INT2019-02: IDENTIFICATION OF SEABIRDS CAPTURED IN NEW ZEALAND FISHERIES

1 July 2021 to 30 June 2022

WMIL Wildlife Management International

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INT2019-02: Identification of seabirds captured in New Zealand fisheries, 1 July 2021 to 30 June 2022.

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This report was prepared by Wildlife Management International Limited for the Department of Conservation as fulfilment of the contract variation INT2019-02 signed 30 November 2020.

Version History:

VERSION	DATE	AUTHOR	REASON FOR CHANGE
1	15 May 2023	WMIL: Bell, E. & Larcombe, S.	First WMIL draft.
2	4 July 2023	WMIL: Bell, E. & Larcombe, S.	Revised version.

Citation:

This report should be cited as:

Bell, E. & Larcombe, S. 2023. INT2019-02: Identification of seabirds caught in New Zealand fisheries, 1 July 2021 to 30 June 2022. Annual Technical Report to the Conservation Services Programme, Department of Conservation. Wellington, New Zealand.

Cover image: Fishing crew ushering a sooty shearwater (*Ardenna grisea*) off the vessel after a deck strike. Image provided by MPI/DOC Government Observer, 10 May 2022.

INT2019-02: IDENTIFICATION OF SEABIRDS CAPTURED IN NEW ZEALAND FISHERIES, 1 JULY 2021 TO 30 JUNE 2022

ABSTRACT

The New Zealand Exclusive Economic Zone (EEZ) supports a diverse range of seabird species. Much of the commercial fishing activity in the region overlaps with seabird foraging ranges. The accurate identification of bycatch seabirds interacting with New Zealand fisheries is vital for determining the impact of fisheries on these seabird populations. Between 1 July 2021 and 30 June 2022, a total of 568 seabirds were reported as incidental interactions with commercial fishing vessels by on-board New Zealand Government Observers; of these 242 seabirds were returned for necropsy, and 326 were recorded as interactions (photographed (*n* = 144) or non-photographed (*n* = 182)) as deceased or alive captures.

242 individual seabirds, grouped into 23 species, were killed incidentally as bycatch and returned for necropsy. Seabirds were returned from 45 individual vessels, comprised of 12 longline (n = 98 seabirds), 28 trawl (n = 118 seabirds), two purse seine (n = 6 seabirds), and three set net (n = 20 seabirds) vessels, and were dominated numerically by four bycatch species: white-chinned petrel (n = 83, 34.3%), Buller's albatross (n = 33, 13.6%), New Zealand white-capped albatross (n = 25, 11.3%), and Salvin's albatross (n = 21, 8.7%). These four species accounted for 66.9% of all returned seabirds. All birds returned from longline fisheries had injuries consistent with being hooked in the bill, throat, or wing. Most birds returned from trawl fisheries were caught through entanglement in the net, cod-end, or pound (66.1%), with 15.2% likely to have specifically interacted with the warp. The cause of death for seven birds was deck strike on trawl vessels. Birds had a lower mean body fat score in comparison to birds from the previous three survey years. 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 (MPI) Central Observer Database (COD) and images provided by Government Observers gave a total of a further 326 seabirds that were reported as interactions or photographed (as dead or alive captures) aboard 52 fishing vessels. Over half (54%) of the seabirds reported in these interactions and photographs were released alive. Out of these 326 records of seabird interactions, photographs were taken of 144 seabirds consisting of 16 species. Image quality had improved compared to previous reporting periods.

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 the New Zealand EEZ overlaps with the ranges of these seabirds (Robertson, et al., 2003), and seabirds are regularly interacting with fishing vessels and gear. Therefore, the accurate identification of seabirds interacting with commercial fisheries operations is vital for determining the impact of fisheries on these seabird populations.

New Zealand Government Observers have been placed on a subset of inshore and deep-water commercial vessels since 1989, partly to investigate interactions between fisheries and seabird species. However, Observers are not always able to accurately identify seabirds to species level at sea. Consequently, a necropsy and morphometrics programme has been in place since 1996 to accurately determine the taxon (as well as age, sex, diet, and provenance) of specimens recovered as deceased by observers. Observers

present on fishing trips within New Zealand's EEZ are generally required to return all bycatch seabirds recovered during fishing operations for necropsy. Additional information such as vessel name, location of bycatch (latitude and longitude), and date of bycatch is also recorded. Specific bycatch 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 INT2019-02.

In the past, Observer identification of seabirds released alive was often of unknown accuracy, and was 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, or interacting with, New Zealand fisheries between 1 July 2021 and 30 June 2022. Species identification was made from specimens returned for necropsy, or from photographs or videos recorded by Observers.

1.1 Objectives

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

The specific objectives of the necropsy programme are to:

1. Determine the taxon, sex and, where possible, age class, morphometrics, 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 deceased specimens).
3. Report any changes in the protocol used for necropsy of seabirds (for returned deceased specimens).
4. Determine the species and, where possible, sex, age-class and provenance of bycatch seabirds in New Zealand fisheries through examination of photographs (for live interactions or deceased specimens discarded at sea).

2. METHODS

Common and scientific names of all species caught, photographed, or recorded in the COD extract 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).

Table 1: *Common and scientific names of seabirds recorded by observers as interacting with fishing vessels between 1 July 2021 and 30 June 2022.*

COMMON NAME	SCIENTIFIC NAME
Albatross (unidentified)	
Antarctic prion	*Pachyptila desolata*
Black (Parkinson's) petrel	*Procellaria parkinsoni*
Black-backed gull	*Larus dominicanus*
Buller's albatross	*Thalassarche bulleri bulleri*
Buller's and Pacific albatross	*Thalassarche bulleri*
Campbell albatross	*Thalassarche impavida*

COMMON NAME	SCIENTIFIC NAME
Cape petrels	*Daption spp.*
Chatham Island albatross	*Thalassarche eremita*
Common diving petrel	*Pelecanoides urinatrix*
Fairy prion	*Pachyptila turtur*
Fiordland crested penguin	*Eudyptes pachyrhynchus*
Flesh-footed shearwater	*Puffinus carneipes*
Fluttering shearwater	*Puffinus gavia*
Giant petrel (unidentified)	*Macronectes spp.*
Great albatross (unidentified)	*Diomedea spp.*
Grey petrel	*Procellaria cinerea*
Grey-backed storm petrel	*Garrodia nereis*
Grey-headed albatross	*Thalassarche chrysostoma*
Mid-sized petrel & shearwater (unidentified)	
Mottled petrel	*Pterodroma inexpectata*
New Zealand white-capped albatross	*Thalassarche steadi*
Northern giant petrel	*Macronectes halli*
Otago shag	*Leucocarbo chalconotus*
Petrel (unidentified)	
Petrels, prions and shearwaters (unidentified)	
Prion (unidentified)	*Pachyptila spp.*
Procellaria petrel (unidentified)	*Procellaria spp.*
Pterodroma petrel (unidentified)	*Pterodroma spp.*
Red-billed gull	*Larus scopulinus*
Salvin's albatross	*Thalassarche salvini*
Shearwater (unidentified)	*Puffinus spp.*
Small albatross (unidentified)	*Thalassarche spp.*
Snares Cape petrel	*Daption capense australe*
Sooty shearwater	*Puffinus griseus*
Southern black-browed albatross	*Thalassarche melanophris*
Southern giant petrel	*Macronectes giganteus*
Southern royal albatross	*Diomedea epomophora*
Storm petrel (unidentified)	
Wandering (Snowy) albatross	*Diomedea exulans*
Wandering albatross (unidentified)	*Diomedea exulans spp.*
Westland petrel	*Procellaria westlandica*
White-bellied storm petrel	*Fregetta grallaria*
White-chinned petrel	*Procellaria aequinoctialis*
White-faced storm petrel	*Pelagodroma marina*
Yellow-eyed penguin	*Megadytes antipodes*

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; Robertson & Bell, 2002b; Robertson, et al., 2003; Robertson, et al., 2004; Conservation Services Programme, 2008; Thompson, 2009; Thompson, 2010a;

Thompson, 2010b; Bell, 2011; Bell, 2012; Bell, 2013; Bell & Mischler, 2014; Bell & Mischler, 2015; Bell & Bell, 2016; Bell & Bell, 2017; Bell & Bell, 2018; Bell & Bell, 2019; Bell & Larcombe, 2022).

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 by age class (adult, sub-adult, immature, juvenile) and adults were assigned a breeding status (breeding adult or non-breeding adult) where possible. Categorisation was based on a combination of plumage, morphological (such as bill size and colour), gonadal and brood patch characteristics.

- *Adult* – adult morphology (e.g. body size, bill size, bill colour, plumage colour). Active breeding could not be confirmed.
- *Sub-adult (pre-breeder)* – non-adult or near-adult plumage and/or morphology (e.g. bill colour). No gonadal evidence that they had obtained breeding condition.
- *Immature* – non-adult plumage, plumage indicates that individual is 1+ years from breeding age.
- *Juvenile* - juvenile plumage and/or morphology (e.g. bill colour, bill size, leg, and foot colour).
- *Breeding adult* - considered to be actively breeding at the time of capture (e.g. bare brood patch, swollen ovaries or testes).
- *Non-breeding adult* - identified by feather moult (e.g. downy brood patch, body moult, wing moult) and gonadal evidence (i.e. regressed or small ovaries and testes).

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 became difficult). In instances where the birds had 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 specimen, any injuries were recorded, and this information, together with observer comments on the necropsy label, was used to determine the likely cause of death.

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 a Microsoft 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 seabirds for which the records indicated that only observer identification had been made, rather than a confirmed identification following necropsy. This covered live specimens, 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 MPI COD extracts) and reported interactions in the MPI COD extract with no corresponding image, including 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 deceased 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 bycatch, time of capture etc.) in an Excel spreadsheet.

Deceased 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 specimens 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 taxonomic level. Various seabird reference books (i.e., such as 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 level, 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 level 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(s), the information from the observers, and any other information observed in the photograph or the MPI COD extract were entered into a Microsoft Access database.

2.3 Statistical Analyses

Statistical analyses were conducted using Microsoft Excel. Descriptive statistics are presented. Means are given as values +/- standard error (SE).

Figures and tables were produced using Microsoft Excel and QGIS.

3. RESULTS

3.1 Summary

Table 2 summarises all seabird interactions with vessels in New Zealand EEZ between 1 July 2021 and 30 June 2022. There were 242 seabirds returned for necropsy, 144 photographed interactions (22 released alive, one of these with terminal injuries, and 122 deceased), and 182 recorded (not photographed) interactions (154 seabirds released alive and 28 deceased).

Table 2: *Common and scientific names of seabirds recorded as interacting with fishing vessels between 1 July 2021 and 30 June 2022, grouped by end status (alive/dead). Records are classified as interactions (I) if no photograph was obtained, photographed (P) if a photograph was obtained, and necropsy (N) if the whole specimen was retained for necropsy.*

COMMON NAME	END STATUS							TOTAL
	ALIVE			DECEASED				
	I	P	Total	I	P	N	Total	
Albatross (unidentified)	9		9	1			1	**10**
Antarctic prion						2	2	**2**
Black (Parkinson's) petrel	3	1	4					**4**

Black-backed gull	1		1					1
Buller's albatross	5	1	6	1	6	33	40	46
Buller's and Pacific albatross	8		8					8
Campbell albatross						1	1	1
Cape petrels	1		1	1			1	2
Chatham Island albatross						1	1	1
Common diving petrel	8	1	9			14	14	23
Fairy prion	1		1	1	1	1	3	4
Fiordland crested penguin					6		6	6
Flesh-footed shearwater	10	6	16		1	3	4	20
Fluttering shearwater						2	2	2
Giant petrel (unidentified)	3		3	1			1	4
Great albatross (unidentified)	5		5					5
Grey petrel						3	3	3
Grey-backed storm petrel						1	1	1
Grey-headed albatross	2		2					2
Mid-sized petrel & shearwater (unidentified)	1		1					1
Mottled petrel		1	1			1	1	2
New Zealand white-capped albatross	23	3	26	3	5	25	33	59
Northern giant petrel	1		1			3	3	4
Otago shag						17	17	17
Petrel (unidentified)	10		10	1			1	11
Petrels, prions, and shearwaters (unidentified)	11		11	3			3	14
Prion (unidentified)	4		4					4
Procellaria petrel (unidentified)	2		2	5			5	7
Pterodroma petrel (unidentified)	1		1					1
Red-billed gull	1		1					1
Salvin's albatross	14	2	16	3	15	21	39	55
Shearwater (unidentified)	1		1					1
Small albatross (unidentified)				1			1	1
Snares Cape petrel		1	1			1	1	2
Sooty shearwater	2	2	4	1	5	10	16	20
Southern black-browed albatross		1	1					1
Southern giant petrel						1	1	1
Southern royal albatross	3		3			5	5	8
Storm petrel (unidentified)	4		4	1			1	5
Wandering (Snowy) albatross	1		1					1
Wandering albatross (unidentified)				1			1	1
Westland petrel	2		2		2	10	12	14
White-bellied storm petrel		1	1				0	1
White-chinned petrel	17	2	19	4	80	83	167	186
White-faced storm petrel						2	2	2
Yellow-eyed penguin					1	2	3	3
TOTAL	**154**	**22**	**176**	**28**	**122**	**242**	**392**	**568**

3.1.1 Returned seabirds

A total of 242 seabirds comprised of 23 species were returned from 45 vessels between 1 July 2021 and 30 June 2022. The species returned most frequently was white-chinned petrels (n = 83, 34.3% of returned specimens) (Tables 2 and 3). Buller's albatross (n = 33, 13.6%), New Zealand white-capped albatross (n = 25, 10.3%), and Salvin's albatross (n = 21, 8.7%) were also returned in high numbers (Tables 2 and 3). These four species accounted for 66.9% of all returned seabirds.

Banded seabird specimens provide valuable longevity and survival data. No banded birds were within those captured and returned during this reporting period. Two yellow-eyed penguins uniquely identified with RFID tags were returned. One of these penguins was identified as a one-year-old male juvenile that had fledged from Papanui Beach, Otago. The other penguin was identified as a one-year-old female juvenile that was tagged at Pipikaretu, Otago Peninsula.

The monthly distribution of returned specimens was not evenly spread across the time period analysed in this study. Most returned birds were caught in March (n = 50, 20.7%), February (n = 39, 16.1%), April (n = 35, 14.5%), and May (n = 24, 9.9%) (Table 3).

The majority of returned seabirds were males (n = 153, 63.2%). All Campbell albatross, fairy prion, grey petrel, grey-backed storm petrel, and Snares Cape petrel returned were males (Figure 1). All three northern giant petrels, and the single Chatham Island albatross, mottled petrel, and southern giant petrel returned were female (Figure 1). Sex ratios of returned fluttering shearwaters, Otago shags, white-faced storm petrels, and yellow-eyed penguins were even (Figure 1). The sex of 13 birds (5.4%) was not able to be determined (Figure 1).

Most returned seabirds were adults (n = 216, 89.3%) (Figure 2). 13 returned seabirds were juveniles (5.4%), and ten were sub-adults (4.1%) (Figure 2). The age class of three birds (1.2%) was not able to be determined (Figure 2).

Of the adult seabirds returned, 82 (38.0%) were breeding and 11 (5.1%) were non-breeding (Figure 3). Breeding status of the remaining 123 adult birds (56.9%) was not able to be determined (Figure 3).

Table 3: *Number of seabirds of each species returned for necropsy from observed fishing vessels between 1 July 2021 and 30 June 2022, by month of capture.*

SPECIES	MONTH												TOTAL	ANNUAL TOTAL (%)
	2021						2022							
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Antarctic prion						1			1				2	0.8
Buller's albatross	6	6		1	1	1	2	1		7	4	4	33	13.6
Campbell albatross						1							1	0.4
Chatham Island albatross					1								1	0.4
Common diving petrel								1					1	0.4
Fairy prion				2	2			2	2	2		4	14	5.8
Flesh-footed shearwater							1	1					2	0.8
Fluttering shearwater		1											1	0.4
Grey petrel						1			2				3	1.2
Grey-backed storm petrel			1										1	0.4
Mottled petrel											3		3	1.2
New Zealand white-capped albatross										1			1	0.4
Northern giant petrel	2				1								3	1.2
Otago shag				1			1	9	6				17	7.0
Salvin's albatross		1	1		2						1		5	2.1
Snares Cape petrel	2			2	5	6	2	3	1				21	8.7
Sooty shearwater				2				5	2	1			10	4.1
Southern giant petrel												1	1	0.4
Southern royal albatross					1	3	2	13	31	22	11		83	34.3
Westland petrel					1		1						2	0.8
White-chinned petrel	6	4			2			3	4	2	4		25	10.3
White-faced storm petrel	1	5		1	1			1			1		10	4.1
Yellow-eyed penguin				1					1				2	0.8
TOTAL	17	17	2	10	17	13	9	39	50	35	24	9	242	
MONTHLY TOTAL (%)	7.0	7.0	0.8	4.1	7.0	5.4	3.7	16.1	20.7	14.5	9.9	3.7		

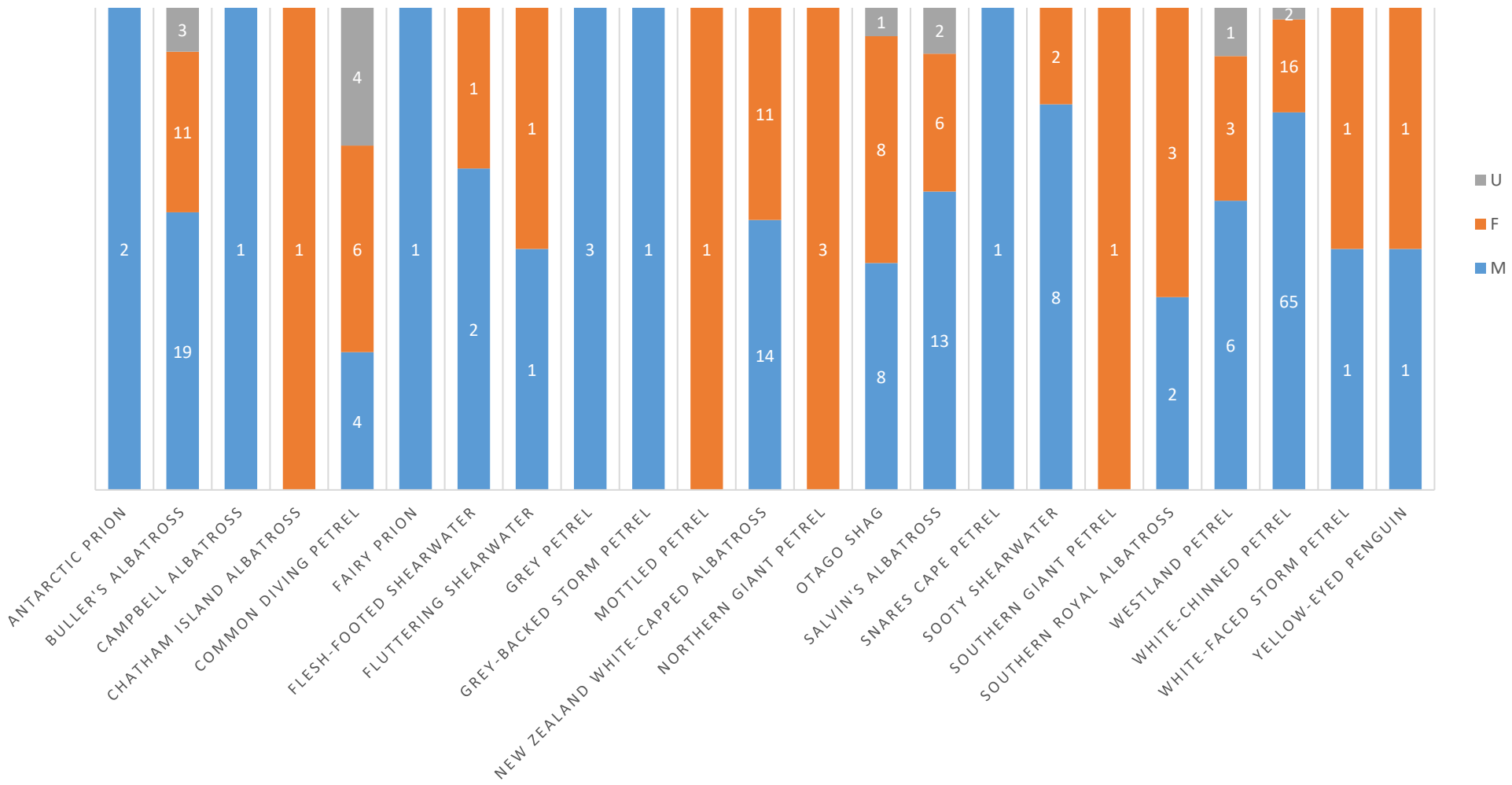

Figure 1: *Proportions of deceased seabirds returned from observed fishing vessels between 1 July 2021 and 30 June 2022, by species and sex (U = unknown, F = female, M = male). Total numbers returned for each category are shown inside the coloured bars.*

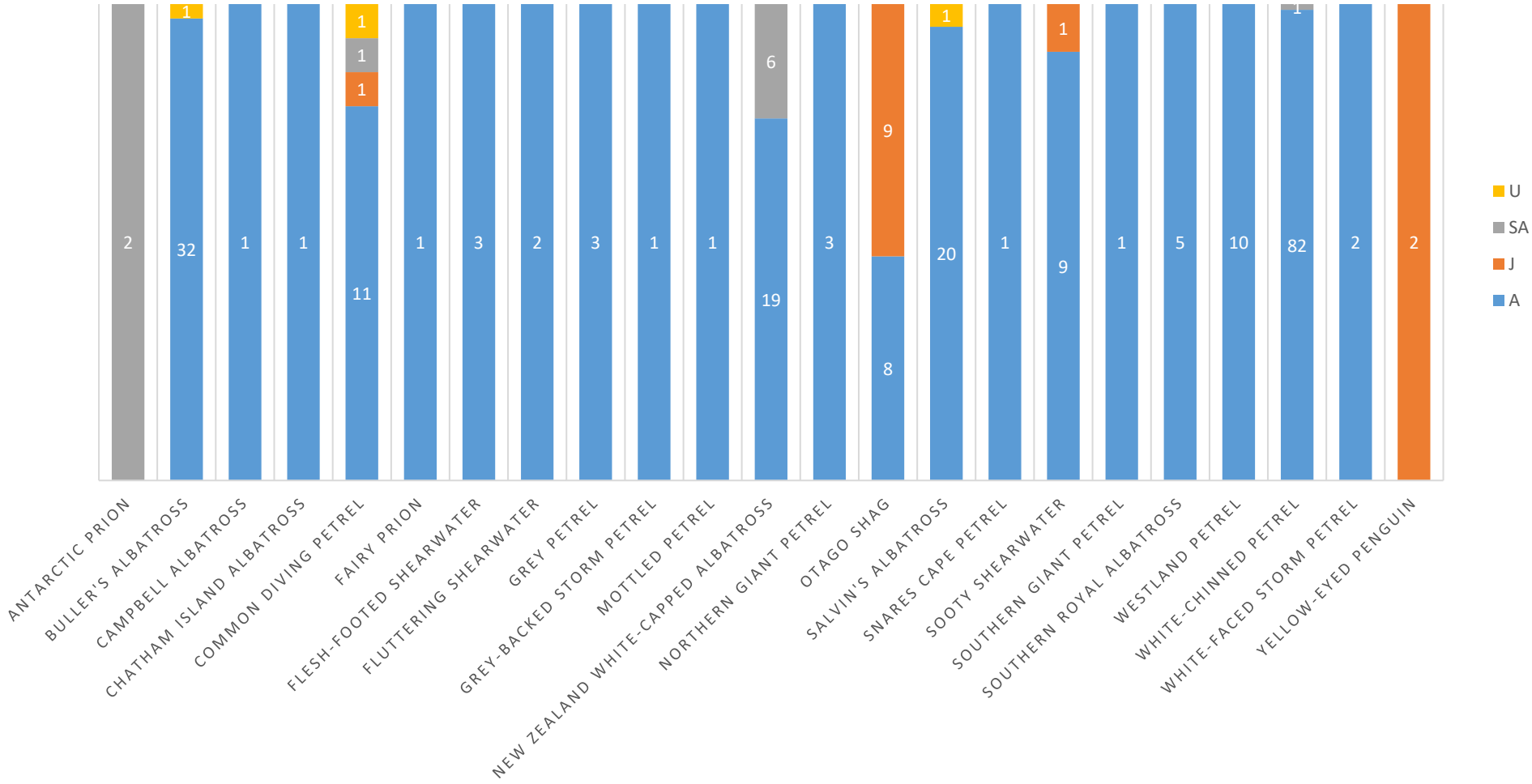

Figure 2: *Proportions of deceased seabirds returned from observed fishing vessels between 1 July 2021 and 30 June 2022, by species and age class (U = unknown, SA = sub-adult, J = juvenile, A = adult. Total numbers returned for each category are shown inside the coloured bars.*

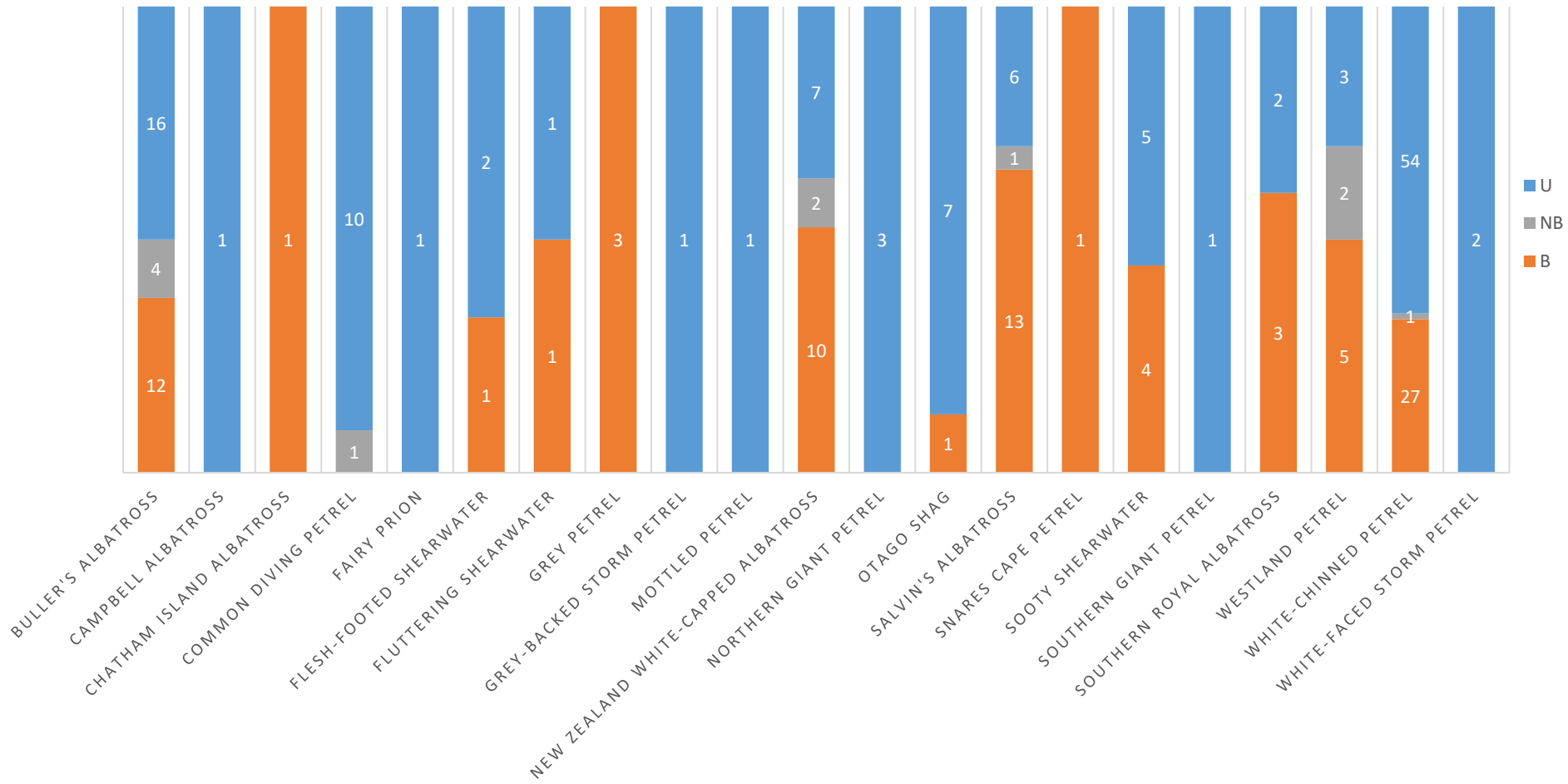

Figure 3: *Proportions of deceased adult seabirds returned from observed fishing vessels between 1 July 2021 and 30 June 2022, by species and breeding class (U = unknown breeding status, NB = non-breeding, B = breeding). Total numbers returned for each category are shown inside the coloured bars.*

3.1.2 Vessel type and target fishery of necropsy seabirds

The bycatch seabirds returned for necropsy were caught in a range of Fishery Management Areas (FMAs) (1, 2, 3, 4, 5, 6, 7 and 8). General positions are show in Figure 4.

For the study period 1 July 2021 to 30 June 2022, there were 238 observed trips on 122 vessels (Observer data, unpublished). 45 vessels (36.9% of observed vessels) are known to have returned seabirds for necropsy during this period from 86 observed trips (36.1% of observed trips). The majority of the vessels returned relatively low numbers of birds (≤ 5 birds; n = 32, 71.1%). Six vessels returned more than ten birds: one bottom longline vessel returned 31 birds from one observed trip, three surface longline vessels returned 23, 18, and 13 birds respectively from a single observed trip, one set net vessel returned 17 birds from one observed trip, and one trawl vessel returned 11 birds from four observed trips. The remaining seven vessels returned between six and nine birds from between one and four observed trips.

Of those vessels that returned seabirds, 12 were longline vessels (26.7%; seven bottom longline and five surface longline), three were set-net vessels (6.7%), two were purse seine vessels (4.4%) and 29 were trawl vessels (63.6%).

Of the 241 returned seabirds for which fishing method and target species information has been obtained to date, 117 birds were returned from trawl fisheries (bottom and midwater trawl, 48.5% of total returns), with trawlers targeting squid *Nototodarus* spp. accounting for 42.7% (n = 50) of all trawl returns, and those targeting hoki *Macruronus novaezelandiae* accounting for 26.5% (n = 31) of all trawl returns (Table 4).

98 seabirds were returned from longline vessels (bottom and surface longline, 40.5% of total returns; bottom longline n = 39, and surface longline n = 59), with surface longline vessels targeting southern bluefin tuna *Thunnus maccoyii* returning 60.2% of longline specimens (n=59), and bottom longline vessels targeting ling *Genypterus blacodes* returning 36.7% of longline specimens (n = 36) (Table 5).

20 seabirds were returned from set net vessels (8.3% of total returns), with vessels targeting school shark *Galeorhinus galeus* accounting for 85% of set net returns (n = 17) (Table 5).

The target species for one returned seabird caught by a trawl vessel has not been obtained to date.

3.1.3 Injuries and likely cause of death of necropsied seabirds

Of the 117 birds returned from trawl vessels, most had been caught in the net or recovered in the pound or cod-end (i.e. had drowned, n = 88, 75.2%), and were very wet and sandy with crush injuries (Tables 6 and 7). Other birds had injuries suggesting entanglement and crush injuries from the trawl warp and blocks (n = 18, 15.4%), 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 (51.8%), while only albatross taxa were affected by warp strikes exhibiting serious wing injuries or lacerations (Tables 6 and 7). There were 11 seabirds returned that had been killed by striking a trawl vessel (10.3%) (Tables 6 and 7).

All 20 birds caught in set nets were caught in the net with occasional damage to legs or bills (Tables 6 and 7).

The condition of the returned birds ranged from ‘no obvious or visible injury’, ‘waterlogged’, ‘greased’ or ‘hook present’ to ‘crushed’. As in previous years, birds caught and returned from trawl fisheries had different injuries from those caught by longline vessels.

Of the 98 birds returned from longline vessels, most were waterlogged and had hook injuries, and of these, 13 (13.5%) still had hooks present (ten in the bill/throat/neck and three in the wing) (Tables 6 and 7).

Many birds had multiple injuries, resulting in the total number of injuries recorded (n = 318) being higher than the total number of seabirds returned (n = 242, Table 7).

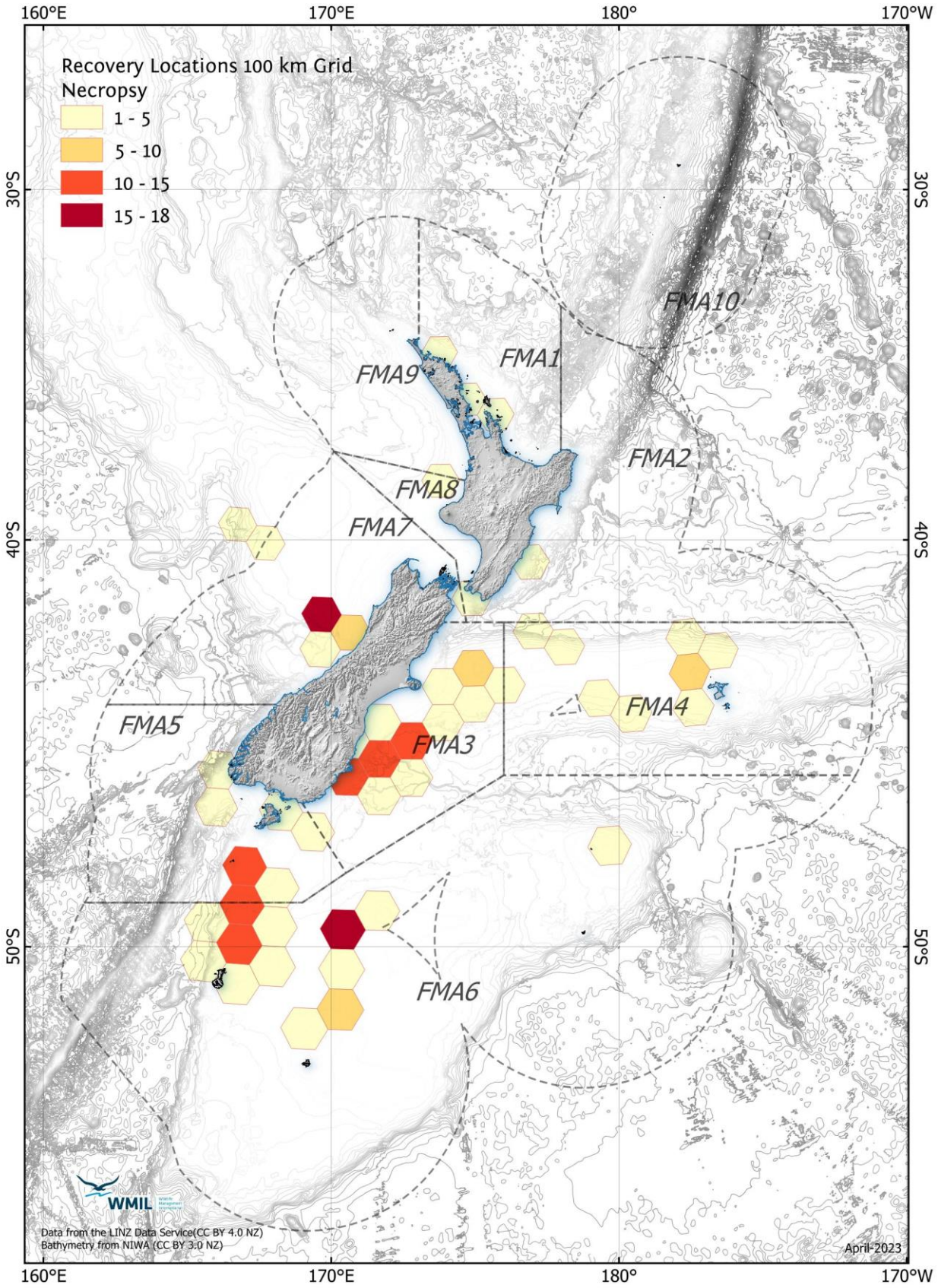

Figure 4: *Grouped catch locations of all bycatch seabirds returned in New Zealand fisheries for necropsy between 1 July 2021 and 30 June 2022.*

Table 4: *Number of seabirds of each species returned from observed Bottom/Midwater Trawl fishing vessels between 1 July 2021 and 30 June 2022 by fishing target species.*

Species	Bottom/Midwater Trawl								
	Barracouta	Hoki	Jack Mackerel	Ling	Orange Roughy	Southern Blue Whiting	Scampi	Squid	Silver Warehou
Antarctic prion	1							1	
Buller's albatross	3	8		2				9	1
Chatham Island albatross	1								
Common diving petrel	1	1		1	1			3	
Fairy prion					1				
Flesh-footed shearwater		1							
Grey-backed storm petrel						1			
New Zealand white-capped albatross	4			1				8	
Northern giant petrel			1		2				
Salvin's albatross	3	12		1			1	4	
Snares Cape petrel		1							
Sooty shearwater	3							6	
Southern giant petrel					1				
Southern royal albatross	2					2			
Westland petrel		2						1	
White-chinned petrel	1	5						18	
White-faced storm petrel	1	1							
TOTAL	**20**	**31**	**1**	**5**	**5**	**3**	**1**	**50**	**1**

Table 5: *Number of seabirds of each species returned from observed fishing vessels between 1 July 2021 and 30 June 2022, by fishery type (Bottom Longline, Surface Longline, Purse Seine, and Set Net) and target species.*

Species	Bottom Longline		Surface Longline	Purse Seine	Set Net	
	Ling	Snapper	Southern Bluefin Tuna	Blue Mackerel	School Shark	Rig
Buller's albatross			10			
Campbell albatross	1					
Common diving petrel				5	1	
Flesh-footed shearwater		2				
Fluttering shearwater		1		1		
Grey petrel			3			
Mottled petrel	1					
New Zealand white-capped albatross			12			
Otago shag					15	2
Sooty shearwater	1					
Southern royal albatross			1			
Westland petrel	2		5			
White-chinned petrel	31		28			
Yellow-eyed penguin					1	1
TOTAL	**36**	**3**	**59**	**6**	**17**	**3**

Table 6: *Number of seabirds of each species returned from Longline, Trawl, Set Net, and Purse Seine fisheries between 1 July 2021 and 30 June 2022, by likely cause of death. The proportion of albatross and non-albatross species returned by fishing method is also presented as a percentage.*

Species	Trawl				Longline				Set Net	Purse Seine	Total
	Warp	Net	Pound or Cod-end	Vessel strike	Hook found in: Bill, neck, or throat	Hook found in: Wing	Drowned on line	Vessel Strike	Tangled	Tangled	
Antarctic prion		1		1							2
Buller's albatross	6	15	1	1	2		8				33
Campbell albatross							1				1
Chatham Island albatross	1										1
Common diving petrel		2		5					1	5	13
Fairy prion		1									1
Flesh-footed shearwater		1					2				3
Fluttering shearwater							1			1	2
Grey petrel							3				3
Grey-backed storm petrel				1							1
Mottled petrel								1			1
New Zealand white-capped albatross	3	9	1		5	2	5				25
Northern giant petrel		3									3
Otago shag									17		17
Salvin's albatross	7	13	1								21
Snares Cape petrel		1									1
Sooty shearwater		8	1				1				10
Southern giant petrel				1							1
Southern royal albatross	1	3					1				5
Westland petrel		3			2		5				10
White-chinned petrel		23	1		1	1	57				83
White-faced storm petrel				2							2
Yellow-eyed penguin									2		2
Total	**18**	**83**	**5**	**11**	**10**	**3**	**84**	**1**	**20**	**6**	**241**
Total (by fishing method)	117				98				20	6	
Albatrosses (%)	100.0	48.2	60.0	9.1	70.0	66.7	17.9				
Non-albatross (%)		51.8	40.0	90.9	30.0	33.3	82.1	100.0	100.0	100.0	

Table 7: *Injury types recorded for seabird species returned from commercial fisheries between 1 July 2021 and 30 June 2022 (n = 242). The proportion of albatross and non-albatross species returned is also presented as a percentage.*

Species	No visible injuries	Waterlogged	Broken wing	Broken legs or feet	Broken bill	Hook wound in bill or throat	Hook wound in wing, or body	Open wound or severed body part	Crushed, or more than 3 injuries	Greased	Liced	Total injury types
Antarctic prion			1	1								2
Buller's albatross	3	9	8	3	3	3		13	1	3	1	47
Campbell albatross			1									1
Chatham Island albatross										1		1
Common diving petrel	3	2	3	1					5			14
Fairy prion		1							1			2
Flesh-footed shearwater		1										1
Fluttering shearwater	1	1										2
Grey-backed storm petrel	1											1
Mottled petrel									1			1
NZ white-capped albatross	5	4	6	1	4	5	2	4	1	2	1	35
Northern giant petrel	1		1	1						1		4
Otago shag		12		2	1						3	18
Salvin's albatross	3	6	8	6				5	6	4	1	39
Snares Cape petrel	1											1
Sooty shearwater	3	2	1	1	2			2				11
Southern giant petrel	1											1
Southern royal albatross		1	3	2		1		1				8
Westland petrel	3	1				2	2	1			1	10
White-chinned petrel	7	46	4	9	7	5	9	17	2		9	115
White-faced storm petrel	1							2				3
Yellow-eyed penguin			1									1
Total	**33**	**86**	**37**	**27**	**17**	**16**	**13**	**45**	**17**	**11**	**16**	**318**
% of birds with this injury type	10.4	27.0	11.6	8.5	5.3	5.0	4.1	14.2	5.3	3.5	5.0	
Albatrosses (%)	18.2	18.6	56.8	44.4	17.6	25.0	0.0	42.2	47.1	63.6	12.5	
Non-albatross (%)	81.8	81.4	43.2	55.6	82.4	75.0	100.0	57.8	52.9	36.4	87.5	

3.1.4 Body condition of necropsy seabirds

The mean fat scores of returned birds (1.97 ± SE 0.07) was lower than the previous three survey years (2020/2021 = 2.09 ± 0.1; 2019/2020 = 2.2 ± 0.1; 2018/2019 = 2.2 ± 0.1), but higher than the 2016-18 survey years (2017/18 (1.8 ± 0.1), 2016/17 (1.7 ± 0.1), 2015/16 (1.3 ± 0.0)) (Bell & Bell 2016, Bell & Bell 2017, Bell & Bell 2018, Bell & Bell 2019; Bell 2021; Bell & Larcombe 2022) (Table 8, Figure 4). Fat scores were not obtained from 16 birds due to damage.

Table 8: *Fat scores of bycatch seabirds returned from fishing vessels between 1 July 2021 and 30 June 2022 (1= no fat; 5 = extremely fat; U = unknown).*

SPECIES	FAT SCORE						Total No. Birds	Mean Fat Score	SE (±)
	1	2	3	4	5	U			
Antarctic prion				2			2		
Buller's albatross	8	16	7			2	33	1.97	0.88
Campbell albatross	1						1	1.00	0.00
Chatham Island albatross	1						1	1.00	0.00
Common diving petrel	3	6	2	1		2	14	2.00	0.76
Fairy prion		1					1	2.00	0.00
Flesh-footed shearwater		1	2				3	2.67	0.61
Fluttering shearwater	2						2	1.00	0.50
Grey petrel		1	1	1			3	3.00	0.68
Grey-backed storm petrel			1				1	3.00	0.00
Mottled petrel			1				1	3.00	0.00
NZ white-capped albatross	9	5	1	7	1	2	25	2.39	0.86
Northern giant petrel		1		2			3	3.33	0.75
Otago shag	1	4	9	3			17	2.82	0.81
Salvin's albatross	7	5	3	4		2	21	2.21	0.83
Snares Cape petrel	1						1	1.00	0.00
Sooty shearwater	6	2	1	1			10	1.70	0.80
Southern giant petrel				1			1	4.00	0.00
Southern royal albatross	2		3				5	2.20	0.66
Westland petrel	2	5	1			2	10	1.86	0.64
White-chinned petrel	50	19	7	1		6	83	1.46	0.95
White-faced storm petrel	1		1				2	2.00	0.59
Yellow-eyed penguin			2				2	3.00	1.00
TOTAL	**94**	**66**	**42**	**23**	**1**	**16**	**242**	1.97	0.07
% TOTAL	38.84	27.27	17.36	9.50	0.41	6.61			

The mean fat score has fluctuated over the past 12 years (Figure 5). Mean fat scores steadily increased over five survey years since the lowest fat score of 1.3 in 2015/16 to a mean fat score of 2.2 in 2018/19 and 2019/20 fishing years (Bell & Bell, 2020; Figure 5) The mean fat score has decreased over the past two recording periods.

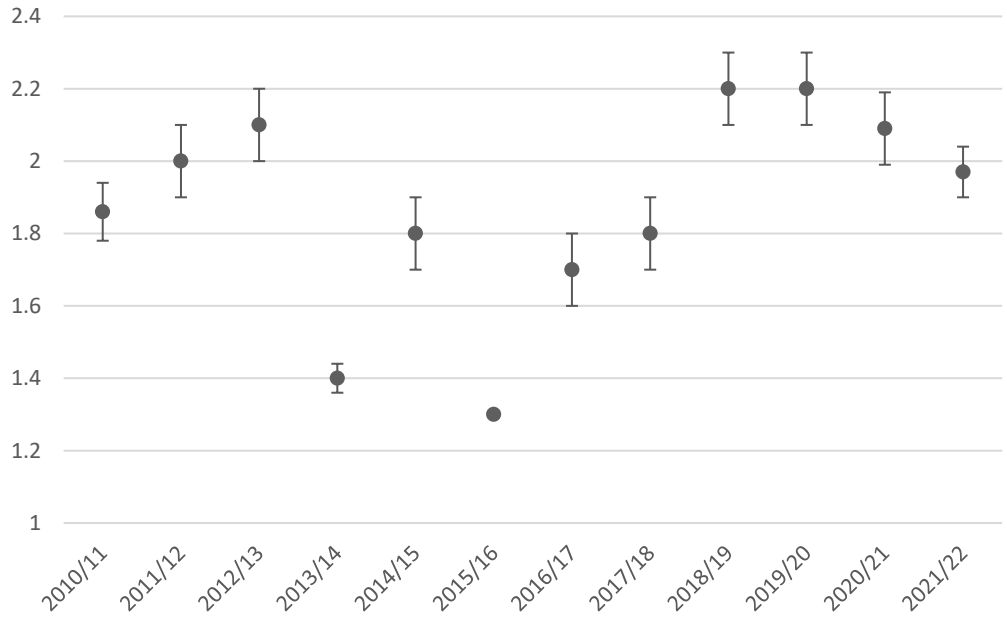

Figure 5: *Mean fat scores for all bycatch seabirds returned from New Zealand fisheries, per survey year, between 1 October 2010 and 30 June 2022 (1= no fat; 5 = extremely fat; U = unknown). Error bars show standard error.*

Table 9: *Stomach contents of bycatch seabirds returned from commercial fishing vessels between 1 July 2021 and 30 June 2022.*

SPECIES	EMPTY	MISSING	BAIT	OFFAL (OR DISCARDS)	NATURAL	PLASTIC	PROVENTRICULAR OIL	WORMS	HOOK
Antarctic prion	2								
Buller's albatross	11	3	9	12	3		1	2	
Campbell albatross			1	1					
Chatham Island albatross			1						
Common diving petrel	5	2			7				
Fairy prion	1								
Flesh-footed shearwater	2		1	1					
Fluttering shearwater					1	1			
Grey petrel	1		2	1					1
Grey-backed storm petrel	1								
Mottled petrel			1						
New Zealand white-capped albatross	7	1	7	15	1				
Northern giant petrel			1	3	3		2	1	
Otago shag			7	17	6		1	1	
Salvin's albatross	5	2	6	16	1				
Snares Cape petrel			1				1		
Sooty shearwater	2		7		3		3		
Southern giant petrel			1		1	1			
Southern royal albatross	2		1	3	1			1	
Westland petrel		1	1	8					1
White-chinned petrel	23	2	6	13	2	2	18	1	1
White-faced storm petrel	1				1				
Yellow-eyed penguin	1		1		2				
TOTAL no. birds	**64**	**11**	**54**	**90**	**32**	**4**	**26**	**6**	**3**
% of birds with status	22.1	3.8	18.6	31.0	11.0	1.4	9.0	2.1	1.0

***Table 10**: Gizzard contents of bycatch seabirds returned from commercial fishing vessels between 1 July 2021 and 30 June 2022.*

SPECIES	EMPTY	MISSING	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	PROVENTRICULAR OIL
Antarctic prion							1			1	
Buller's albatross	6	3	1	1	6	7		1	3	5	
Campbell albatross						1					
Chatham Island albatross										2	
Common diving petrel	4	1								9	
Fairy prion	1										
Flesh-footed shearwater			2	1		3	1				
Fluttering shearwater							1			1	
Grey petrel			3	2							
Grey-backed storm petrel	1										
Mottled petrel			1								
New Zealand white-capped albatross	4		8	2	5	10		1	2		
Northern giant petrel			1		4	1	1		1	3	
Otago shag											
Salvin's albatross	3	2	3	4	6	12			1	1	
Snares Cape petrel						1			1		
Sooty shearwater	2		3	2	1	2	1		1	1	
Southern giant petrel					1		1			1	
Southern royal albatross			4		4	1			2		
Westland petrel		1	9	4	1	4			3		
White-chinned petrel	1	3	77	19	5	23	4	1	34	1	4
White-faced storm petrel				2						1	
TOTAL no. birds	**22**	**10**	**112**	**37**	**33**	**65**	**10**	**3**	**48**	**26**	**4**
% of birds with status	5.9	2.7	30.3	10.0	8.9	17.6	2.7	0.8	13.0	7.0	1.1

3.1.5 Stomach and gizzard contents

Many returned seabirds contained multiple categories of stomach and/or gizzard content, resulting in higher stomach and gizzard contents totals than the number of seabirds killed and returned (n = 242).

The stomach contents from returned seabirds contained offal or discards in 90 samples (41.9%) and bait in 54 samples (25.1%) (Table 9). 64 birds had empty stomachs. A further 11 birds had missing stomachs due to interaction with fishing gear or damage due to sea lice. Four birds had plastic in their stomachs (Table 9). Photographs and samples of plastics were taken.

Most items of gizzard contents were categorized as natural food items (squid beaks 33.1%, fish bones and skin 19.2%, squid or fish eyeballs 9.8%, and otoliths 10.9%). Ten seabirds (3.0%) had gizzards containing plastic, metal, or string. Photographs and samples of plastics were taken. 22 birds had empty gizzards and ten birds had missing gizzards due to damage by fishing gear or sea lice. Samples of gizzard contents (e.g. squid beaks and otoliths) were collected for detailed identification to species level if required.

3.1.6 Identification of necropsied birds

Necropsy confirmed that the majority (71.9%) of retained seabirds were identified correctly to species level by on-board Observers (based on the information provided by observers on the specimen tags) (Table 11).

Table 11: *Comparison of identifications (ID) recorded by on-board observers compared with necropsy identification for seabirds returned from fishing boats between 1 July 2021 and 30 June 2022.*

Species	ID correct	ID to correct species group*	ID wrong	ID not on label or code did not exist	Total
Antarctic prion				2	2
Buller's albatross	8	23	1	1	33
Campbell albatross			1		1
Chatham Island albatross	1				1
Common diving petrel	10	1	3		14
Fairy prion			1		1
Flesh-footed shearwater	3				3
Fluttering shearwater	2				2
Grey petrel	3				3
Grey-backed storm petrel		1			1
Mottled petrel	1				1
New Zealand white-capped albatross	25				25
Northern giant petrel	2		1		3
Otago shag		16		1	17
Salvin's albatross	16	2	2	1	21
Snares Cape petrel		1			1
Sooty shearwater	9		1		10
Southern giant petrel			1		1
Southern royal albatross	3	1	1		5
Westland petrel	7	2		1	10
White-chinned petrel	82	1			83
White-faced storm petrel	1	1			2
Yellow-eyed penguin	1	1			2
Total	**174**	**50**	**12**	**6**	**242**
% Total	71.9	20.7	5.0	2.5	

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

50 seabirds (20.6%) 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 species were Buller's albatross, common diving petrel, grey-backed storm petrel, Otago shag, Salvin's albatross, Snares Cape petrel, southern royal albatross, Westland petrel, white-chinned petrel, white-faced storm petrel, and yellow-eyed penguin. A further 12 seabirds (5.0%) were identified incorrectly. Six seabirds (2.5%) did not have an observer identification code on the return label or had a code that did not exist (Table 11).

3.2 Photographs and Interactions

3.2.1 Numbers of photographed seabirds or those listed as interactions

326 incidents involving seabirds and fishing vessels were reported in the MPI COD extract, either as 'photographed' records, or as 'interaction' records (if the seabird interacted with the fishing vessel but was not photographed). This total includes both live and deceased seabirds recorded (Table 12).

Of these, 182 records had no associated photographs taken. Most of the birds that were not photographed were released alive or left the vessel unaided (*n* = 154; Table 12). There were 144 seabird interactions that were photographed and had corresponding entries in the MPI COD extract (Table 12).

The predominant species recorded through photographs or interactions seabirds was the white-chinned petrel (n = 103, 31.6%). New Zealand white-capped albatross (n = 34, 10.4%) and Salvin's albatross (n = 34, 10.34) were frequently recorded (Table 12). These three species accounted for 52.5% of all reported interactions and photographed birds.

As with records of seabird captures retained for necropsy, the distribution of photograph and interaction records was not evenly spread across the study time period. Most bird interactions were reported in April 2022 (n = 76, 23.3%), March 2022 (n = 69, 21.2%), and February 2022 (n = 43, 13.2%) (Table 13). This pattern reflects the timing of presence of these seabird species within the New Zealand EEZ, timing and location of all observed fisheries, and observer coverage.

Table 12: *Number of seabirds of each species reported as photographed, or recorded as interacting with fishing vessels (not photographed), between 1 July 2021 and 30 June 2022.*

Species	Photo			Interaction			Total
	Alive	Dead	Total	Alive	Dead	Total	
Albatross (unidentified)				9	1	10	**10**
Black (Parkinson's) petrel	1		1	3		3	**4**
Black-backed gull				1		1	**1**
Buller's albatross	1	6	7	5	1	6	**13**
Buller's and Pacific albatross			0	8		8	**8**
Cape petrels	1		1	1	1	2	**3**
Common diving petrel	1		1	8		8	**9**
Fairy prion		1	1	1	1	2	**3**
Fiordland crested penguin		6	6				**6**
Flesh-footed shearwater	6	1	7	10		10	**17**
Giant petrel (unidentified)				3	1	4	**4**
Great albatross (unidentified)				5		5	**5**
Grey-headed albatross				2		2	**2**
Mid-sized petrel & shearwater (unidentified)				1		1	**1**
New Zealand white-capped albatross	3	5	8	23	3	26	**34**
Northern giant petrel				1		1	**1**
Petrel (unidentified)	1		1	10	1	11	**12**

Petrels, prion and shearwaters (unidentified)				11	3	14	**14**
Prion (unidentified)				4		4	**4**
Procellaria petrel (unidentified)				2	5	7	**7**
Pterodroma petrel (unidentified)				1		1	**1**
Red-billed gull				1		1	**1**
Salvin's albatross	2	15	17	14	3	17	**34**
Shearwater (unidentified)				1		1	**1**
Small albatross (unidentified)					1	1	**1**
Sooty shearwater	2	5	7	2	1	3	**10**
Southern black-browed albatross	1		1				**1**
Southern royal albatross				3		3	**3**
Storm petrel (unidentified)				4	1	5	**5**
Wandering (Snowy) albatross					1	1	**1**
Wandering albatross (unidentified)				1		1	**1**
Westland petrel		2	2	2		2	**4**
White-bellied storm petrel	1		1				**1**
White-chinned petrel	2	80	82	17	4	21	**103**
Yellow-eyed penguin		1	1				**1**
TOTAL	**22**	**122**	**144**	**154**	**28**	**182**	**326**

Table 13: *Number of seabirds recorded as interactions (photographed or non-photographed) with fishing vessels between 1 July 2021 and 30 June 2022, by month of incident.*

SPECIES	2021						2022						TOTAL	TOTAL %
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun		
Albatross (unidentified)		1		1			2			1	1	4	10	3.1
Black (Parkinson's) petrel								1	1	2			4	1.2
Black-backed gull											1		1	0.3
Buller's albatross		2						1		6		4	13	4.0
Buller's and Pacific albatross	2					1					4	1	8	2.5
Cape petrels						2							2	0.6
Common diving petrel				6				2		1			9	2.8
Fairy prion	1								2				3	0.9
Fiordland crested penguin				6									6	1.8
Flesh-footed shearwater							1		6	10			17	5.2
Giant petrel (unidentified)	1							1	1	1			4	1.2
Great albatross (unidentified)						3	2						5	1.5
Grey-headed albatross									2				2	0.6
Mid-sized petrel & shearwater (unidentified)								1					1	0.3
Mottled petrel								1					1	0.3
New Zealand white-capped albatross	4	1		4		1	2	4	2	6	4	6	34	10.4
Northern giant petrel										1			1	0.3
Petrel (unidentified)								3	6	2			11	3.4
Petrels, prion and shearwaters (unidentified)	1			1		1		1	3	3	3	1	14	4.3
Prion (unidentified)			1						2	1			4	1.2
Procellaria petrel (unidentified)							1	4		1	1		7	2.1
Pterodroma petrel (unidentified)	1												1	0.3
Red-billed gull							1						1	0.3
Salvin's albatross				10	9	6	2	6	1				34	10.4
Shearwater (unidentified)								1					1	0.3

Small albatross (unidentified)	1												1	0.3
Snares Cape petrel											1		1	0.3
Sooty shearwater				1				5	2	1	1		10	3.1
Southern black-browed albatross					1								1	0.3
Southern royal albatross							2			1			3	0.9
Storm petrel (unidentified)					1					1	2	1	5	1.5
Wandering (Snowy) albatross								1					1	0.3
Wandering albatross (unidentified)												1	1	0.3
Westland petrel	1	1			1						1		4	1.2
White-bellied storm petrel		1												
White-chinned petrel			1			3	4	11	41	38	5			
Yellow-eyed penguin				1									1	0.3
TOTAL INTERACTIONS	12	6	2	30	12	17	17	43	69	76	24	18	326	
TOTAL INTERACTIONS (%)	3.7	1.8	0.6	9.2	3.7	5.2	5.2	13.2	21.2	23.3	7.4	5.5		

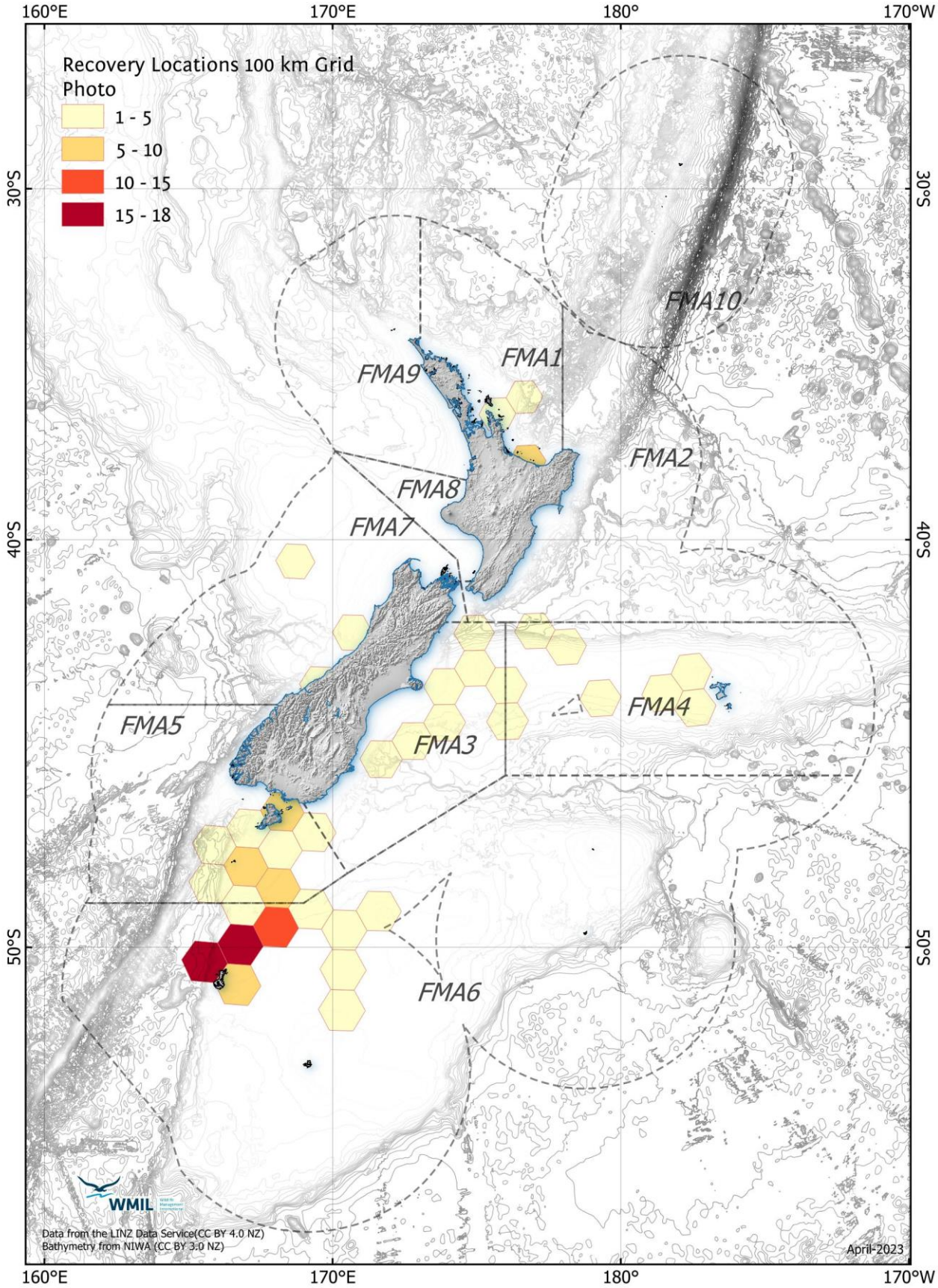

Figure 6: *Grouped catch locations of all seabirds caught and photographed in New Zealand fisheries between 1 July 2021 and 30 June 2022.*

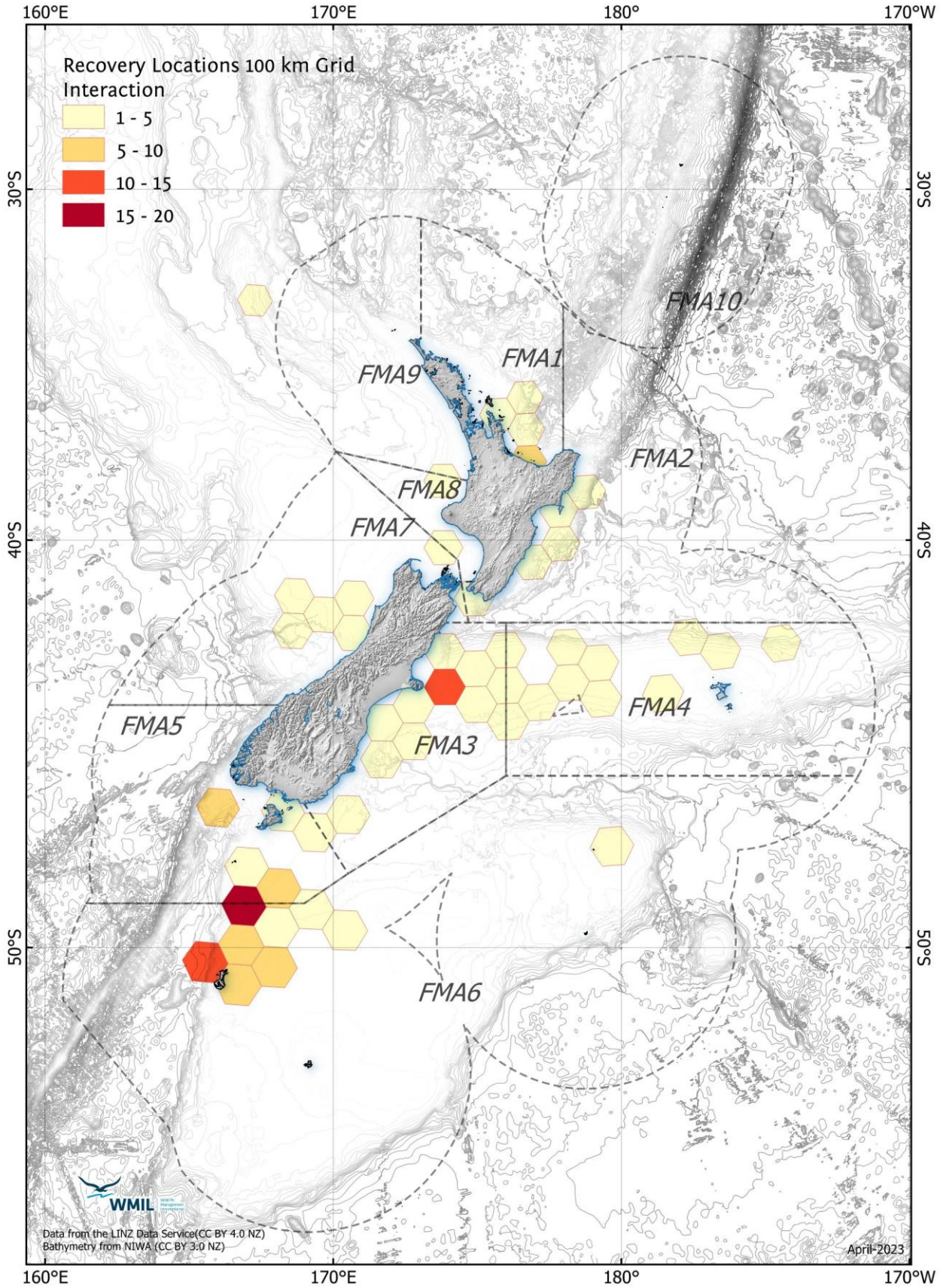

Figure 7: *Grouped catch locations of all seabirds reported as an interaction (and not photographed) in New Zealand fisheries between 1 July 2021 and 30 June 2022.*

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 or released alive were caught in a range of FMAs (FMA 1, 3, 4, 5, 6, and 7). General positions are shown in Figure 6.

The seabirds that were reported as an interaction in the MPI COD extract but not photographed were caught in a range of FMAs (FMA 1, 2, 3, 4, 5, 6, 7, and 8). General positions are shown in Figure 7.

The 326 seabirds that were either photographed or recorded as an interaction were from 53 individual vessels: 14 birds (4.2%) from five bottom long line vessels, 16 birds (4.9%) from seven surface long line vessels, 284 birds (87.1%) from 36 bottom/midwater trawl vessels, three birds (0.9%) from two bottom trawl vessels, seven birds (2.1%) from one set net vessel, and two birds (0.6%) from two purse seine vessels (Table 14).

Table 14: *Number of seabirds photographed or recorded as interactions from fisheries vessels between 1 July 2021 and 30 June 2022. The total number of unique vessels on which both photographed and non-photographed interactions were recorded is given.*

Fishery Type	Photograph		Interaction		Total	
	Seabirds	Vessels	Seabirds	Vessels	Seabirds	Vessels
Bottom Long Line	10	4	4	3	14	5
Surface Long Line	2	2	14	6	16	7
Bottom/Midwater Trawl	123	23	161	32	284	36
Bottom Trawl			3	2	3	2
Set Net	7	1			7	1
Purse Seine	2	2			2	2
TOTAL	**144**	**32**	**182**	**43**	**326**	**53**

There were 238 observed trips on 122 unique vessels (Observer data, unpublished) within this reporting period. Interactions with seabirds (photographed and non-photographed) were reported from 53 vessels (Table 14). Most of these 53 vessels reported relatively low numbers of bird interactions (≤5 birds reported; n = 39, 73.6%). There were seven vessels (13.2%) that had interactions with ten or more seabirds.

The number of vessels that recorded any type of interaction with seabirds (photograph, interaction, retained for necropsy) was 63 (51.6% of observed vessels). Of the vessels that reported any type of interaction with seabirds, over half of these vessels reported low numbers of interactions or returned low numbers of seabirds (≤5 birds; n = 34, 54.0%). 24 vessels (38.1%) had interactions with or returned ten or more seabirds.

3.2.3 Injuries of photographed or interaction seabirds

Over half of the 326 records of interaction or photographs of seabirds were records of seabirds being released alive (n = 176, 54.0%) (Table 15). Of the birds released alive, only 22 were photographed (12.5%) compared to 154 seabirds that were released alive being recorded as interactions (87.5%) (Table 15). Most of these interaction-only birds left the vessel without requiring human assistance, or were released by the crew prior to the observer being able to photograph them (as reported by the observer in the notes provided in the MPI COD extract). One Buller's albatross that was photographed with a dislocated left wing after striking the vessel was released alive but likely had terminal injuries. 12 reportedly deceased birds could not be recovered as they fell off the warp or hook before being transferred on-board, or were discarded by crew before the observer could view them (Table 15).

Table 15: *Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2021 and 30 June 2022.*

	Photograph	Interaction	Total	Total %
Alive	21	154	175	53.7
Alive, terminal injuries	1		1	0.3
Deceased, recovered	122	16	138	42.3
Deceased, not recovered		12	12	3.7
Total	**144**	**182**	**326**	

Of the 144 seabirds that were photographed, 22 were released alive and 122 died for a range of reasons (Tables 15, 16, and 17).

There were a range of injury types recorded against the interaction-only and photographed birds, as shown in Table 17. Around half of the birds had no visible injuries (n = 148, 45.4%) and most of these birds were released alive (n = 131, 88.5%). Several deceased birds had injuries recorded in multiple injury categories, so the given total number of deceased birds (n = 150, Table 17) differs from the total number of injuries recorded (n = 181).

Table 16: *Numbers of seabirds that were photographed after interacting with commercial fishing vessels between 1 July 2021 and 30 June 2022, by species, end status (alive/deceased) and likely cause of death. The proportions of albatross and non-albatross records are also presented as a percentage.*

Species	LONGLINE		TRAWL				SET NET	PURSE SEINE	Total
	Vessel Strike	Hook	Warp	Net		Vessel Strike	Net	Net	
	Alive	Deceased	Deceased	Alive	Deceased	Alive	Deceased	Alive	
Black (Parkinson's) petrel	1								1
Buller's albatross			2		4	1			7
Common diving petrel								1	1
Fairy prion					1				1
Fiordland crested penguin							6		6
Flesh-footed shearwater		1		6					7
Mottled petrel						1			1
NZ white-capped albatross			3	2	2	1			8
Salvin's albatross			7	2	8				17
Snares Cape petrel						1			1
Sooty shearwater	1			1	5				7
Southern black-browed albatross						1			1
Westland petrel		1			1				2
White-bellied storm petrel						1			1
White-chinned petrel		7	1	2	72				82
Yellow-eyed penguin							1		1
Total	**2**	**9**	**13**	**13**	**93**	**6**	**7**	**1**	**144**
% of total birds photographed	**1.4**	**6.3**	**9.0**	**9.0**	**64.6**	**4.2**	**4.9**	**0.7**	
Total (fishery type)	**11**		**125**				**7**	**1**	
Albatrosses (%)			92.3	30.8	15.1	50.0			22.9
Non-albatross (%)	100.0	100.0	7.7	69.2	84.9	50.0	100.0	100.0	77.1

Table 17: *Types of injuries recorded on seabirds that were photographed or recorded as interacting with commercial fishering vessels between 1 July 2021 and 30 June 2022.*

Injury Type	Photograph			Interaction		Total		% of birds with injury
	Alive	Alive, terminal injuries	Deceased	Alive	Deceased	Alive	Deceased	
No visible injuries	17		8	114	9	**131**	**17**	45.4
Disorientated	2			10		**12**	**0**	3.7
Waterlogged			87	3	11	**3**	**98**	31.0
Greased			6			**0**	**6**	1.8
Broken bill, neck, or wing		1	23	3	2	**4**	**25**	8.9
Hook in bill or throat			1			**0**	**1**	0.3
Hook in body				1		**1**	**0**	0.3
Open wound			10	1	1	**1**	**11**	3.7
Severed body part			4		2	**0**	**6**	1.8
More than 3 injuries (crushed)					1	**0**	**1**	0.3
Liced			7		2	**0**	**9**	2.8
Unknown (unable to assess)	2			26	7	**28**	**7**	10.7
Total	**21**	**1**	**122**	**154**	**28**	**176**	**150**	
	144			**182**		**326**		

3.2.4 Identification of photographed seabirds

Examination of 144 photographed seabird interactions confirmed that observers had accurately identified 74.3% (n = 107) of seabirds (Table 18). 17 seabirds (11.8%) were identified to the correct species group, but not to species level (Table 18). Another 17 seabird identification (11.8%) were presumed correct, as the photographs of these specimens have not been received for examination to date. Two sooty shearwaters and one southern black-browed albatross were incorrectly identified (n= 3, 2.1%; Table 18).

Table 18: *Comparison of 144 observer identifications with expert identifications for photographed captures listed in COD from fishing vessels between 1 July 2021 and 30 June 2022, by species. 'ID correct' = identification confirmed the observer identification; 'ID as correct species group' = identification was to a lower taxonomic group, but consistent with the observer identification; 'ID presumed correct' = photographs not received to date', and 'ID wrong = identification was not consistent with the observer identification (i.e. observer identified the species incorrectly).*

Species	ID correct	ID as correct species group	ID presumed correct	ID wrong	Total
Black (Parkinson's) petrel	1				1
Buller's albatross	3	4			7
Common diving petrel	1				1
Fairy prion	1				1
Fiordland crested penguin		6			6
Flesh-footed shearwater	2		5		7
Mottled petrel		1			1
New Zealand white-capped albatross	8				8
Salvin's albatross	14	3			17

Snares Cape petrel		1			1
Sooty shearwater	4	1		2	7
Southern black-browed albatross				1	1
Westland petrel	1	1			2
White-bellied storm petrel	1				1
White-chinned petrel	70		12		82
Yellow-eyed penguin	1				1
Total	**107**	**17**	**17**	**3**	**144**
% of total	**74.3**	**11.8**	**11.8**	**2.1**	

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. Video footage was useful in determining species released alive in situations where photos may not have provided enough detail, such as in poor lighting and at a distance.

Photography of deceased 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 being photographed, poor focus, labels being omitted from the photographs, 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).

Some of the cameras used by observers had not been programmed with the current date and time, so that the metadata of each image did not match the data and time recorded in the COD. This was particularly unhelpful in situations where several seabirds were photographed in the same haul or set and labels were unclear.

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). Cameras are programmed to show correct date and time. 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. DISCUSSION

The four seabird species retained for necropsy most frequently in 2021/2022 (white-chinned petrel, New Zealand white-capped albatross, Salvin's albatross, and Buller's albatross) were the same most frequently reported species as those reported in the preceding year, in similar proportions. These four species and sooty and flesh-footed shearwaters consistently comprise the vast majority of seabirds caught in New Zealand commercial fisheries.

Where the sex of seabirds retained in 2021/2022 could be identified, most of the birds (63.2%) were males. Almost twice as many males were retained as females. This proportion is consistent with observations in previous years. Sex-specific differences in foraging behaviour have been documented in a number of seabird species (Patrick & Weimerskirch 2014). Furthermore, the behaviour of seabirds around fishing vessels may vary by sex (Giménez et al. 2021).

White-chinned petrels made up two thirds of all 'photograph' (deceased, non-retained) records (65.6%, n = 80; Table 12). This is likely attributable to observer requirements not necessitating that all specimens of white-chinned petrel be retained, and this species typically being caught in multiple numbers over short time spans. Observer requirements determining the frequency at which each species is retained must be considered when comparing necropsy figures over time.

5. ACKNOWLEDGMENTS

This work was funded through the Conservation Services Programme (INT2019-02), 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). Hollie McGovern and Katie Clemens-Seely 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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