



INT2016-02: IDENTIFICATION OF SEABIRDS CAPTURED IN NEW ZEALAND FISHERIES: 1 JULY 2018 to 30 June 2019



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Cover image: Image of sooty shearwater interaction (deck landing) provided by Shane Hart (MPI/DOC Government Observer), 28 March 2019.

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 2018 and 30 June 2019, a total of 247 seabirds comprising 23 taxa were incidentally killed as bycatch and returned for necropsy by on-board New Zealand Government observers. Birds were returned from 16 longline (n = 66 birds), 37 trawl (n = 173 birds) and five set net (n = eight birds) vessels and were dominated numerically by six species: Westland petrel (n = 10, 4%), Salvin's albatross (n = 11, 4.5%), Buller's albatross (n = 34, 13.8%), sooty shearwater (n = 36, 13.8%), white-chinned petrel (n = 59, 23.9%) and New Zealand white-capped albatross (n = 61, 24.7%) (Table 2). These six species accounted for 85.4% of all returns. All birds returned from longline fisheries had injuries consistent with being hooked or entangled in the bill, throat or wing. In contrast, most birds (81.5%) returned from trawl fisheries were killed through entanglement in the net, cod-end or pound, with 16.8% likely to have been killed by warp interaction or entanglement. Three birds were killed by striking the deck of the trawl vessel. Birds had 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 necropsy, examination of the Ministry for Primary Industries Central Observer Database (COD) and images provided by Government observers gave a total of a further 417 seabirds that were reported as interactions or photographed (as dead or alive captures) aboard 58 fishing vessels (and may include some non-capture interactions). Half (51.8%) of the seabirds reported in these interactions were released alive. Out of these 417 records of seabird interactions, photographs were taken of 223 seabirds consisting of 20 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.

Keywords: commercial fishing, seabirds, necropsy, 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, a necropsy 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 necropsy. 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 necropsies

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 2018 and 30 June 2019. 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 necropsy 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 Necropsy

The necropsy methods followed those described by Bartle (2000) and used in necropsies 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, 2018). 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 necropsy, 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 necropsy 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 2018 and 30 June 2019.

COMMON NAME	SCIENTIFIC NAME	NECROPSY	PHOTO	INTERACTION
Albatross (unidentified)			✓	✓
Antipodean albatross	<i>Diomedea antipodensis antipodensis</i>	✓		
Black (Parkinson's) petrel	<i>Procellaria parkinsoni</i>	✓	✓	✓
Black-backed gull	<i>Larus dominicanus</i>		✓	
Black-browed albatross (unidentified)	<i>Thalassarche spp.</i>			✓
Buller's albatross	<i>Thalassarche bulleri bulleri</i>	✓	✓	✓
Buller's or Pacific albatross (unidentified)	<i>Thalassarche spp.</i>		✓	✓
Buller's shearwater	<i>Puffinus bulleri</i>			✓
Campbell albatross	<i>Thalassarche impavida</i>	✓		
Cape petrels (unidentified)	<i>Daption spp.</i>			✓
Chatham albatross	<i>Thalassarche eremita</i>	✓	✓	✓
Common diving petrel	<i>Pelecanoides urinatrix</i>	✓		✓
Fairy prion	<i>Pachyptila turtur</i>	✓	✓	✓
Fiordland crested penguin	<i>Eudyptes pachyrhynchus</i>	✓		
Flesh-footed shearwater	<i>Puffinus carneipes</i>	✓	✓	
Giant petrel (unidentified)	<i>Macronectes spp.</i>			✓
Gibson's albatross	<i>Diomedea antipodensis gibsoni</i>	✓		
Great albatross (unidentified)	<i>Diomedea spp.</i>			✓
Great-winged (grey-faced) petrel	<i>Pterodroma macroptera</i>		✓	✓
Grey petrel	<i>Procellaria cinerea</i>	✓	✓	✓
Grey-backed storm petrel	<i>Garrodia nereis</i>	✓	✓	✓
Little blue penguin	<i>Eudyptula minor</i>			✓
Mid-sized petrel and shearwater (unidentified)				✓
Mottled petrel	<i>Pterodroma inexpectata</i>	✓		
NZ white-capped albatross	<i>Thalassarche steadi</i>	✓	✓	✓

COMMON NAME	SCIENTIFIC NAME	NECROPSY	PHOTO	INTERACTION
Otago shag	<i>Leucocarbo chalconotus</i>	✓		
Petrel (unidentified)				✓
Petrels, prion and shearwaters (unidentified)				✓
Prion (unidentified)	<i>Pachyptila</i> spp.			✓
Procellaria petrel (unidentified)	<i>Procellaria</i> spp.		✓	✓
Salvin's albatross	<i>Thalassarche salvini</i>	✓	✓	✓
Seabird (small)				✓
Shag (unidentified)				✓
Shearwater (unidentified)	<i>Puffinus</i> spp.			
Shy albatross	<i>Thalassarche cauta</i>			✓
Small albatross (unidentified)	<i>Thalassarche</i> spp.			✓
Sooty shearwater	<i>Puffinus griseus</i>	✓	✓	✓
Southern royal albatross	<i>Diomedea epomophora</i>	✓	✓	✓
Spotted shag	<i>Phalacrocorax punctatus</i>	✓		
Stewart Island shag (Foveaux shag)	<i>Leucocarbo stewarti</i>	✓		
Storm petrel (unidentified)				✓
Wandering albatross (unidentified)	<i>Diomedea exulans</i> spp.	✓		
Wandering (Snowy) albatross	<i>Diomedea exulans</i>		✓	
Westland petrel	<i>Procellaria westlandica</i>	✓	✓	✓
White-chinned petrel	<i>Procellaria aequinoctialis</i>	✓	✓	✓
White-faced storm petrel	<i>Pelagodroma marina</i>			✓
White-headed petrel	<i>Pterodroma lessonii</i>		✓	
TOTAL		247	223	194
			664	

Each specimen was allocated a unique necropsy number and photographed. This number, along with the information on the observer specimen tag and all other information collected during necropsy 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 necropsy. This covered live captures, mortalities where a specimen was not returned for necropsy (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 Necropsy

3.1.1 Returned seabirds

A total of 247 seabirds comprising 23 taxa were returned from 58 vessels between 1 July 2018 and 30 June 2019 (Table 2, Figure 1).

Seabirds returned were dominated by six species: Westland petrel ($n = 10$, 4%), Salvin's albatross ($n = 11$, 4.5%), Buller's albatross ($n = 34$, 13.8%), sooty shearwater ($n = 36$, 13.8%), white-chinned petrel ($n = 59$, 23.9%) and New Zealand white-capped albatross ($n = 61$, 24.7%) (Table 2). These six species accounted for 85.4% of all returns. Of the remaining 18 taxa, ten had only single captures, one had two captures, two had three captures, two had four captures and two had five captures (Table 2).

There was a banded bird within those captured and returned between 1 July 2018 and 30 June 2019. One male NZ white-capped albatross had a uniquely numbered metal band (O29544) and white darvic band (497) and had been banded as an adult on Disappointment Island in the Auckland Islands on 5 February 2019. 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 February 2019 ($n = 42$, 17%), March 2019 ($n = 40$, 16.2%), May 2019 ($n = 30$, 12.1%) and June 2019 ($n = 29$, 11.7%) (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 2018 and 30 June 2019, by month of capture.

SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Antipodean albatross												5	5	2.0%
Black (Parkinson's) petrel	1	1										2	4	1.6%
Buller's albatross		1	3	5	5	14	4	1				1	34	13.8%
Campbell albatross									1				1	0.4%
Chatham Island albatross							1		1	1		1	4	1.6%
Common diving petrel		1											1	0.4%
Fairy prion							1						1	0.4%
Fiordland crested penguin									1				1	0.4%
Flesh-footed shearwater		1			1						1		3	1.2%
Gibson's albatross												1	1	0.4%
Grey petrel							1	1	3				5	2.0%
Grey-backed storm petrel					1								1	0.4%
Mottled petrel					1								1	0.4%
NZ white-capped albatross	7	10	11	5	16	9	1	1			1		61	24.7%
Otago shag		2										1	3	1.2%
Salvin's albatross	1						1		2	2	4	1	11	4.5%
Sooty shearwater	5	9	11	6	2					2	1		36	14.6%
Southern royal albatross										1			1	0.4%
Spotted shag						1					1		2	0.8%
Stewart Island shag (Foveaux shag)			1										1	0.4%
Wandering albatross (unidentified)									1				1	0.4%
Westland petrel					2	5			1	1	1		10	4.0%
White-chinned petrel	8	17	14	11	2					2	5		59	23.9%
TOTAL	22	42	40	27	30	29	9	3	10	9	14	12	247	
% TOTAL	8.9%	17.0%	16.2%	10.9%	12.1%	11.7%	3.6%	1.2%	4.0%	3.6%	5.7%	4.9%		

Table 3 Species and numbers of seabirds killed and returned from observed fishing vessels between 1 July 2018 and 30 June 2019, 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		
Antipodean albatross	1	4		3				2			5	2.0%
Black (Parkinson's) petrel	3	1		4	4						4	1.6%
Buller's albatross	19	14	1	34	24						34	13.8%
Campbell albatross	1			1		1					1	0.4%
Chatham Island albatross	4			4	4						4	1.6%
Common diving petrel	1			1							1	0.4%
Fairy prion	1			1	1						1	0.4%
Fiordland crested penguin		1		1	1						1	0.4%
Flesh-footed shearwater	3			3	1						3	1.2%
Gibson's albatross	1			1		1					1	0.4%
Grey petrel	5			5	4	1					5	2.0%
Grey-backed storm petrel	1			1		1					1	0.4%
Mottled petrel	1				1				1		1	0.4%
NZ white-capped albatross	32	24	5	56	22	26	1	3		1	61	24.7%
Otago shag	3			2		1		1			3	1.2%
Salvin's albatross	6	5		10	10		1				11	4.5%
Sooty shearwater	30	5	1	34	11		1		1		36	14.6%
Southern royal albatross	1			1							1	0.4%
Spotted shag		2		2							2	0.8%
Stewart Island shag (Foveaux shag)		1						1			1	0.4%
Wandering albatross (unidentified)			1							1	1	0.4%
Westland petrel	6	4		10	9	1					10	4.0%
White-chinned petrel	44	12	3	58	28	4				1	59	23.9%
TOTAL	163	73	11	232	120	36	3	7	2	3	247	
% TOTAL	66.0%	29.6%	4.5%	93.9%	51.7%	15.5%	1.2%	2.8%	0.8%	1.2%		

The majority of birds were males (n = 163, 66%, Table 3). Campbell albatross, Chatham albatross, common diving petrel, fairy prion, flesh-footed shearwater, Gibson's albatross, grey petrel, grey-backed storm petrel, mottle petrel, Otago shag and southern royal albatross returned only males. However, Antipodean albatross, Fiordland crested penguin, spotted shag and Stewart Island (Foveaux) shag had only female returns. Most birds were adults (n = 232, 93.9%) (Table 3). Of these adults, 120 (51.7%) were breeding and 36 (15.5%) were non-breeding (Table 3). Twelve birds (4.8%) 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 shown in Figures 1 and 2.

For the fishing period 1 July 2018 to 30 June 2019, there were 273 observed trips on 116 vessels (Shannon Weaver, CSP DOC, pers. comm.). Fifty-eight vessels (50%) returned birds during this period. Over half of these 58 vessels returned relatively low numbers of birds (< 5 birds caught and returned; n = 36, 62.1%) (Figure 3). Seven vessels caught 10 or more birds (Figure 3). Of these seven vessels, one surface longliner caught and returned 14 birds from one observed trip and one bottom longliner caught and returned 14 birds from one out of two observed trips. Two other surface longline vessels caught and returned nine birds from one observed trip and a trawler caught and returned nine birds from one out of three observed trips as shown in Figure 3.

Fifty-eight vessels did not return any dead seabirds from 116 observed trips during this fishing year (Shannon Weaver, CSP DOC, pers. comm.). From 58 vessels that did catch and return birds, the average was 4.3 birds (± 0.5) caught and returned from 3.2 observed trips (± 0.3) per vessel.

Of the 58 vessels that caught and returned seabirds, 16 were longline vessels (27.5%; 10 bottom and 6 surface longline vessels), five were set-net vessels (8.6%) and 37 were trawlers (63.8%) (Table 4).

Longline vessels returned a total of 66 seabirds (26.7% of total returns; bottom longline n = 29, 11.7% and surface longline n = 37, 15%), with vessels targeting tuna *Thunnus* spp. accounting for 54.5% of longline specimens (n = 36) and those targeting snapper *Centroberyx affinis* accounting for 3% of longline specimens (n = 2) and the remainder targeting 'other' species (mainly ling *Genypterus blacodes*, swordfish *Xiphias gladius* or bluenose *Hyperoglyphe antarctica*) accounting for 42.4% of longline specimens (n = 28) (Table 4).

Bottom and midwater trawl fisheries combined returned 173 birds (70% of total returns), with trawlers targeting squid *Nototodarus* spp. accounting for 61.3% (n = 106) of all trawl returns, trawlers targeting hoki *Macruronus novaezelandiae* accounting for 16.2% (n = 28), trawlers targeting ling accounting for 2.9% (n = 5), trawlers targeting scampi *Metanephrops challengerii* accounting for 2.9% (n = 5) and trawlers targeting 'other' species accounting for 16.2% (n = 28) (Table 4). The 'other' species included barracouta *Thyrstites atun*, orange roughy *Hoplostethus atlanticus*, jack mackerel *Trachurus* spp., trevally *Pseudocaranx georgianus*, silver warehou *Seriola punctata* and southern blue whiting *Micromesistius australis*.

Eight seabirds were caught and killed on set net vessels (3.2% of total returns), with vessels targeting school sharks (*Galeorhinus galeus*) and other shark species accounting for 62.5% of all set-net returns (n = 5) and those targeting 'other' species (mainly butterflyfish *Odax pullus* or elephant fish *Callorhynchus milii*) accounting for 37.5% of all set-net returns (n = 3) (Table 4).

Figure 1 Individual catch locations of all seabirds killed and returned in New Zealand fisheries for necropsy between 1 July 2018 and 30 June 2019.

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).

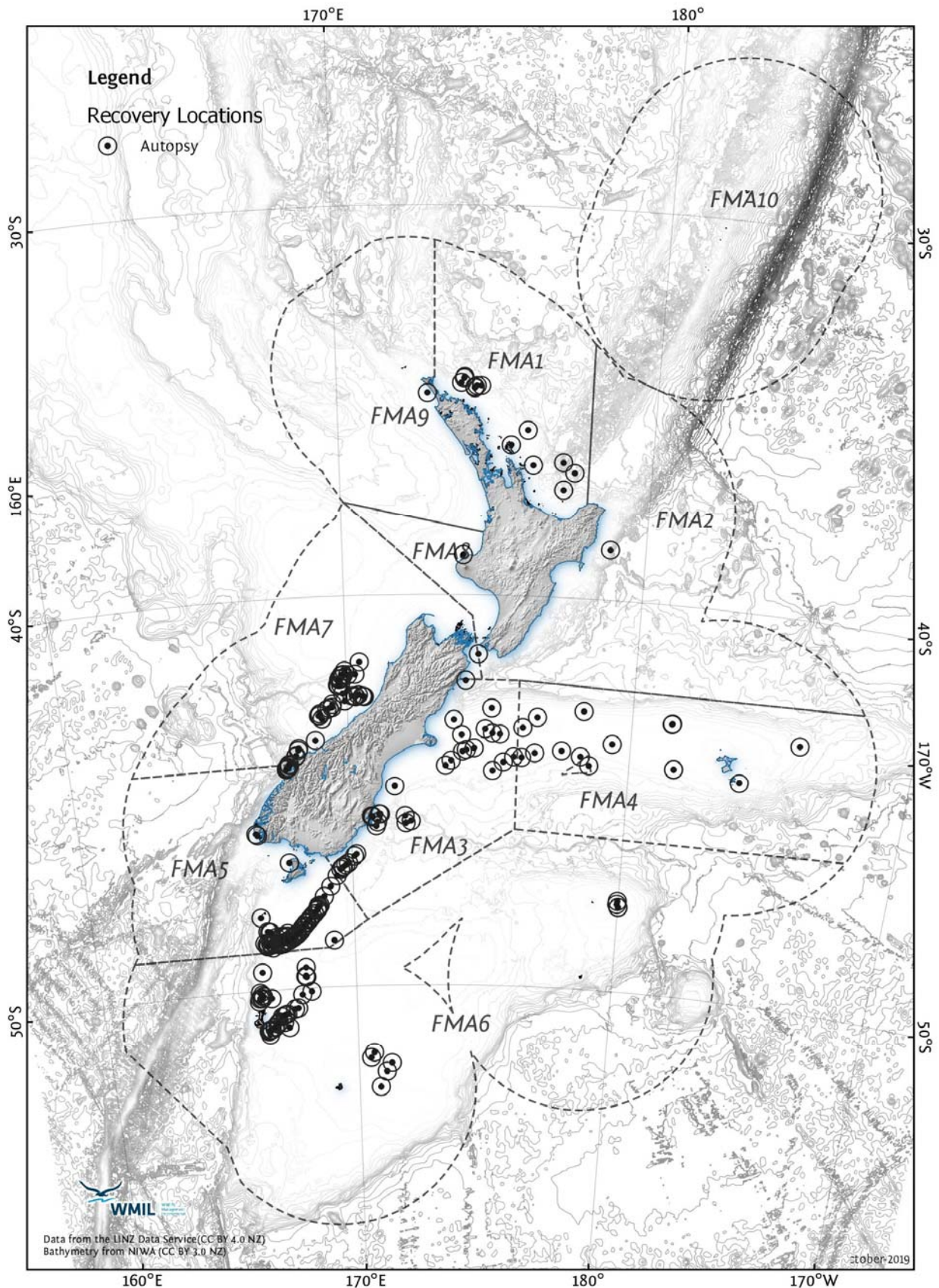


Figure 2 Grouped catch locations of all seabirds killed and returned in New Zealand fisheries for necropsy between 1 July 2018 and 30 June 2019.

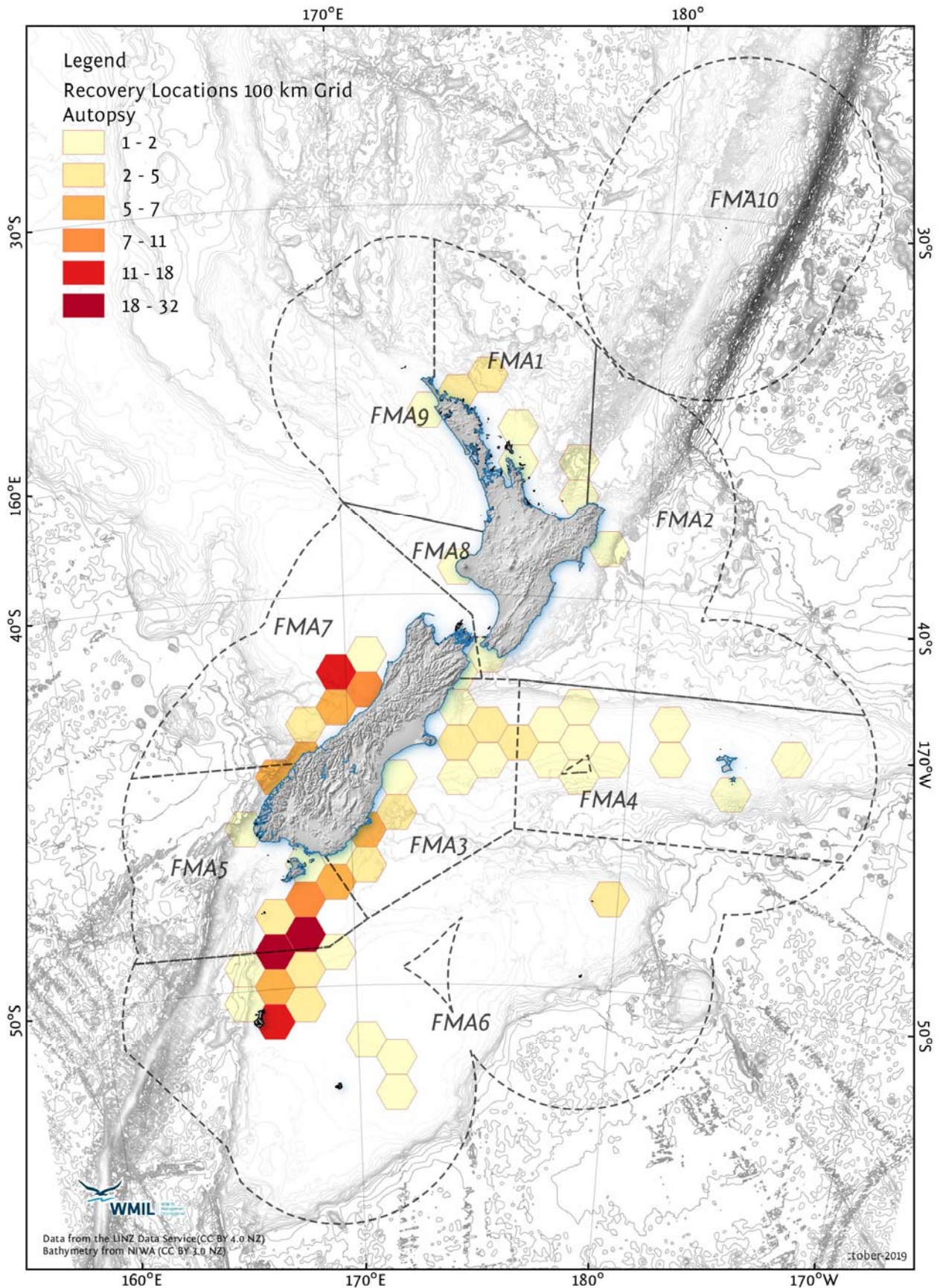


Figure 3 The number of seabirds killed and returned in New Zealand fisheries, and the number of trips for each observed vessel between 1 July 2018 and 30 June 2019.

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.

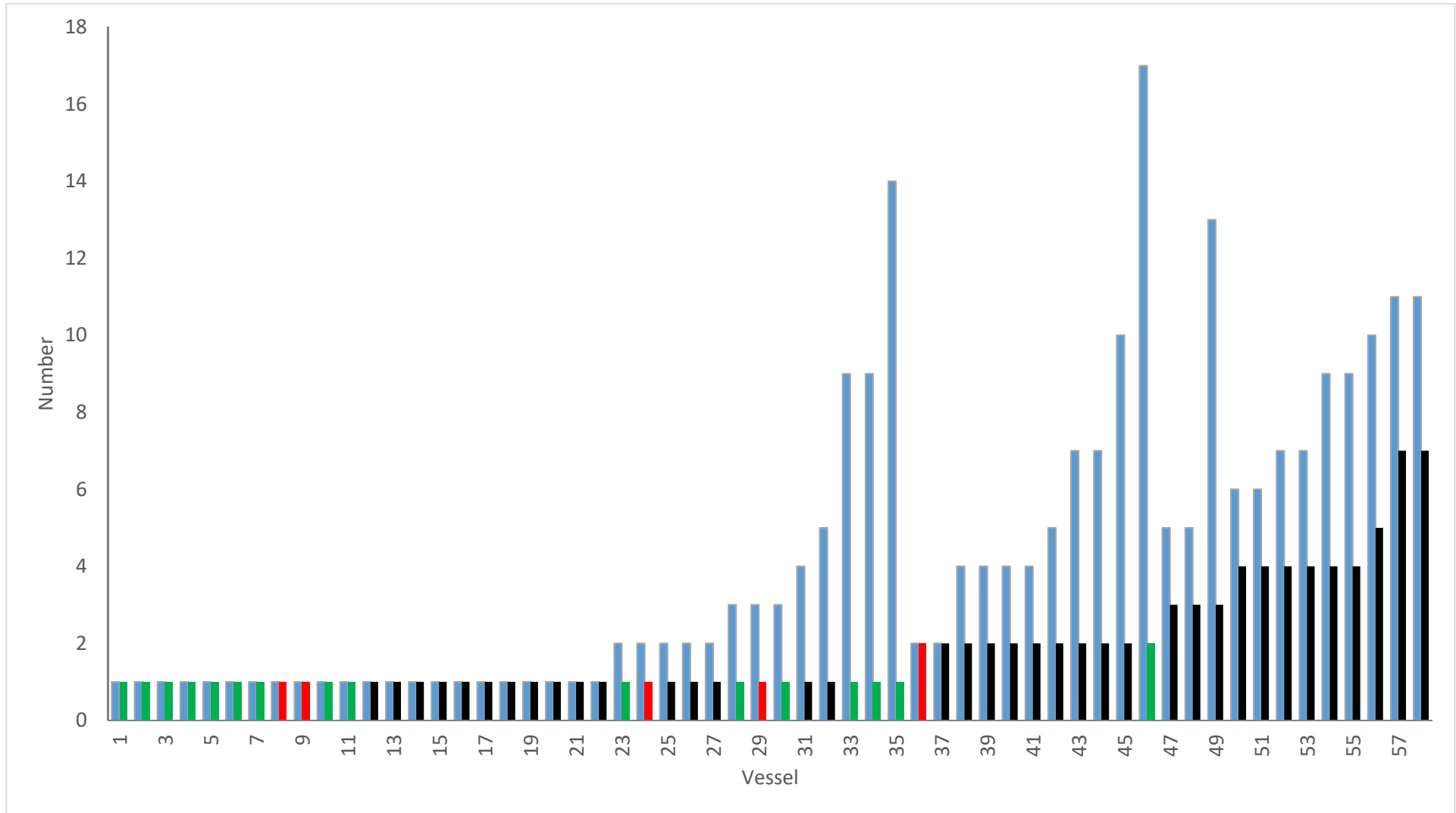


Table 4 Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2018 and 30 June 2019, by fisheries type.

Species	Trawl (Bottom/Midwater)					Longline (Surface/Bottom)				Setnet	Total
	Scampi	Squid	Hoki	Ling	Other	Tuna	Snapper	Ling	Other		
Antipodean albatross						5					5
Black (Parkinson's) petrel					1	3					4
Buller's albatross	1	11	6		2	6			8		34
Campbell albatross					1						1
Chatham Island albatross			1		1			2			4
Common diving petrel		1									1
Fairy prion			1								1
Fiordland crested penguin										1	1
Flesh-footed shearwater							2		1		3
Gibson's albatross						1					1
Grey petrel					4			1			5
Grey-backed storm petrel					1						1
Mottled petrel		1									1
NZ white-capped albatross	1	29	5		3	17			6		61
Otago shag										3	3
Salvin's albatross	1		6	1	2			1			11
Sooty shearwater	1	25	4	1	5						36
Southern royal albatross				1							1
Spotted shag										2	2
Stewart Island shag (Foveaux shag)										1	1
Wandering albatross (unidentified)				1							1
Westland petrel			2			3		2	3		10
White-chinned petrel	1	39	3	1	9	2		2	1	1	59
TOTAL	5	106	28	5	29	37	2	8	19	8	247
	2.9%	61.3%	16.2%	2.9%	16.7%	56.1%	3.0%	12.1%	28.8%		
% TOTAL	173					66				3.3%	
	70.0%					26.7%					

Table 5 Number of seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2018 and 30 June 2019, 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		
Antipodean albatross	4			1									5
Black (Parkinson's) petrel	1			1	1			1					4
Buller's albatross	8	1		5			5	12		3			34
Campbell albatross											1		1
Chatham Island albatross	2						2						4
Common diving petrel								1					1
Fairy prion									1				1
Fiordland crested penguin												1	1
Flesh-footed shearwater				3									3
Gibson's albatross	1												1
Grey petrel				1				4					5
Grey-backed storm petrel											1		1
Mottled petrel								1					1
NZ white-capped albatross	18			5			16	14	4	3	1		61
Otago shag												3	3
Salvin's albatross	1						4	5	1				11
Sooty shearwater								24	6	6			36
Southern royal albatross										1			1
Spotted shag												2	2
Stewart Island shag (Foveaux shag)												1	1
Wandering albatross (unidentified)							1						1
Westland petrel	4	2		2				2					10
White-chinned petrel	1	1		2	1		1	37	7	8		1	59
Total	40	4	0	20	2	0	29	101	19	21	3	8	247
Total (each type)	66						173						
% of total longline or trawl	60.6%	6.1%		30.3%	3%		16.8%	58.4%	11%	12.1%	1.7%		
Albatrosses (%)	85%	25%		55%			96.6%	30.7%	26.3%	33.3%	75.0%		
Non-albatross (%)	15%	74%		45%	100%		3.4%	69.3%	73.7%	66.6%	25.0%	100.0%	

Table 6 Types of injuries recorded on seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2018 and 30 June 2019. 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 ($n = 247$).

	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
Antipodean albatross	2	1					3						
Black (Parkinson's) petrel	3	1								1			
Buller's albatross	12	4	7		3		5			3	13	2	
Campbell albatross	1												
Chatham Island albatross		1	1		1		2			1	4	1	
Common diving petrel										1			
Fairy prion	1	1											
Fiordland crested penguin	1	1											
Flesh-footed shearwater	3	1											
Gibson's albatross							1						
Grey petrel		1	1		4					1			
Grey-backed storm petrel	1												
Mottled petrel	1												
NZ white-capped albatross	17	2	9		3	2	5			20	13	7	4
Otago shag	3	3											
Salvin's albatross	3	5	3		2		1			3	3		
Sooty shearwater	21	7	2		10	3				2			
Southern royal albatross	1												
Spotted shag		1	1									1	
Stewart Island shag (Foveaux shag)	1	1											
Wandering albatross (unidentified)											1		
Westland petrel	6	2			1		1	1		2			
White-chinned petrel	33	12	1		12	2		1		5	4	1	2
Total	110	44	25		36	7	18	2		39	38	12	6
% Total	44.5%	17.8%	10.1%	0.0%	14.6%	2.8%	7.3%	0.8%	0.0%	15.8%	15.4%	4.9%	2.4%
Albatrosses (%)	32.7%	29.5%	80.0%		25.0%	28.6%	94.4%			69.2%	89.5%	83.3%	66.7%
Non-albatross (%)	75.5%	86.4%	32.0%		80.6%	71.4%	11.1%	100.0%		38.5%	18.4%	16.7%	33.3%

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, 2018), birds caught and returned from trawl fisheries had different injuries from those caught by longline vessels.

Of the 66 birds from longline vessels, most were waterlogged and had hook injuries (Tables 5 and 6). Of these, 20 (30.3%) still had hooks present (18 in the bill, throat or neck and two in the wing) (Tables 5 and 6).

Of the 173 birds from trawl vessels, most had been caught in the net or recovered in the pound or cod end (i.e. had drowned, $n = 120$, 69.4%) 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 ($n = 38$, 22%), 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 (69.3%) while almost only albatross taxa were affected by warp strikes (96.6%) exhibiting serious wing injuries or lacerations (Tables 5 and 6). There were three seabirds returned that had been killed by impacting the trawl vessel (1.7%) (Tables 5 and 6).

All eight 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 2018 and 30 June 2019, 65.2% of returned birds had fat scores of less than 3, 17.4% of birds had fat scores of 3 and 11.8% of birds had fat scores over 3 (Table 7).

Table 7 Fat scores of seabirds killed and returned from fishing vessels between 1 July 2018 and 30 June 2019 (1= no fat, to 5 = extremely fat; U = unknown).

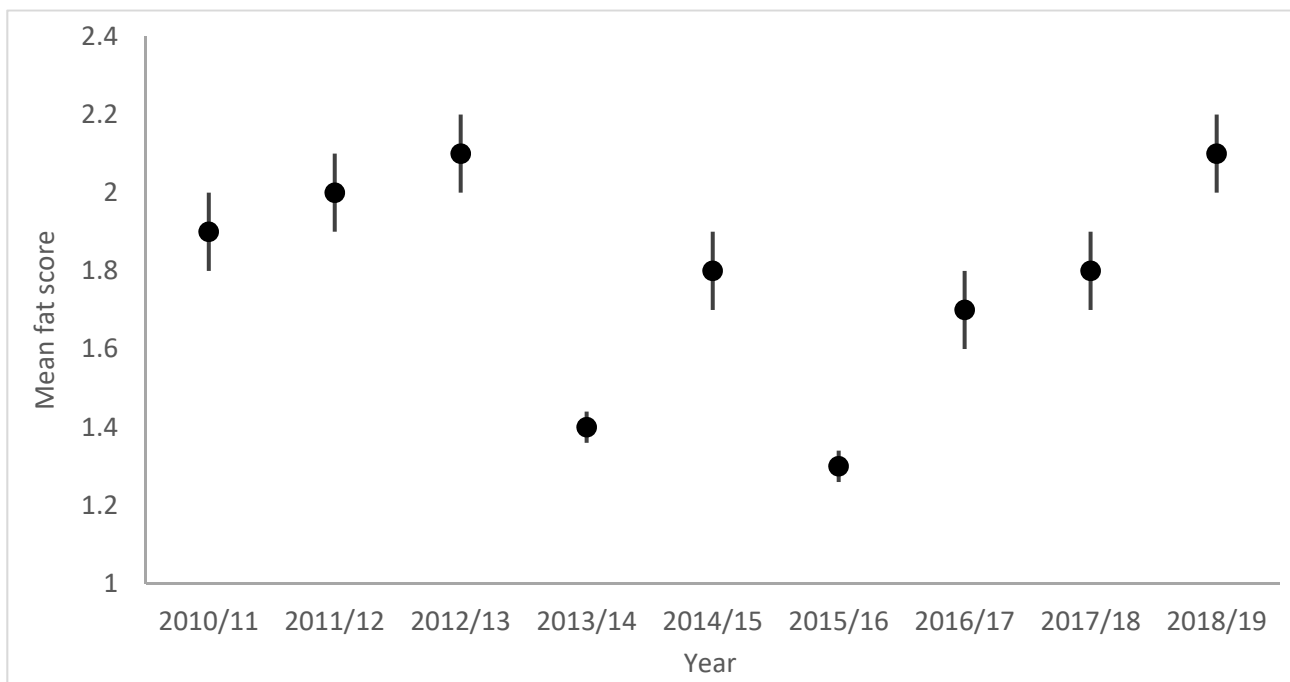
SPECIES	FAT SCORE						TOTAL	MEAN (\pm SE)
	1	2	3	4	5	U		
Antipodean albatross	2	2	1				5	1.8 \pm 0.4
Black (Parkinson's) petrel	1	2		1			4	2.3 \pm 0.6
Buller's albatross	9	12	9	2	1	1	34	2.2 \pm 0.2
Campbell albatross	1						1	1.0 \pm 0.0
Chatham Island albatross	1	2			1		4	2.5 \pm 0.9
Common diving petrel					1		1	5.0 \pm 0.0
Fairy prion			1				1	3.0 \pm 0.0
Fiordland crested penguin			1				1	3.0 \pm 0.0
Flesh-footed shearwater		1	2				3	2.7 \pm 0.3
Gibson's albatross	1						1	1.0 \pm 0.0
Grey petrel	1	3		1			5	2.2 \pm 0.5
Grey-backed storm petrel	1						1	1.0 \pm 0.0
Mottled petrel					1		1	5.0 \pm 0.0
NZ white-capped albatross	19	17	7	6	3	7	61	2.2 \pm 0.2
Otago shag	3						3	1.0 \pm 0.0
Salvin's albatross		2	4	3	1	1	11	3.3 \pm 0.3
Sooty shearwater	11	12	10	1	2		36	2.2 \pm 0.2
Southern royal albatross	1						1	1.0 \pm 0.0
Spotted shag	1	1					2	1.5 \pm 0.5
Stewart Island shag (Foveaux shag)					1		1	5.0 \pm 0.0
Wandering albatross (unidentified)							1	
Westland petrel	6	2	2				10	1.6 \pm 0.3
White-chinned petrel	18	29	6	4		2	59	1.9 \pm 0.1
TOTAL	76	85	43	18	11	11	247	2.2 \pm 0.1
% TOTAL	30.8%	34.4%	17.4%	7.3%	4.5%	4.5%		

Eleven birds (4.5%) 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 2018 and 30 June 2019 (mean (\pm SE) = 2.2 ± 0.1) was higher than the last three fishing years (2017/18 = 1.8 ± 0.1 ; 2016/17 = 1.7 ± 0.1 ; 2015/16 = 1.3 ± 0.04) and the same as the 2012/13 fishing year (Bell, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017, 2018).

The mean fat score has fluctuated over the past nine years, mean fat scores steadily increased until 2012/13 and then alternating between lower and higher mean fat scores between 2013/14 and 2015/26 and steadily increasing over the past five fishing years since the lowest fat score of 1.3 in 2015/16 (Bell, 2013; Bell & Mischler, 2014, 2015; Bell & Bell, 2016, 2017, 2018; 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 2019.



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, 2018).

In total, 77 birds (31.2%) had offal or discards in their stomachs and 24 birds (9.7%) had bait in their stomach (Table 8). In addition, 99 birds (40.1%) had empty stomachs. A further ten birds (4%) had missing stomachs due to interaction with fishing gear or damage due to sea lice. One Buller's albatross and one NZ white-capped albatross had plastic in its stomach (Table 8).

Most of the gizzard contents were natural food items (squid beaks 52.6%, fish bones and skin 24.3%, squid or fish eyeballs 13.4% and otoliths 15.8%), but 7.7% of the birds returned had also ingested plastic, metal or string and 1.6% had ingested stones or seeds (Table 9).

In addition, 51 birds (20.6%) had empty stomachs and nine birds (3.6%) 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 2018 and 30 June 2019.

Note: Birds can have multiple items in the stomachs resulting in higher stomach content figures than the total number of seabirds killed and returned ($n = 247$).

SPECIES	EMPTY	GONE ¹	BAIT ²	OFFAL/DISCARDS ³	NATURAL ⁴	SLUDGE ⁵	PROVENTRICULAR OIL	PLASTIC or TWINE	OTHER ⁶
Antipodean albatross	4			1	1				
Black (Parkinson's) petrel	1			2		1			
Buller's albatross	11	2	5	13	4	4	1	1	1
Campbell albatross				1					
Chatham Island albatross							1		
Common diving petrel	1								
Fairy prion	3								
Fiordland crested penguin	1								
Flesh-footed shearwater	1			3		1	3		
Gibson's albatross	5		1	4	1				2
Grey petrel	24	5	5	17	12	4		1	1
Grey-backed storm petrel	16		1	13	1	7	4		
Mottled petrel			2	3					
NZ white-capped albatross	1								
Otago shag						1			
Salvin's albatross	1								
Sooty shearwater	1								
Southern royal albatross				1	1				
Spotted shag				1					
Stewart Island shag (Foveaux shag)	1				3	1			3
Wandering albatross (unidentified)		1							
Westland petrel	5		3		1		2		
White-chinned petrel	23	2	7	18	5	6	2		
TOTAL	99	10	24	77	29	25	13	2	7
% TOTAL	40.1%	4%	9.7%	31.2%	11.2%	10.1%	5.3%	0.8%	2.8%

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 or worms

Table 9 Gizzard contents of seabirds killed and returned from fishing vessels between 1 July 2018 and 30 June 2019.

Note: Birds can have multiple items in the gizzard resulting in higher figures than the total number of seabirds killed and returned ($n = 247$).

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
Antipodean albatross	1		4		1	3				
Black (Parkinson's) petrel	1		3		1	1				
Buller's albatross	12	2	8	3	4	10				2
Campbell albatross	1									
Chatham Island albatross			2	1		4			1	2
Common diving petrel	1									
Fairy prion			1							
Fiordland crested penguin	1									
Flesh-footed shearwater			1				3	1		
Gibson's albatross					1					
Grey petrel			5	2		4			4	1
Grey-backed storm petrel	1									
Mottled petrel	1									
NZ white-capped albatross	17	5	16	13	13	18	1			
Otago shag	2					1			1	2
Salvin's albatross	4		4	5	4	4				
Sooty shearwater	7		22	6	2	3	12	1		
Southern royal albatross			1		1					
Spotted shag	2									
Stewart Island shag (Foveaux shag)						1			1	
Wandering albatross (unidentified)		1								
Westland petrel			10	3	1				1	
White-chinned petrel		1	53	6	5	11	3	2	5	2
TOTAL	51	9	130	39	33	60	19	4	13	9
% TOTAL	20.6%	3.6%	52.6%	15.8%	13.4%	24.3%	7.7%	1.6%	5.3%	3.6%

3.1.6 Identification of necropsy birds

Necropsy confirmed that the majority (80.2%) of the seabirds returned between 1 July 2018 and 30 June 2019 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 necropsy identification for seabirds killed and returned from observed fishing boats between 1 July 2018 and 30 June 2019.

Species	ID correct	ID wrong	ID to correct species group*	ID as seabird small, large or albatross*	ID as petrel or <i>Procellaria</i> unidentified*	ID not on label or code didn't exist	Total
Antipodean albatross			5				5
Black (Parkinson's) petrel	4						4
Buller's albatross	24	1	9				34
Campbell albatross	1						1
Chatham Island albatross	4						4
Common diving petrel		1					1
Fairy prion	1						1
Fiordland crested penguin	1						1
Flesh-footed shearwater	3						3
Gibson's albatross			1				1
Grey petrel	4	1					5
Grey-backed storm petrel			1				1
Mottled petrel		1					1
NZ white-capped albatross	56	2	1	1		1	61
Otago shag			3				3
Salvin's albatross	10	1					11
Sooty shearwater	28		4	2		2	36
Southern royal albatross	1						1
Spotted shag	1		1				2
Stewart Island shag (Foveaux shag)	1						1
Wandering albatross (unidentified)			1				1
Westland petrel	9	1					10
White-chinned petrel	50	6	1			2	59
Total	198	14	27	3		5	247
% Total	80.2%	5.7%	10.9%	1.2%		2.0%	

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

Twenty-seven (10.9%) 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 Antipodean albatross, Buller's albatross, Gibson's albatross, grey-backed storm petrel, New Zealand white-capped albatross, Otago shag, sooty shearwater, spotted shag, wandering albatross, and white-chinned petrel. A further 14 (5.7%) were identified incorrectly including the following species: Buller's albatross, common diving petrel, grey petrel, mottled petrel, New Zealand white-capped albatross, Salvin's albatross, Westland petrel and white-chinned petrel. Five birds (2%) 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 417 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 2018 and 30 June 2019 (Table 11).

Table 11 Number of seabirds of each species reported as photographed or interacting with fishing vessels between 1 July 2018 and 30 June 2019.

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)	1			16	17
Black (Parkinson's) petrel	2			1	3
Black-backed gull	1				1
Black-browed albatross (unidentified)				1	1
Buller's albatross	5	3		4	12
Buller's and Pacific albatross		5		3	8
Buller's shearwater				2	2
Cape petrels				3	3
Chatham albatross	2			1	3
Common diving petrel				7	7
Fairy prion	2			2	4
Flesh-footed shearwater		1			1
Giant petrel (unidentified)				3	3
Great albatross (unidentified)				2	2
Great-winged (Grey-faced) petrel	2			1	3
Grey petrel	4			1	5
Grey-backed storm petrel	3			1	4
Little blue penguin				1	1
Mid-sized petrel & shearwater (unidentified)				1	1
New Zealand white-capped albatross	42	8		23	73
Petrel (unidentified)				8	8
Petrels, prion and shearwaters (unidentified)				1	1
Prion (unidentified)				1	1
Procellaria petrel (unidentified)		1		8	9
Salvin's albatross	4			13	17
Seabird (small)				2	2
Shag (unidentified)				1	1
Shy albatross				2	2
Small albatross (unidentified)				1	1
Sooty shearwater	45	4		25	74
Southern royal albatross	1			1	2
Storm petrel (unidentified)				4	4
Wandering (Snowy) albatross		1			1
Westland petrel	3	1		4	8
White-chinned petrel	78	3		48	129
White-faced storm petrel				2	2
White-headed petrel		1			1
Total	195	28	0	194	417
	223				

Table 12. Number of photograph and interaction seabirds recorded from observed fishing vessels between 1 July 2018 and 30 June 2019, by month of capture.

SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Albatross (unidentified)	3	2	1	1					2	2	1	5	17	4.1%
Black (Parkinson's) petrel											1	2	3	0.7%
Black-backed gull							1						1	0.2%
Black-browed albatross (unidentified)											1		1	0.2%
Buller's albatross				1	10		1						12	2.9%
Buller's and Pacific albatross					3	4		1					8	1.9%
Buller's shearwater		1									1		2	0.5%
Cape petrels						1			1		1		3	0.7%
Chatham albatross										3			3	0.7%
Common diving petrel							3		1	1		2	7	1.7%
Fairy prion	1			1		1			1				4	1.0%
Flesh-footed shearwater				1									1	0.2%
Giant petrel (unidentified)			1	1	1								3	0.7%
Great albatross (unidentified)				1							1		2	0.5%
Great-winged (Grey-faced) petrel										1		2	3	0.7%
Grey petrel							3	1	1				5	1.2%
Grey-backed storm petrel									4				4	1.0%
Little blue penguin											1		1	0.2%
Mid-sized petrel & shearwater (unidentified)	1												1	0.2%
New Zealand white-capped albatross	4	22	15	14	14		1		1		1	1	73	17.5%
Petrel (unidentified)			4	3						1			8	1.9%
Petrels, prion and shearwaters (unidentified)			1										1	0.2%
Prion (unidentified)												1	1	0.2%
Procellaria petrel (unidentified)	1	4	3			1							9	2.2%
Salvin's albatross	1	1	3				4		3	1	4		17	4.1%
Seabird (small)										1		1	2	0.5%
Shag (unidentified)											1		1	0.2%
Shy albatross				2									2	0.5%
Small albatross (unidentified)					1								1	0.2%
Sooty shearwater	2	12	33	21	3					1	1	1	74	17.7%

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SPECIES	MONTH												TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D		
Southern royal albatross	1											1	2	0.5%
Storm petrel (unidentified)		2	1				1						4	1.0%
Wandering (Snowy) albatross					1								1	0.2%
Westland petrel			1		2			1	1	1	2		8	1.9%
White-chinned petrel	4	50	30	30	6					1	5	3	129	30.9%
White-faced storm petrel											1	1	2	0.5%
White-headed petrel					1								1	0.2%
TOTAL	18	94	93	76	42	7	14	3	15	13	22	20	417	
% TOTAL	4.3%	22.5%	22.3%	18.2%	10.1%	1.7%	3.4%	0.7%	3.6%	3.1%	5.3%	4.8%		

Of these, 194 had no photographs taken (a mixture of birds that were either released alive or discarded dead by the crew) and 195 seabird interactions that were photographed and had corresponding entries in the MPI COD extract (Table 11). **There are 25 images still to be supplied by DOC for expert identification.**

Similar to the seabirds caught and returned for necropsy, the photograph and interaction seabirds were dominated by three species: New Zealand white-capped albatross (n = 73, 17.5%), sooty shearwater (n = 74, 17.7%) and white-chinned petrel (n = 129, 30.9%) (Table 12). These three species accounted for 66.2% 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 2019 (n = 94, 22.5%), March 2019 (n = 93, 22.3%), April 2019 (n = 76, 18.2%) and May 2019 (n = 42, 10.1%) (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 8) and general positions are shown in Figures 5 and 6. Two photographed birds were recorded outside the New Zealand EEZ (Figures 5 & 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, 2, 3, 4, 5, 6, 7, 8 and 9) and general positions are shown in Figures 7 and 8. Two seabirds that were reported as an interaction in the MPI COD extract were recorded outside the New Zealand EEZ (Figures 7 & 8).

The 417 seabirds that were either photographed or recorded as an interaction were from 54 different vessels; two on three set net vessels (3.7%), 42 on 14 longline vessels (25.9%) and 372 on 38 trawl vessels (85.0%) (Table 13).

Table 13 Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2018 and 30 June 2019 (with the number of individual vessels in parentheses).

		Photograph seabirds	Interaction Seabirds	Total
Longline vessels	Bottom	4 (3)	5 (3)	9 (4)
	Surface	8 (2)	6 (2)	14 (3)
	Unknown	3 (3)	16 (6)	19 (7)
Trawl vessels		208 (26)	164 (32)	372 (38)
Set net vessels			3 (2)	3 (2)
Total		223 (34)	194 (45)	417 (54)

For the fishing period 1 July 2018 to 30 June 2019, there were 273 observed trips on 116 vessels (Shannon Weaver, CSP DOC, pers. comm.). Fifty-four vessels (46.6%) reported interactions (photographed and/or non-photographed) with seabirds (Table 13). Over half of these 54 vessels reported relatively low numbers of bird interactions (< 5 birds reported; n = 37, 68.5%) (Figure 9). There were 14 vessels (25.9%) 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 73 (62.9%) (Figure 10). Over half of these vessels reported low numbers of interactions or returned low numbers of seabirds (<5 birds; n = 43, 58.91%) (Figure 10). Twenty vessels (27.4%) 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 2018 and 30 June 2019.

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).

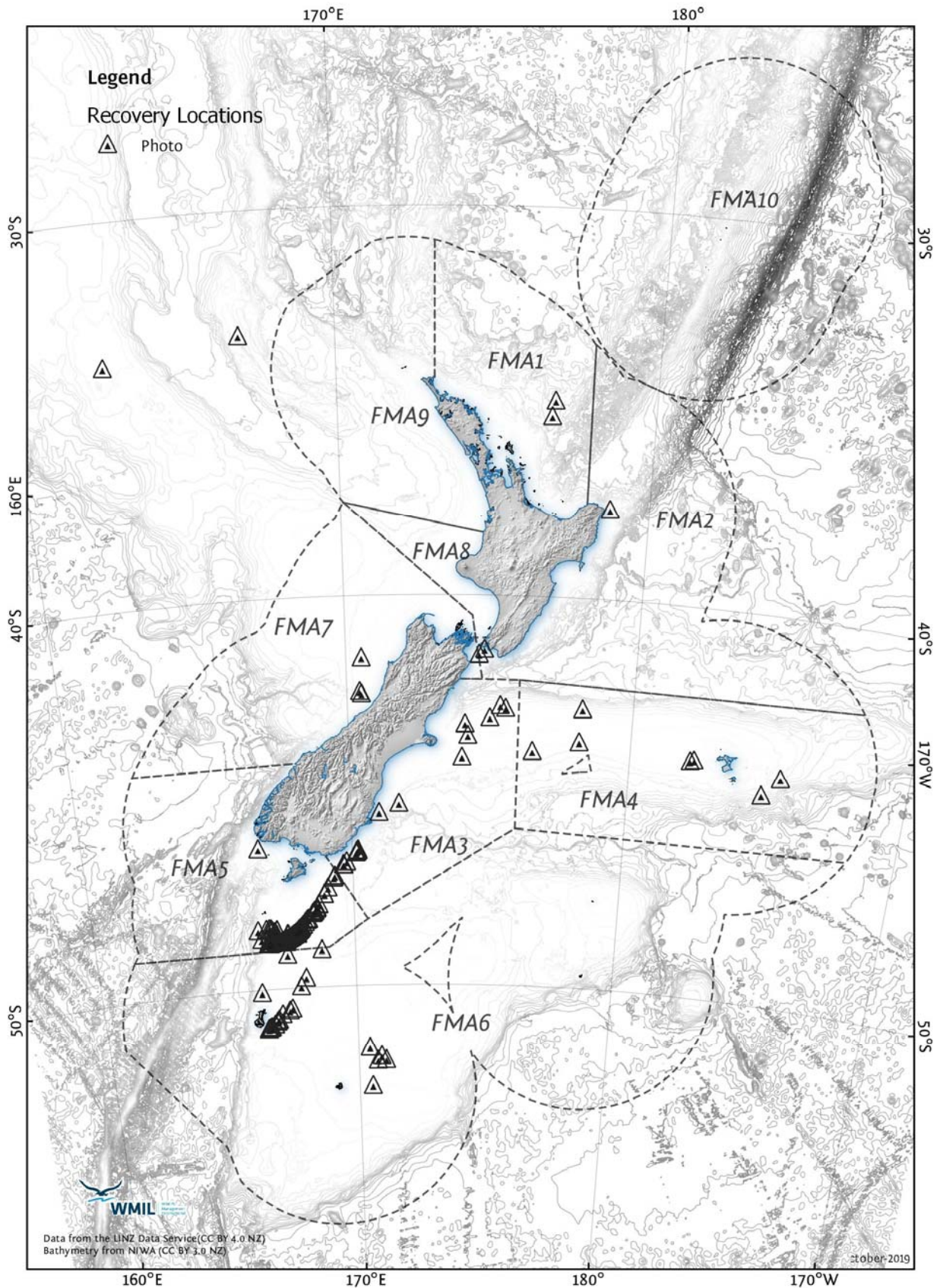


Figure 6 Grouped catch locations of all seabirds caught and photographed in New Zealand fisheries between 1 July 2018 and 30 June 2019.

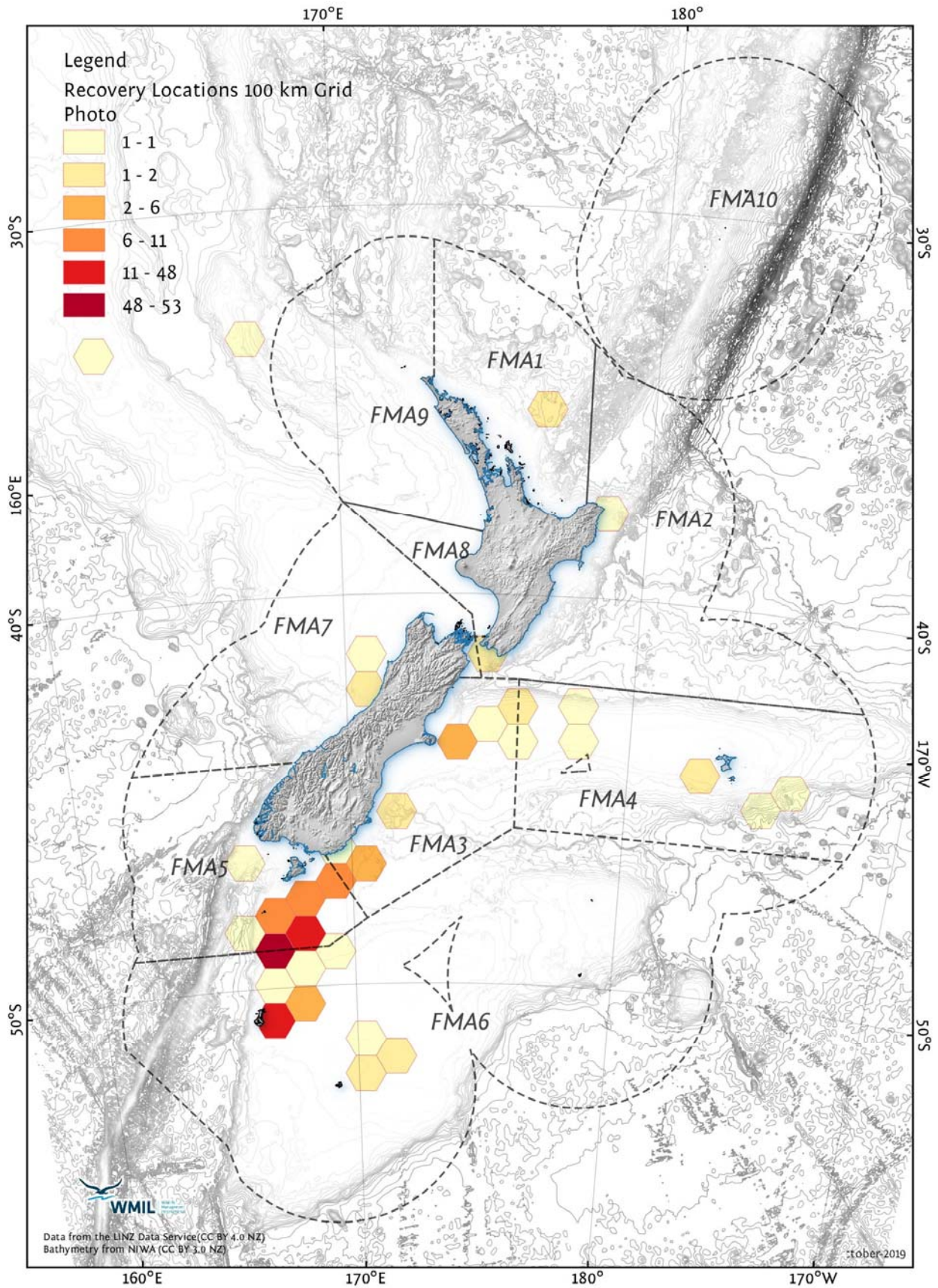


Figure 7 Individual catch locations of all seabirds reported as an interaction (and not photographed) in New Zealand fisheries between 1 July 2018 and 30 June 2019.
Note: catch location symbols may be obscured by overlying symbols (e.g. where several individuals were captured from the same tow or set, each bird will have the same catch location and appear on the maps as a single symbol).

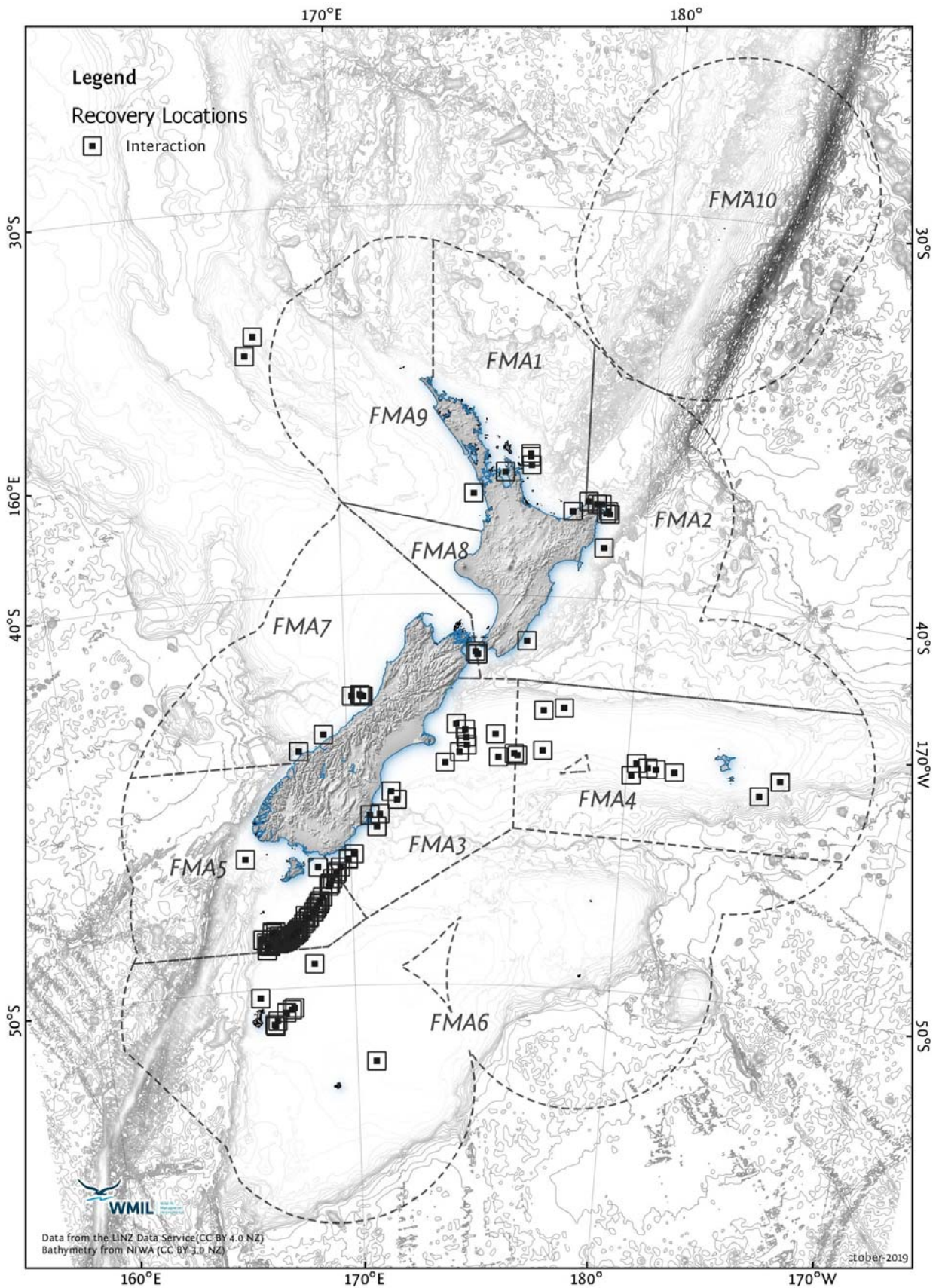


Figure 8 Grouped catch locations of all seabirds reported as an interaction (and not photographed) in New Zealand fisheries between 1 July 2018 and 30 June 2019.

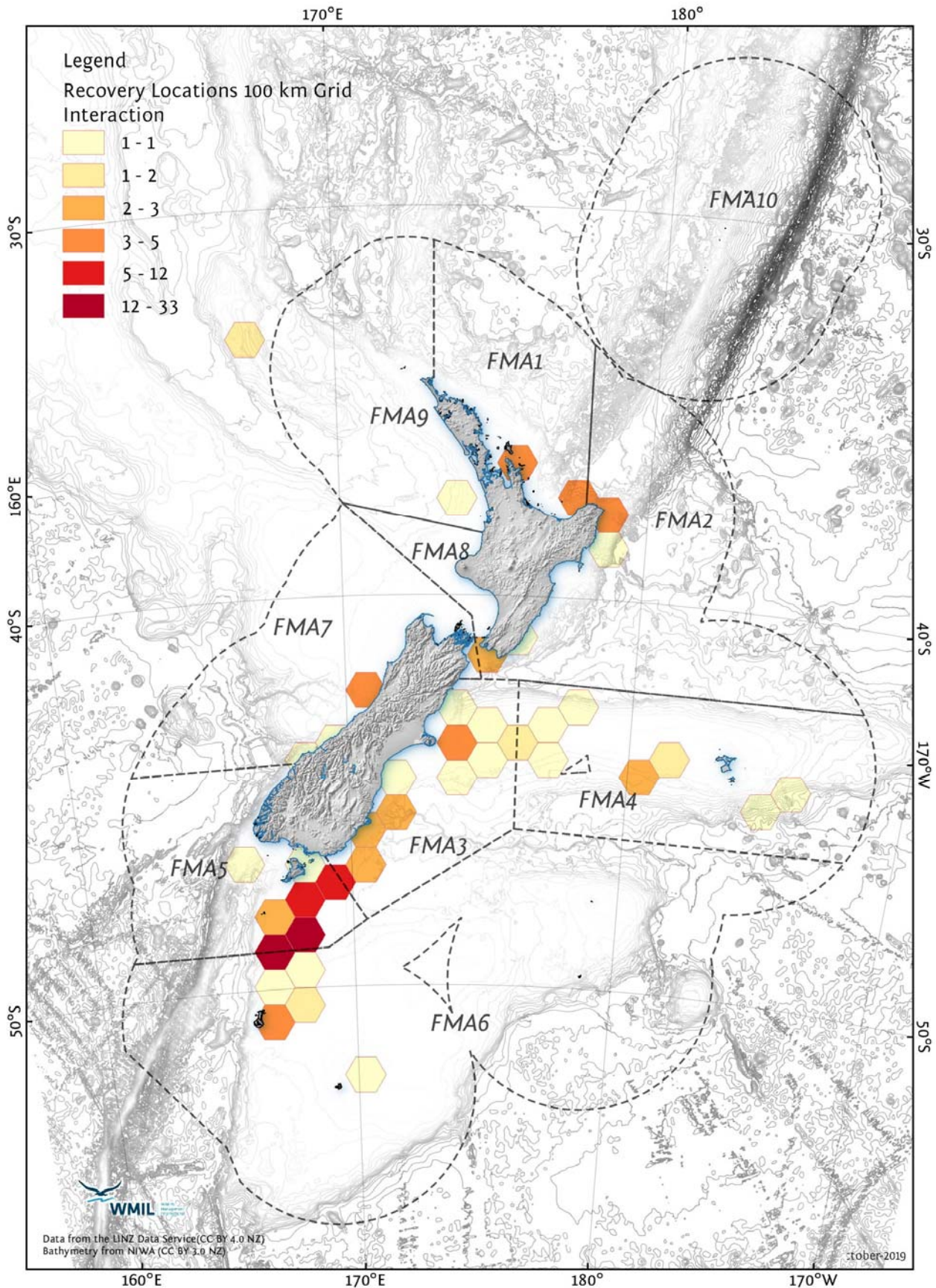


Figure 9 The number of seabird interactions (photographed and non-photographed live and dead birds) in New Zealand fisheries, and the number of trips for each observed vessel between 1 July 2018 and 30 June 2019.

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.

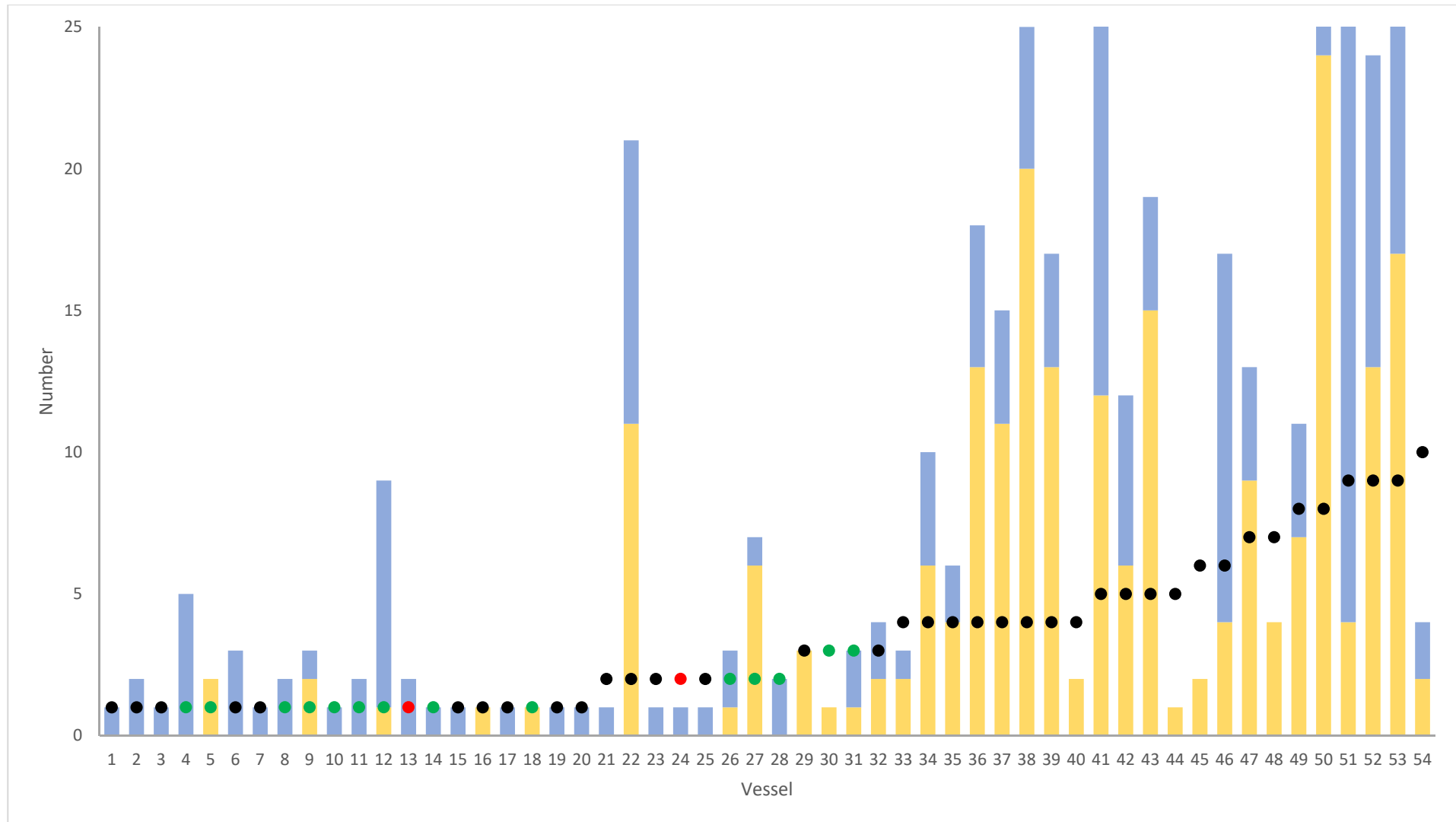
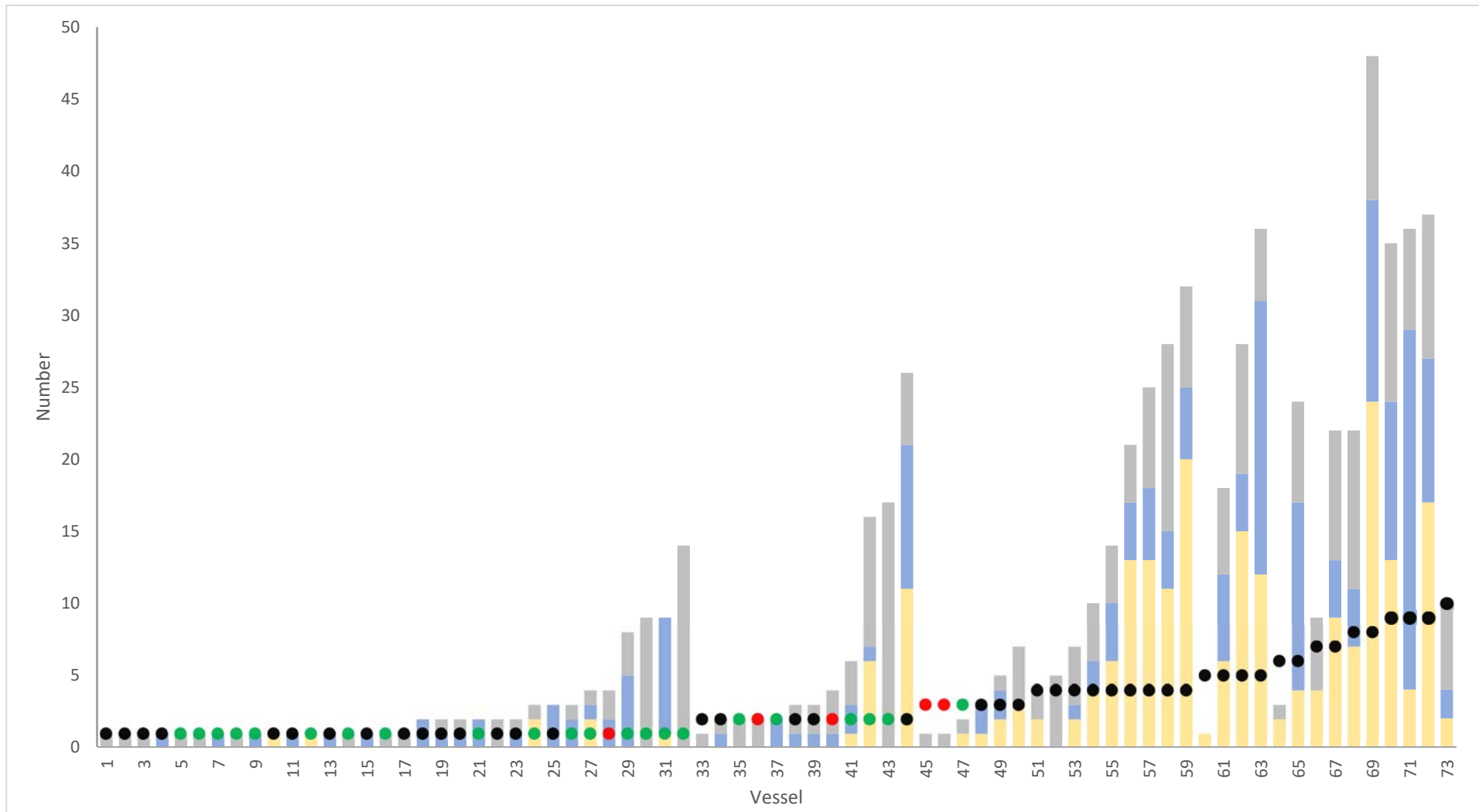


Figure 10 The number of seabirds caught and returned for necropsy, seabird interactions (live and dead birds, photographed and non-photographed) in New Zealand fisheries, and the number of trips for each observed vessel between 1 July 2018 and 30 June 2019.

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

Half of the 417 interaction or photographed birds represented live bird interactions (n = 216, 51.7%) (Table 14). Only 38 of the photographed birds were released alive (17.5%) compared to 178 interaction birds (82.4%) (Table 14). Most of these interaction birds were released by the crew prior to the Observer being able to photograph the birds (as reported by the observer in the notes provided in the MPI COD extract).

Table 14 Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2018 and 30 June 2019.

	Photograph seabirds	Interaction Seabirds	Total	% Total
Alive	38	178	216	51.7%
Dead	185	13	198	47.52%
Not recovered (alive)			0	
Not recovered (dead)		3	3	0.7%
Total	223	194	417	

Three reported dead birds could not be recovered as they fell off the warp or hook prior to coming aboard (Table 14). Observers reported that one bird was released alive with a broken wing and another with a broken leg; it is unlikely that these birds 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 2018 and 30 June 2019.

	Photograph		Interaction		Total			% Total
	Alive	Dead	Alive	Dead	Alive	Dead	All	
No visible injuries	32	51	152	2	184	53	237	56.8%
Disorientated	2		5		7	0	7	1.7%
Waterlogged	2	67		1	2	68	70	16.8%
Broken wing	1	24		1	1	25	26	6.2%
Broken neck		4			0	4	4	1.0%
Broken leg			1		1	0	1	0.2%
Hook (unspecified)		1			0	1	1	0.2%
Hook in bill or throat		4		2	0	6	6	1.4%
Hook in wing	1				1	0	1	0.2%
Open wound		4			0	4	4	1.0%
Severed body part		8			0	8	8	1.9%
More than 3 injuries (crushed)		8		1	0	9	9	2.2%
Greased		9	1		1	9	10	2.4%
Liced		1			0	1	1	0.2%
Unknown (unable to assess)		4	19	9	19	13	32	7.7%
Total	38	185	178	16	216	201	417	

For the 223 seabirds that had been photographed, 38 were released alive (although some had injuries that is likely to cause death) and 185 died for a range of reasons (Table 15). Of the 185 dead photographed birds, 127 were drowned in the trawl nets (57%), eight were drowned on longline hooks (4.3%), 26 died as results of warp strike (11.6%), two were drowned in the codend (of the trawl nets) (0.9%), 18 died on trawl vessels for other reasons (8.1%) and four died by striking the vessel (1.8%) and five died after getting tangle in tori lines or the net lines (2.2%) (Table 16).

For the 16 seabirds that were recorded dead following an interaction (but not photographed) with the fishing vessel, five were drowned in the trawl nets (31.25%), five could not be recovered after falling off the warp (31.25%), one drowned in a set net (6.25%), and five were drowned on longline hooks, but fell off before reaching the vessel or were discarded by crew (31.25%).

Table 16 Number of seabirds of each species that were photographed after vessel interaction from commercial fisheries between 1 July 2018 and 30 June 2019, by likely cause of death. The proportion of albatross and non-albatross taxa returned is also presented.

Species	Longline						Trawl								Total		
	Hook					Tangled	Vessel strike	Warp	Net		Codend	Other	Tangled	Vessel strike			
	Bill		Wing		Not obvious	Alive	Alive	Dead	Alive	Dead	Dead	Dead	Dead	Dead		Alive	Dead
	Alive	Dead	Alive	Dead	Dead												
Albatross (unidentified)								1								1	
Black (Parkinson's) petrel		2														2	
Black-backed gull					1											1	
Buller's albatross								3	1	4						8	
Buller's and Pacific albatross	1		1					1		2						5	
Chatham Island albatross								1						1		2	
Fairy prion															2	2	
Flesh-footed shearwater				1												1	
Great-winged (Grey-faced) petrel														2		2	
Grey petrel		1			1					2						4	
Grey-backed storm petrel														3		3	
NZ white-capped albatross		1	1			1		17	2	17		7	2	2		50	
Procellaria petrel (unidentified)										1						1	
Salvin's albatross		1						2		1						4	
Sooty shearwater									3	38		2		5	1	49	
Southern royal albatross														1		1	
Wandering (Snowy) albatross														1		1	
Westland petrel			1				1			1				1		4	
White-chinned petrel							1	1	2	61	2	9	3	1	1	81	
White-headed petrel														1		1	
Total	1	5	3	1	2	1	2	26	8	127	2	18	5	18	4	223	
% Total	0.4%	2.2%	1.3%	0.4%	0.9%	0.4%	0.9%	11.6%	3.6%	57%	0.9%	8.1%	2.2%	8.1%	1.8%		
Total (each type)	15						208										
% of total longline or trawl	6.7%	33.3%	20%	6.7%	13.3%	6.7%	13.3%	12.5%	3.8%	16.1%	0.1%	8.7%	2.4%	8.7%	1.9%		
Albatrosses (%)	100%	40%	66.7%			100%		96.1%	37.5%	18.9%		38.9%	40%	27.8%			
Non-albatross (%)		60%	33.3%	100%	100%		100%	3.9%	62.5%	81.1%	100%	61.1%	60%	72.2%	100.0%		

There were a range of injuries on the interaction and photographed birds as shown in Table 15. Most of the birds (n = 237, 56.8%) had no visible injuries and most of these birds were released alive (n = 184, 77.6%).

There were 28 interaction birds (14.4%) and four photographed birds (1.8%) 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 20 different seabird taxa that had been photographed by the Observers (Tables 11 and 16).

Examination of the 195 photographed seabird interactions received to date (**25 images are still to be provided**) confirmed that observers had accurately identified 88.2% (n = 172) of seabirds (Table 17). A fairy prion, two grey petrels, one Westland petrel and five white-chinned petrels were incorrectly identified (n= 9, 4.6%; Table 17).

Table 17 Comparison of 195 observer identifications with expert identifications for observed and photographed captures listed in COD from fishing vessels between 1 July 2017 and 30 June 2019, 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	Total
Albatross (unidentified)	1			1
Black (Parkinson's) petrel	2			2
Black-backed gull	1			1
Buller's albatross	2	3		5
Chatham Island albatross	2			2
Fairy prion		1	1	2
Great-winged (Grey-faced) petrel	2			2
Grey petrel	2		2	4
Grey-backed storm petrel	1	2		3
NZ white-capped albatross	41	1		42
Salvin's albatross	4			4
Sooty shearwater	43	2		45
Southern royal albatross	1			1
Westland petrel	1	1	1	3
White-chinned petrel	69	4	5	78
Total	172	14	9	195
% Total	88.2%	7.2%	4.6%	

3.2.5 Quality and number of photographs

The quality of the images obtained by observers continued to vary widely, particularly for live birds. Video footage is 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).

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 logbooks) 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 necropsy and photo-identification work would not have been possible without the dedication of Ministry for Primary Industries observers who retained the birds for necropsy, took the photographs, and completed logbooks (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 necropsy tag data and photograph records. Kelvin Floyd (WMIL) developed and maintained the WMIL necropsy and photo-identification database and produced all maps.

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