1				**1**
Common diving petrel	2	1					**3**
Erect-crested penguin	1						**1**
Fiordland crested penguin			1				**1**
Flesh-footed shearwater	11					1	**12**
Great-winged petrel	1						**1**
Grey petrel	4				1		**5**
NZ white-capped albatross	63	2	1	2			**68**
Northern royal albatross	1						**1**
Salvin's albatross	12	2					**14**
Sooty shearwater	19	4					**23**
Southern royal albatross		2	1				**3**
Spotted shag			1				**1**
Westland petrel	5		3				**8**
White-chinned petrel	56	3	3		3		**65**
White-faced storm petrel						1	**1**
Yellow-eyed penguin	3						**3**
Total	**207**	**16**	**19**	**2**	**5**	**2**	**251**
% Total	**82.5%**	**6.4%**	**7.6%**	**0.8%**	**2.0%**	**0.8%**	

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

Twenty-six (10.4%) 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). These included black petrel, Buller's albatross, cape petrel, Fiordland crested penguin, New Zealand white-capped albatross, spotted shag, Westland petrel and white-chinned petrel. A further 16 (6.4%) were identified incorrectly including the following species: Buller's albatross, Campbell albatross, common diving petrel, New Zealand white-capped albatross, Salvin's albatross, sooty shearwater, southern royal albatross and white-chinned petrel. Two birds (0.8%) did not have an observer identification code on the return label or had a code that did not exist (Table 10).

3.2 Photographs and Interactions

3.2.1 Numbers of photographed seabirds or those listed as interactions

In total 540 birds were either photographed and reported in the MPI COD extract as captured (both live and dead seabirds), photographed but not reported in the MPI COD extract or were recorded in

the MPI COD interacting with fishing vessels (this number may include some non-capture interactions) but not photographed between 1 July 2017 and 30 June 2018 (Table 11).

Table 11 Number of seabirds of each species reported as photographed or interacting with fishing vessels between 1 July 2017 and 30 June 2018.

Species	Photograph			Interaction	Total
	In COD extract & image	In COD extract, but image not received to date	Image received, but not in COD extract to date	In COD extract with no image	
Albatross (unidentified)				16	**16**
Antarctic prion	2				**2**
Black (Parkinson's) petrel	4			10	**14**
Buller's albatross	6			16	**22**
Buller's and Pacific albatross				8	**8**
Buller's shearwater				10	**10**
Campbell albatross	1				**1**
Cape petrels				3	**3**
Common diving petrel	3			8	**11**
Fairy prion				8	**8**
Flesh-footed shearwater	1			6	**7**
Fluttering shearwater				2	**2**
Great albatross (unidentified)				2	**2**
Great-winged (Grey-faced) petrel	14			5	**19**
Grey-backed storm petrel	1			1	**2**
Kerguelen petrel	1				**1**
Mid-sized petrel & shearwater (unidentified)				2	**2**
Mottled petrel	1				**1**
New Zealand white-capped albatross	38			42	**80**
Northern giant petrel				1	**1**
Pacific albatross				1	**1**
Penguin (unidentified)				2	**2**
Petrel (unidentified)				3	**3**
Petrels, prion and shearwaters (unidentified)				27	**27**
Prion (unidentified)				10	**10**
Procellaria petrel (unidentified)				6	**6**
Pterodroma petrel (unidentified)				1	**1**
Salvin's albatross	2			21	**23**
Seabird (small)				1	**1**
Shearwater (unidentified)				1	**1**
Shy albatross				1	**1**
Small albatross (unidentified)				3	**3**
Sooty shearwater	22			14	**36**
Southern royal albatross	2				**2**
Spotted shag				2	**2**
Storm petrel (unidentified)				9	**9**
Wandering albatross (unidentified)				2	**2**
Westland petrel				3	**3**
White-chinned petrel	119	4		52	**175**
White-faced storm petrel	4			8	**12**
White-headed petrel	7			1	**8**
Total	**228**	**4**	**0**	**308**	**540**
	232				

Table 12. Number of photograph and interaction seabirds recorded from observed fishing vessels between 1 July 2017 and 30 June 2018, by month of capture.

SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Albatross (unidentified)	2	3		1	6	2	1			1			**16**	3.0%
Antarctic prion		1										1	**2**	0.4%
Black (Parkinson's) petrel				1	6					2	4	1	**14**	2.6%
Buller's albatross	4			10	5	2	1						**22**	4.1%
Buller's and Pacific albatross					2	3	3						**8**	1.5%
Buller's shearwater	1								9				**10**	1.9%
Cape petrels	1												**1**	0.2%
Campbell albatross		1			1				1				**3**	0.6%
Common diving petrel			2		1	1			6		1		**11**	2.0%
Fairy prion	1	2	1				1	1		2			**8**	1.5%
Flesh-footed shearwater		1	1	2	1						2		**7**	1.3%
Fluttering shearwater									2				**2**	0.4%
Great albatross (unidentified)	1		1										**2**	0.4%
Great-winged (Grey-faced) petrel				9	5		2		2		1		**19**	3.5%
Grey-backed storm petrel		1			1								**2**	0.4%
Kerguelen petrel									1				**1**	0.2%
Mid-sized petrel & shearwater (unidentified)					1						1		**2**	0.4%
Mottled petrel					1								**1**	0.2%
New Zealand white-capped albatross	5	24	13	5	10	15	1				5	2	**80**	14.8%
Northern giant petrel											1		**1**	0.2%
Pacific albatross												1	**1**	0.2%
Penguin (unidentified)	1	1											**2**	0.4%
Petrel (unidentified)	2											1	**3**	0.6%
Petrels, prion and shearwaters (unidentified)			5		2				20				**27**	5.0%
Prion (unidentified)	2	2		2	1	1			2				**10**	1.9%
Procellaria petrel (unidentified)	1	1	1									3	**6**	1.1%
Pterodroma petrel (unidentified)						1							**1**	0.2%
Salvin's albatross	5			1	1		3		1	7		5	**23**	4.3%

SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Seabird (small)			1										**1**	0.2%
Shearwater (unidentified)			1										**1**	0.2%
Shy albatross	1												**1**	0.2%
Small albatross (unidentified)	1										1	1	**3**	0.6%
Sooty shearwater		4	12	10	5	1				3		1	**36**	6.7%
Spotted shag			1	1									**2**	0.4%
Southern royal albatross												2	**2**	0.4%
Storm petrel (unidentified)	1		1			1	1		1	2	2		**9**	1.7%
Wandering albatross (unidentified)	1		1										**2**	0.4%
Westland petrel		2	1										**3**	0.6%
White-chinned petrel	1	68	46	44	2					2	6	6	**175**	32.4%
White-faced storm petrel									7	2	1	2	**12**	2.2%
White-headed petrel		1			7								**8**	1.5%
TOTAL	**31**	**112**	**88**	**86**	**58**	**27**	**13**	**1**	**52**	**21**	**25**	**26**	**540**	
% TOTAL	5.7%	20.7%	16.3%	15.9%	10.7%	5.0%	2.4%	0.2%	9.6%	3.9%	4.6%	4.8%		

Of these, 308 had no photographs taken (a mixture of birds that were either released alive or discarded dead by the crew) and 232 seabird interactions that were photographed and had corresponding entries in the MPI COD extract (Table 11). **Of these 232 photograph birds, the images of 4 birds still need to be received by WMIL (Table 11); these will be updated when the images are obtained**.

Like the seabirds caught and returned for necropsy, the photograph and interaction seabirds were dominated by five species: Buller's albatross (n = 22, 4.1%), Salvin's albatross (n = 23, 4.3%), sooty shearwater (n = 36, 6.7%), New Zealand white-capped albatross (n = 80, 14.8%) and white-chinned petrel (n =175, 32.4%) (Table 12). These five species accounted for 62.2% of all reported interaction or photograph birds.

Like the necropsied seabirds, the monthly distribution of photograph and interaction seabirds was also not evenly spread across the fishing year with most birds being reported in February 2018 (n = 112, 20.7%), March 2018 (n = 88, 16.3%) or April 2018 (n = 86, 15.9%) (Table 12). This pattern reflects the timing of seabird breeding, presence within the New Zealand EEZ, timing and location of all observed fisheries, and observer coverage.

3.2.2 Target fishery and vessels of photographed or interaction seabirds

The seabirds that were photographed and listed in the MPI COD extract and discarded dead or released alive were caught in a range of Fishing Management Areas (FMA 1, 2, 3, 4, 5, 6, 7 and 9) and general positions are show in Figures 5 and 6.

The seabirds that were reported as an interaction in the MPI COD extract but not photographed were caught in a range of Fishing Management Areas (FMA 1, 3, 4, 5, 6, 7, 8 and 9) and general positions are show in Figures 7 and 8.

The 540 seabirds that were either photographed or recorded as an interaction were from 57 different vessels; ten on three set net vessels (1.9%), 71 on 14 longline vessels (13.1%) and 459 on 40 trawl vessels (85.0%) (Table 13).

Table 13 Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2017 and 30 June 2018 (with the number of individual vessels in parentheses).

		Photograph seabirds	Interaction Seabirds	Total
Longline vessels	**Bottom**	5 (2)	5 (5)	10 (6)
	Surface	7 (4)	7 (5)	14 (7)
	Unknown		47 (1)	47 (1)
Trawl vessels		217 (29)	242 (39)	459 (40)
Set net vessels		3 (2)	7 (3)	10 (3)
Total		**232 (37)**	**308 (53)**	**540 (57)**

For the fishing period 1 July 2017 to 30 June 2018, there were 308 observed trips on 127 vessels (Shannon Weaver, CSP DOC, pers. comm.). Fifty-seven vessels (44.9%) reported interactions (photographed and/or non-photographed) with seabirds (Table 13). Nearly half of these 57 vessels reported relatively low numbers of bird interactions (< 5 birds reported; n = 28, 49.1%) (Figure 9). There were 20 vessels (35.1%) that had interactions with 10 or more birds (Figure 9).

When combined with the seabirds that were caught and returned for necropsy, the number of vessels that had live and/or dead interactions with seabirds increased to 71 (55.9%) (Figure 10). Nearly half of these vessels reported low numbers of interactions or returned low numbers of seabirds (<5 birds; n = 32, 45.1%) (Figure 10). Twenty-seven vessels (38.0%) had more than 10 interactions or returned seabirds (Figure 10).

Figure 5 Individual catch locations of all seabirds caught and photographed in New Zealand fisheries between 1 July 2017 and 30 June 20187.

Note: catch location symbols 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.

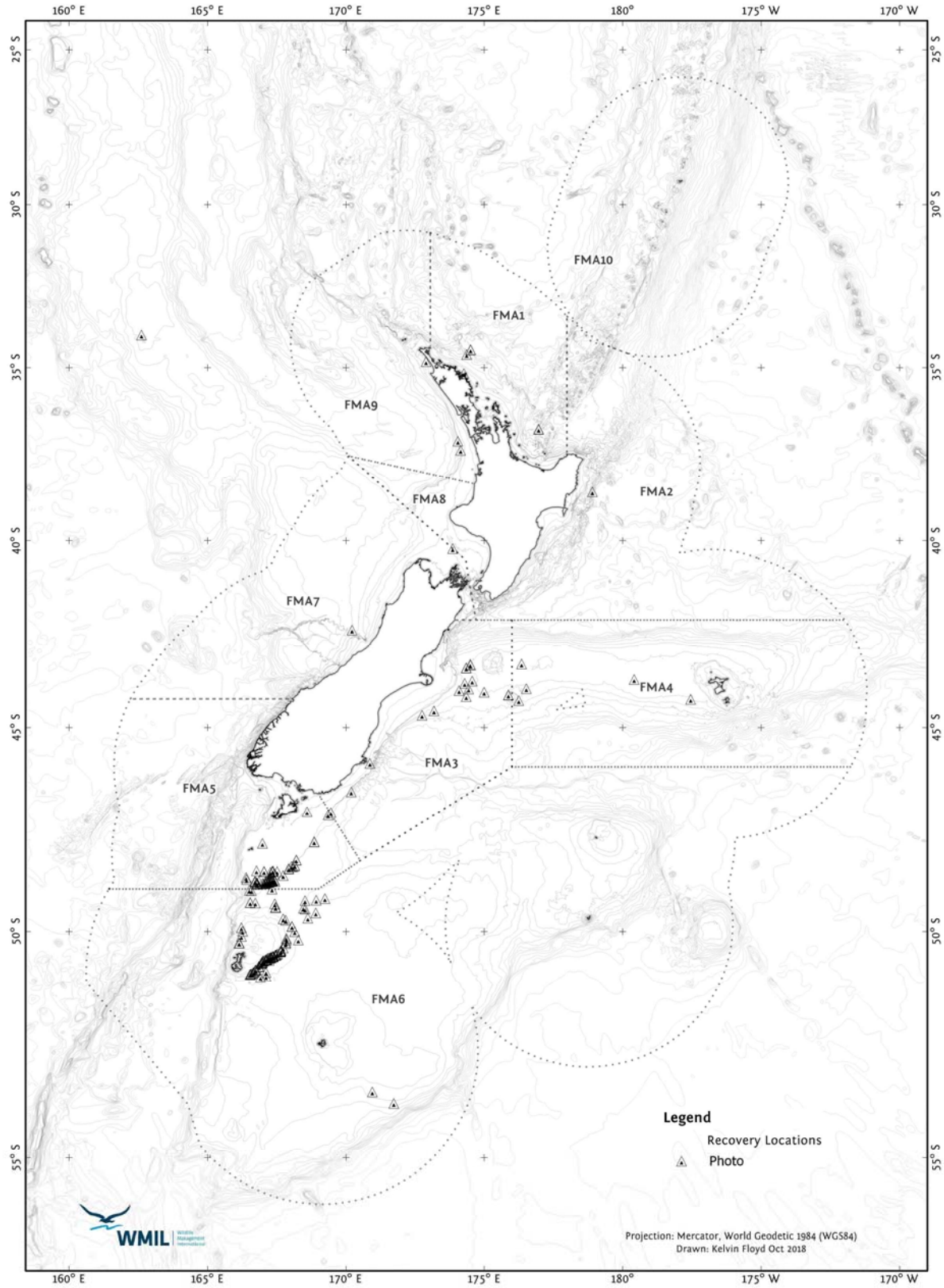


Figure 6 Grouped catch locations of all seabirds caught and photographed in New Zealand fisheries between 1 July 2017 and 30 June 20187.

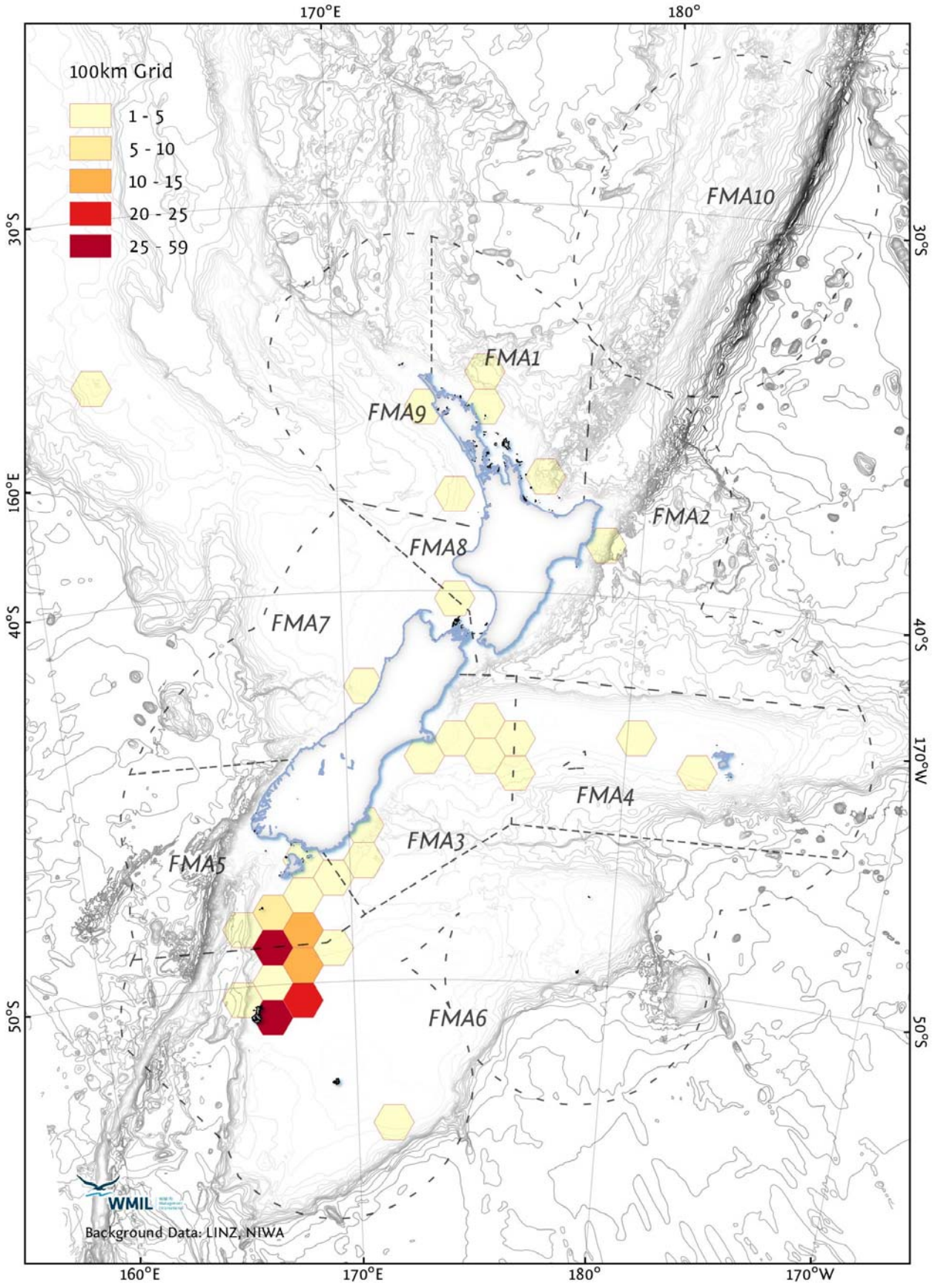


Figure 7 Individual catch locations of all seabirds reported as an interaction (and not photographed) in New Zealand fisheries between 1 July 2017 and 30 June 2018.

Note: catch location symbols 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.

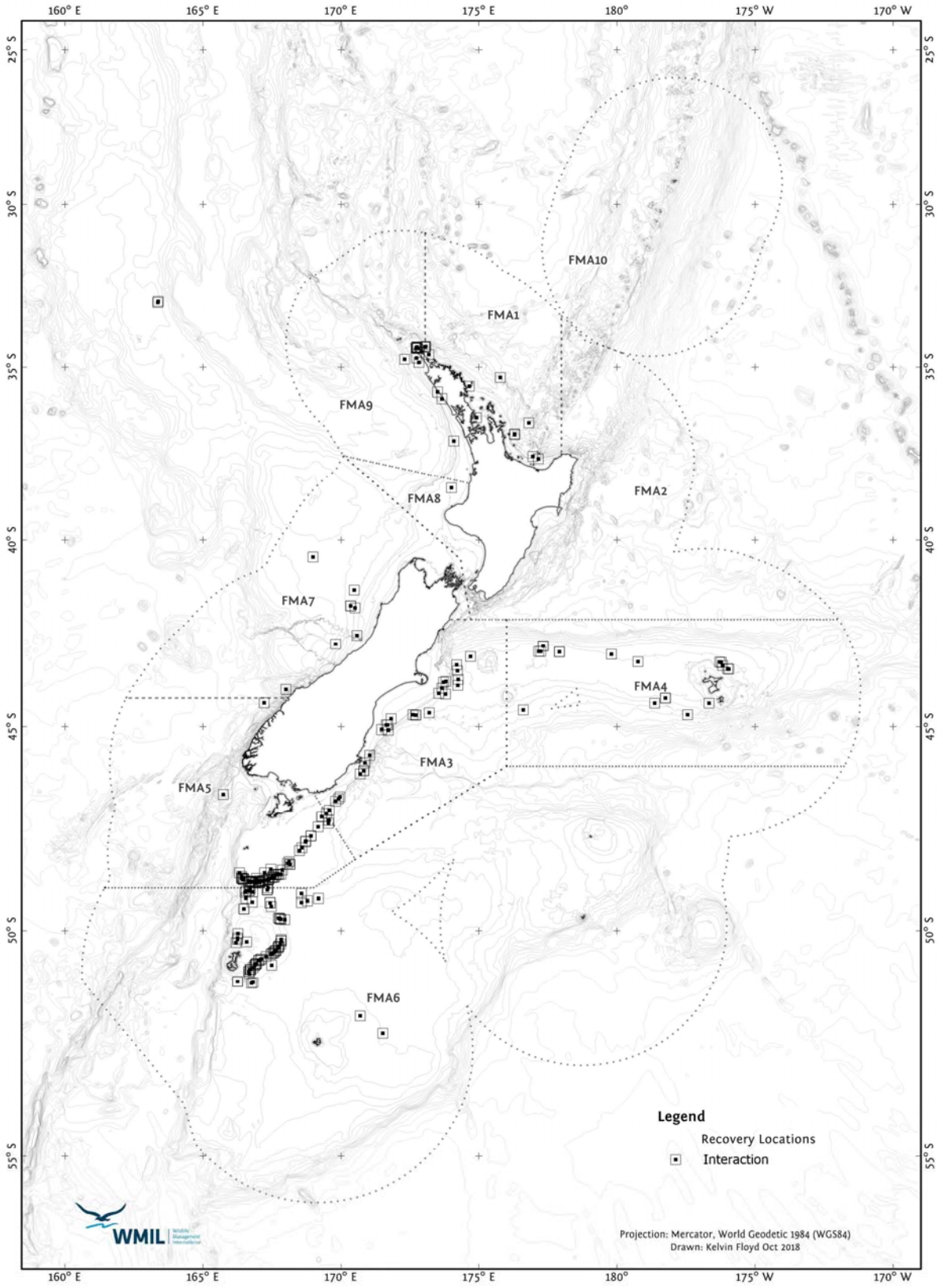


Figure 8 Grouped catch locations of all seabirds reported as an interaction (and not photographed) in New Zealand fisheries between 1 July 2017 and 30 June 2018.

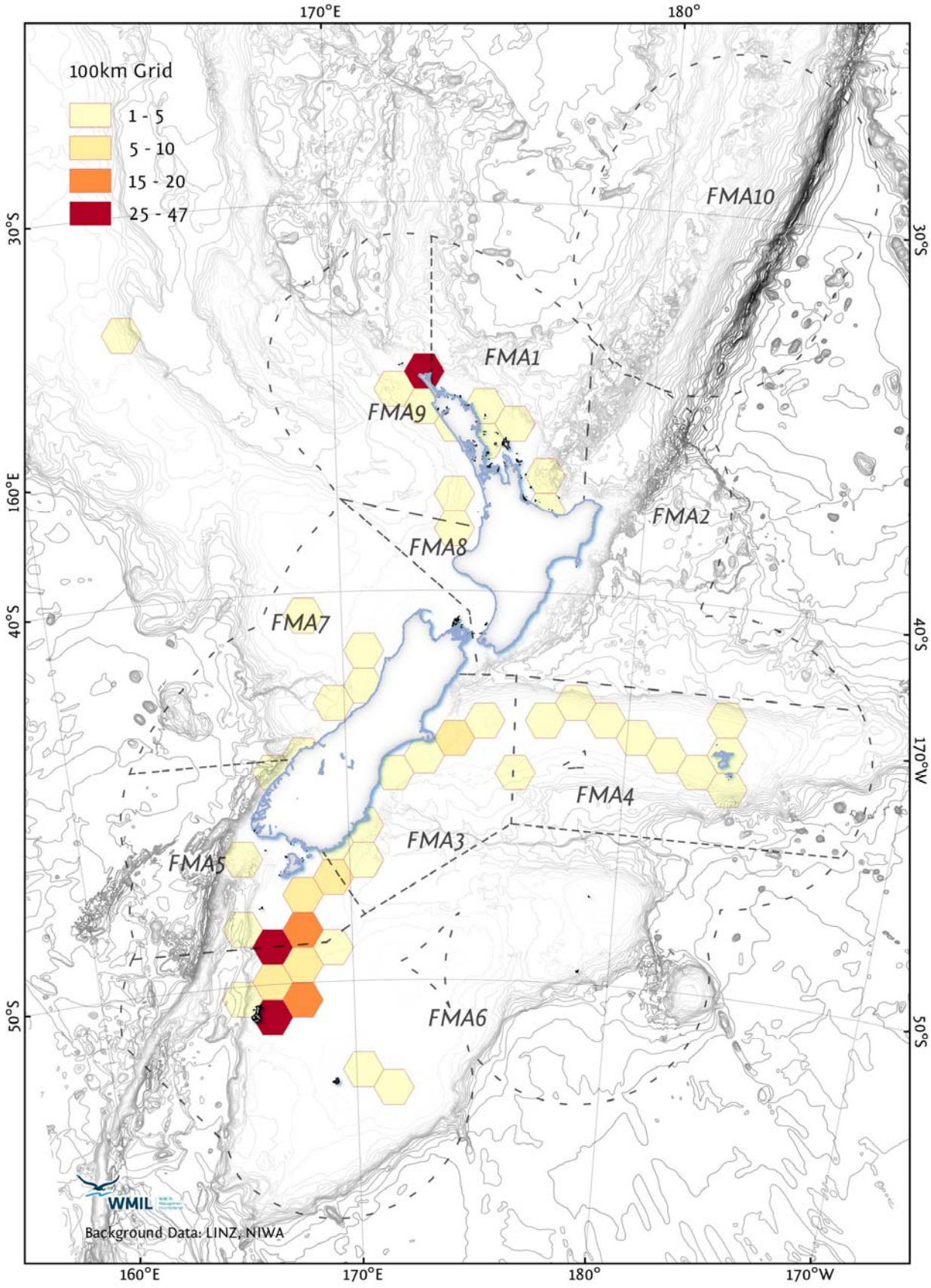


Figure 9 The number of seabird interactions (photographed and non-photographed live and dead birds) in New Zealand fisheries, and the number of trips for each observed vessel between 1 July 2017 and 30 June 2018.

Where ● is the number of observed trips by a trawl vessel, ● is the number of observed trips by a longline vessel and ● is the number of observed trips by a set net vessel, ● is the total number of photographed seabirds (both live and dead) by that vessel in all observed trips combined and ● is the total number of reported seabird interactions (both live and dead) by that vessel in all observed trips combined.

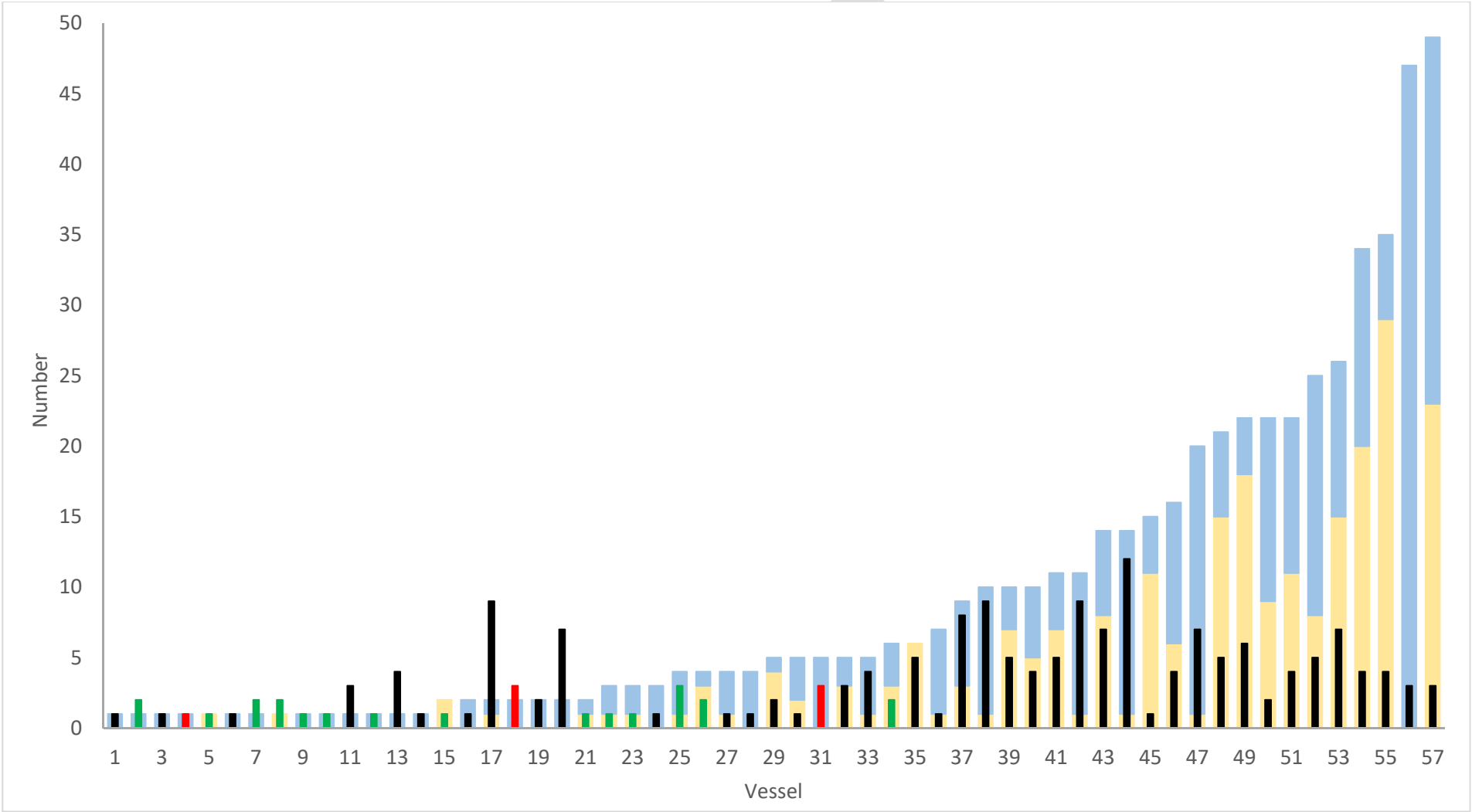
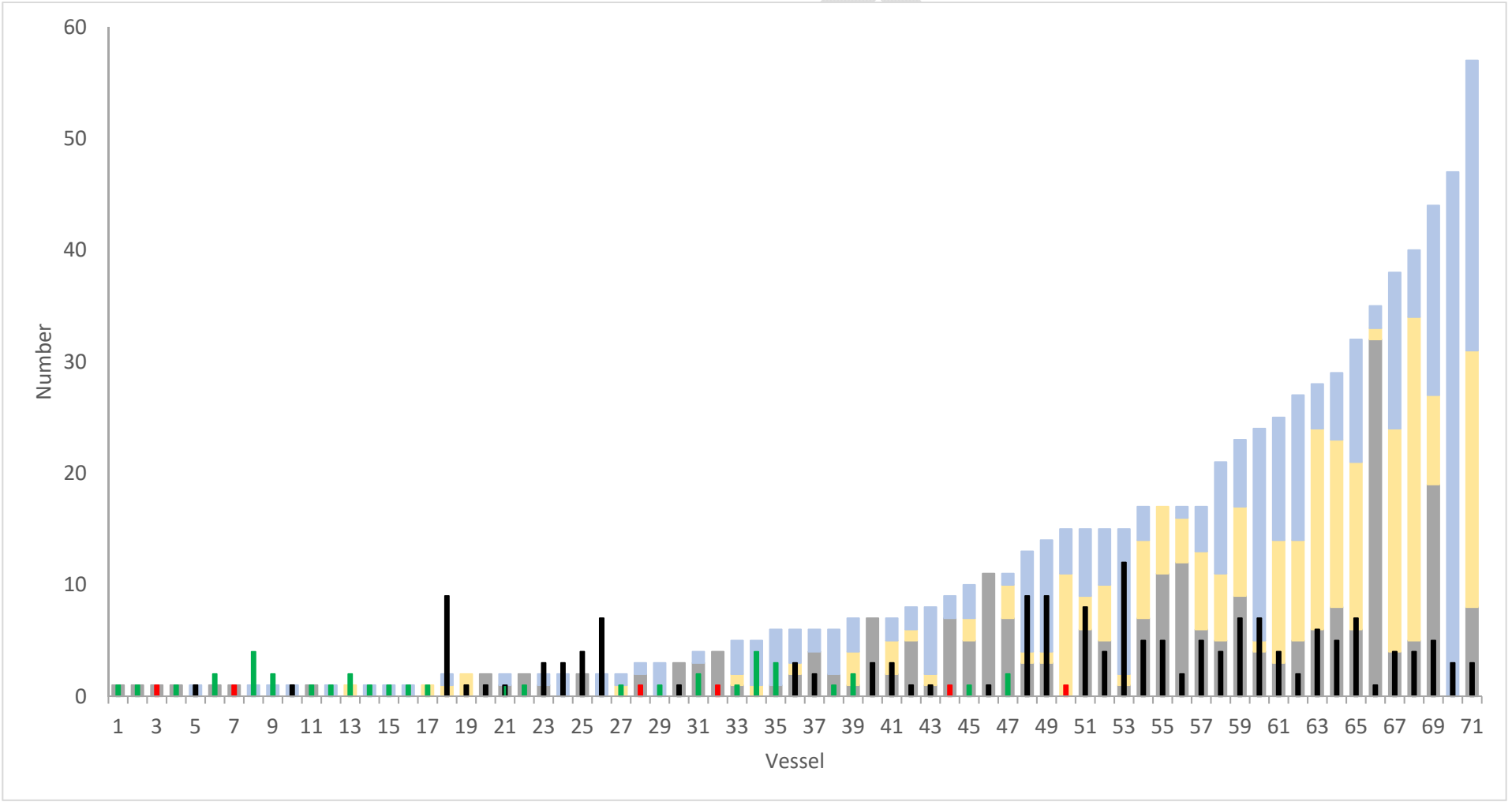


Figure 10 The number of seabirds caught and returned for necropsy, seabird interactions (live and dead birds, photographed and non-photographed) in New Zealand fisheries, and the number of trips for each observed vessel between 1 July 2017 and 30 June 2018.

Where ● is the number of observed trips by a trawl vessel, ● is the number of observed trips by a longline vessel and ● is the number of observed trips by a set net vessel, ● is the total number of caught and returned seabirds by that vessel in all observed trips combined ● is the total number of photographed seabirds (both live and dead) by that vessel in all observed trips combined and ● is the total number of reported seabird interactions (both live and dead) by that vessel in all observed trips combined.



3.2.3 Injuries of photographed or interaction seabirds

Two-thirds of these interaction or photographed birds represented live bird interactions (n = 359, 66.5%) (Table 14). Only 67 of the photographed birds were released alive (28.9%) compared to 489 interaction birds (95.1%) and most of these interaction birds were released by the crew prior to the Observer being able to photograph the birds (Table 14).

Table 14 Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2017 and 30 June 2018.

	Photograph seabirds	Interaction Seabirds	Total	% Total
Alive	67	292	**359**	66.5%
Dead	164	5	**169**	31.2%
Not recovered (alive)		1	**1**	0.2%
Not recovered (dead)	1	10	**11**	2.0 %
Total	**232**	**308**	**540**	

Eleven reported dead birds could not be recovered as they fell off the warp or hook prior to coming aboard (Tables 14 and 15). Four birds were released alive with a broken wing; it is unlikely that these bird will survive (Table 15).

Table 15 Types of injuries recorded on seabirds that were photographed or recorded as interactions from fisheries vessels between 1 July 2017 and 30 June 2018.

	Photograph		Interaction		Total			% Total
	Alive	Dead	Alive	Dead	Alive	Dead	All	
No visible injuries	51	24	212		**263**	**24**	**287**	53.1%
Disorientated	7		14		**19**		**19**	3.5%
Waterlogged	2	98	2		**4**	**98**	**102**	18.8%
Broken wing	1	16	4		**5**	**16**	**21**	3.9%
Broken neck		4				**4**	**4**	0.7%
Broken leg		1				**1**	**1**	0.2%
Hook (unspecified)		2				**2**	**2**	0.4%
Hook in bill or throat	1	3	2	1	**3**	**4**	**7**	1.3%
Hook in wing			3	1	**3**	**1**	**4**	0.7%
Hook in body			1		**1**		**1**	0.2%
Open wound	2	4	2		**4**	**4**	**8**	1.5%
Severed body part		5				**5**	**5**	0.9%
More than 3 injuries (crushed)		1				**1**	**1**	0.2%
Greased	4	1	29		**33**	**1**	**34**	6.3%
Liced		4				**4**	**4**	0.7%
Unknown (unable to assess)		1	24	13	**24**	**14**	**41**	7.6%
Total	**68**	**164**	**293**	**15**	**361**	**179**	**540**	
	232		**308**		**540**			

For the 232 seabirds that had been photographed, 68 were released alive (although some had injuries that is likely to cause death) and 164 died for a range of reasons (Table 15). Of the 164 dead birds, 127 were drowned in the trawl nets (52.7%), 7 were drowned on longline hooks (2.9%), ten died as results of warp strike (4.1%), two were drowned in the codend (of the trawl nets) (0.8%), 14 died on trawl vessels for other reasons (XX%) and three drowned is setnets (1.2%) (Table 16).

For the 15 seabirds that were recorded dead following an interaction (but not photographed) with the fishing vessel, eight were drowned in the trawl nets and fell off before coming onboard (53.3%), one died after being tangled in the tori line and fell off before coming onboard (6.7%), three were drowned on longline hooks but fell off the hooks before coming onboard (20.0%) and three could not be recovered after falling off the warp (20.0%).

Table 16 Number of seabirds of each species that were photographed after vessel interaction from commercial fisheries between 1 July 2017 and 30 June 2018, by likely cause of death. The proportion of albatross and non-albatross taxa returned is also presented.

Species	Longline					Trawl									Setnet	Total
	Hook			Tangled	Vessel strike	Warp		Net		Codend		Other		Vessel strike		
	Bill		Not obvious	Alive	Alive	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	
	Alive	Dead	Dead													
Antarctic prion														2		**2**
Black petrel		3												1		**4**
Buller's albatross								2	1				2	1		**6**
Campbell albatross									1							**1**
Common diving petrel														3		**3**
Flesh-footed shearwater				1												**1**
Great-winged petrel														14		**14**
Grey-backed storm petrel														1		**1**
Kerguelen petrel					1											**1**
Mottled petrel														1		**1**
NZ white-capped albatross						1	9	2	18	1		1	2	4		**38**
Salvin's albatross									1					1		**2**
Sooty shearwater									17				4	1		**22**
Southern royal albatross	1													1		**2**
White-chinned petrel			4				1	14	89		2		5	5	3	**123**
White-faced storm petrel														4		**4**
White-headed petrel														7		**7**
Total	**1**	**3**	**4**	**1**	**1**	**1**	**10**	**18**	**127**	**1**	**2**	**1**	**13**	**46**	**3**	**232**
% Total	**0.4%**	**1.2%**	**1.7%**	**0.4%**	**0.4%**	**0.4%**	**4.1%**	**7.5%**	**52.7%**	**0.4%**	**0.8%**	**0.4%**	**5.4%**	**19.1%**	**1.2%**	
Total (each type)	**10**					**219**									**3**	
% of total longline or trawl	**10%**	**30%**	**40%**	**10%**	**10%**	**0.5%**	**4.6%**	**8.2%**	**58.3%**	**0.5%**	**0.9%**	**0.5%**	**5.9%**	**21.%**		
Albatrosses (%)	**100%**					**100%**	**90%**	**22.2%**	**16.5%**	**100%**		**100%**	**30.7%**	**15.2%**		
Non-albatross (%)		**100%**	**100.0%**	**100%**	**100%**		**10%**	**77.8%**	**83.5%**		**100%**		**69.3%**	**84.7%**	**100.0%**	

There were a range of injuries on the interaction and photographed birds as shown in Tables 15 and 16. Most of the birds (n = 287, 53.1%) had no visible injuries and most of these birds were released alive (n = 261, 90.1%).

There were 40 interaction birds (12.9%) and one photographed birds (0.4%) that could not have injuries assessed by the observer as these birds had been released or discarded by the crew or had fallen overboard before retrieval (Table 15).

3.2.4 Identification of photographed seabirds

There were 17 different seabird taxa that had been photographed by the Observers (Tables 11 and 16). **There are still 4 photographs for this time period still to be provided (Tables 11 and 16); these species will be confirmed when the images and updated COD extract has been received.**

Examination of the 232 photographed seabird interactions confirmed that observers had accurately identified 89.7% (n = 208) of seabirds (Table 17). It should be noted that most specimens were grey-faced (great-winged) petrel, New Zealand white-capped albatross, sooty shearwaters and white-chinned petrels which are relatively easy to identify.

Table 17 Comparison of 241 observer identifications with expert identifications for observed and photographed captures listed in COD from fishing vessels between 1 July 2016 and 30 June 2017, by species.

Where: '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 (i.e. observer identified the species incorrectly).

Species	Confirmed	New, consistent	New, not consistent	To be confirmed when image and/or COD extract received	Total
Antarctic prion		1	1		**2**
Black (Parkinson's) petrel	3	1			**4**
Buller's albatross	5		1		**6**
Campbell albatross	1				**1**
Common diving petrel	2		1		**3**
Flesh-footed shearwater	1				**1**
Great-winged petrel	14				**14**
Grey-backed storm petrel	1				**1**
Kerguelen petrel			1		**1**
Mottled petrel			1		**1**
NZ white-capped albatross	36		2		**38**
Salvin's albatross	2				**2**
Sooty shearwater	20	2			**22**
Southern royal albatross	1	1			**2**
White-chinned petrel	115	2	2	4	**123**
White-faced storm petrel	1	1	2		**4**
White-headed petrel	6		1		**7**
Total	**208**	**8**	**12**	**4**	**241**
% Total	**89.7%**	**3.4%**	**5.2%**	**1.7%**	

An Antarctic prion, Buller's albatross, common diving petrel, Kerguelen petrel, mottled petrel, two New Zealand white-capped albatross, two white-chinned petrel, two white-faced storm petrels and one white-headed petrel were incorrectly identified (n= 12, 5.2%; Table 16).

3.2.5 Quality and number of photographs

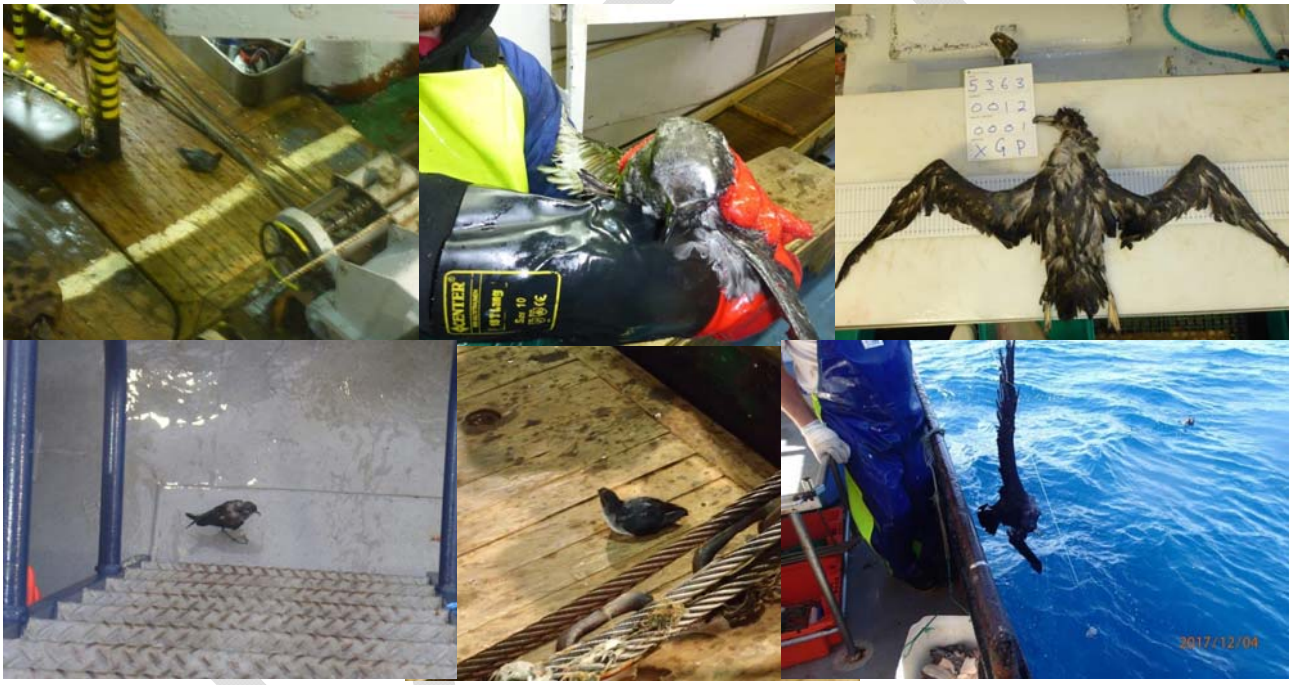
The quality of the images obtained by observers continued to vary widely, particularly for live birds (Figure 8). Video footage is also now being received as well as still imagery.

Photography of dead birds continues to improve with a number of images being taken for most of the dead specimens.

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 on-board for short periods (particularly when photographs were taken from a long distance).

Figure 11 Range of images received from Government observers for seabird interactions recorded between 1 July 2017 and 30 June 2018.



3.2.6 Recommendations for photograph 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. This is particularly important for dead birds.
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 (i.e. number of images, type of images, date and time stamps etc.) is provided for all observers.

4. ACKNOWLEDGMENTS

This work was funded through the Conservation Services Programme (INT2016-02), Department of Conservation. This autopsy and photo-identification work would not have been possible without the dedication of Ministry for 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 on-board). Kristopher Ramm and Shannon Weaver provided the link between Wildlife Management International Ltd, the Department of Conservation and the Ministry for Primary Industries Observer Programme and helped provide clarification on any discrepancies with autopsy tag data and photograph records. Kelvin Floyd (WMIL) developed and maintained the WMIL autopsy and photo-identification database and produced all maps.

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