INT2022-02: IDENTIFICATION OF SEABIRDS CAPTURED IN NEW ZEALAND FISHERIES:

1 July 2022 to 30 June 2023

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Cover image: New Zealand Government Observer image of a storm petrel interaction on commercial fishing vessel, 2023. Credit: NZ Government Observer Scheme.

INT2022-02: IDENTIFICATION OF SEABIRDS CAPTURED IN NEW ZEALAND FISHERIES, 1 JULY 2022 TO 30 JUNE 2023

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 2022 and 30 June 2023, a total of 475 seabirds were reported as incidental interactions with commercial fishing vessels by on-board New Zealand Government Observers. These 475 seabirds comprised 29 identifiable at species level and 16 identified to genus level. There were 216 seabirds classed as live interactions (birds released alive) and 259 resulted in the death of the seabird. Of the 216 alive events, 206 (95%) were interaction-only (i.e., no photograph taken) and only ten (5%) were photographed interactions. Of the 259 deceased seabirds, 24 (9%) were interaction-only (i.e., no photograph taken), 87 (34%) were photographed interactions and the remaining 148 (57%) were returned for necropsy.

Of the 148 individual seabirds killed by incidental bycatch and returned for necropsy, the majority were returned in 2023; during February (n=25, 17%), April (n=21, 14%), and June (n=15, 10%).

A total of 148 seabirds comprised from 23 species were returned for necropsy, from 39 vessels. The top five most prevalent species returned for necropsy were karetai kauae mā/white-chinned petrel (n=29, 20%), toroa/Salvin's albatross (n=27, 18%), toroa/New Zealand white-capped albatross (n=19, 13%), toroa/Buller's albatross (n=18, 12%), and tītī/sooty shearwater (n=14, 10%). These combined species accounted for 107 (73%) of all seabirds returned for necropsy.

The birds returned for necropsy from variety of fishing methods, such as trawl (n=116, 78%), longline (n=16, 11%), set net (n=10, 7%) and purse seine (n=6, 4%). The most predominant causes of injuries identified during necropsy across all birds were: waterlogged (n=72, albatross 68% and non-albatross 32%), broken wings (n=37, albatross 89% and non-albatross 11%), and broken legs and feet (n=28, albatross 54% and non-albatross 46%).

After assessing injuries, other aspects were determined such as sex, age, and breeding status. Of the 148 birds, 131 (89%) were adults, with mostly males (n=93, 63%) returned. Of the 131 adults, the number breeding birds equated to 73 (56%), non-breeding 19 (15%), and 39 (30%) were unconfirmed breeding stage.

Stomach and gizzard contents were assessed via visual examination and discards/offal such as whole bait fish and fish 'puree' (n=113, 76%) appeared to represent higher amounts than naturally foraged prey in the stomach (n=64, 43%). Within the gizzard, most abundantly identified items were squid beaks (n=60, 41%), fish or squid eyeballs (n=37, 24%), fish bones and skin (n=36, 24%), and otoliths (n=30, 20%).

In addition to the seabirds that were returned for necropsy, examination of data, photographs or videos from the Ministry for Primary Industries (MPI) Central Observer Database (COD) and images provided by Government Observers identified a further 327 seabirds reported as seabird-vessel interactions or photographed (as dead or alive captures) aboard 44 fishing vessels. Over half (66%) of these were reportedly released alive. Photographs represented 97 of the 327 seabirds spread across twelve species. Reviewers noted that image quality had improved compared to previous reporting periods, but blurry or distant images continue to be provided.

Keywords: commercial fishing, seabirds, necropsy, photo-identification, interaction-only, incidental mortality, long line, trawl, set-net, purse seine.

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 Exclusive Economic Zone (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 INT2022-02.

Historically, 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 by seabird ecologists (Bell & Larcombe 2023).

This report provides a summary of the seabird species identified as being captured in, or interacting with, New Zealand commercial fisheries between 1 July 2022 and 30 June 2023. Species identification was compiled from specimens returned for necropsy, photographs or videos or entries into the Ministry for Primary Industries (MPI) Central Observer Database (COD) by observers.

1.1 Objectives

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

The specific objectives of this project 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, te reo, and scientific names of all species interactions whether 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, te reo, and scientific names of seabirds recorded by observers as interacting with fishing vessels between 1 July 2022 and 30 June 2023.*

Common Name	Te reo name	*Scientific Name*
Albatross (unidentified)	Toroa	
Black (Parkinson's) petrel	Tākoketai or tāiko	*Procellaria parkinsoni*
Black-bellied storm petrel	Takahikare-rangi	*Fregetta tropica*
Black-browed albatross (unidentified)	Toroa	*Thalassarche spp.*
(Southern) Buller's albatross	Toroa	*Thalassarche bulleri bulleri*
Buller's and Pacific albatross (unidentified)	Toroa	*Thalassarche bulleri* spp.
Campbell albatross	Toroa	*Thalassarche impavida*
Cape petrels		*Daption spp.*
Chatham Island albatross	Toroa	*Thalassarche eremita*
Common diving petrel	Kuaka	*Pelecanoides urinatrix*
Fairy prion	TīTi Wainui	*Pachyptila turtur*
Flesh-footed shearwater	Toanui	*Puffinus carneipes*
Fluttering shearwater	Pakahā	*Puffinus gavia*
Giant petrel (unidentified)		*Macronectes spp.*
Great albatross (unidentified)	Toroa	*Diomedea spp.*
Great-winged (grey-faced) petrel	Ōi	*Pterodroma macroptera gouldi*
Grey petrel	Kuia	*Procellaria cinerea*
Grey-backed storm petrel	Reoreo	*Garrodia nereis*
Mid-sized petrel & shearwater (unidentified)		
Mottled petrel	Kōrure	*Pterodroma inexpectata*
New Zealand white-capped albatross	Toroa	*Thalassarche steadi*
Northern giant petrel	Pāngurunguru	*Macronectes halli*
Otago shag	Matapo	*Leucocarbo chalconotus*
Pacific (Northern Buller's) albatross	Toroa	*Thalassarche bulleri platei*
Petrel (unidentified)		
Petrels, prions, and shearwaters (unidentified)		
Prion (unidentified)		*Pachyptila spp.*
Procellaria petrel (unidentified)		*Procellaria spp.*
Royal albatross (unidentified)	Toroa	*Diomedea spp.*
Salvin's albatross	Toroa	*Thalassarche salvini*
Seabird (large)		
Shearwater (unidentified)		*Puffinus spp.*
Small albatross (unidentified)		*Thalassarche spp.*
Snares Cape petrel	Karetai hurukoko	*Daption capense australe*
Sooty shearwater	Tītī	*Puffinus griseus*
Southern royal albatross	Toroa	*Diomedea epomophora*
Spotted shag	Kawau tikitiki	*Phalacrocorax punctatus*
Foveaux shag	Mapo	*Phalacrocorax stewarti*
Storm petrel (unidentified)		*Hydrobates spp.*
Wandering (snowy) albatross	Toroa	*Diomedea exulans*
Wandering albatross (unidentified)	Toroa	*Diomedea exulans spp.*
Westland petrel	Tāiko	*Procellaria westlandica*
White-bellied storm petrel		*Fregetta grallaria*
White-chinned petrel	Karetai kauae mā	*Procellaria aequinoctialis*
Yellow-eyed penguin	Hoiho	*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, CSP 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 2023).

2.1.1 Individual specimens

Each specimen was allocated a unique necropsy number and photographed. During the necropsy, all birds were sexed by internal examination of reproductive organs, except for birds where that was not possible due to damage from fishing gear, machinery, or sea lice. All injuries were recorded, and the information below, together with observer comments on the necropsy label, was used to determine the likely cause of death.

2.1.2 Moult and morphology

Feather moult and the condition of the brood patch were 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).

2.1.3 Body condition

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.

2.1.4 Stomach and gizzard contents

Stomach and gizzard contents were identified to broad dietary groupings (i.e., squid, fish, crustaceans, etc.) and relative quantities gauged from visual inspection. In addition, any bait material, offal or discarded material, plastic, stones, algae, and goose barnacle plates were recorded. Photographs were taken of plastic or other man-made debris in the gizzard or stomach and samples taken.

Stomach and gizzard content items were categorised into the following groupings:

- Empty: no contents in the stomach or gizzard.
- Missing: stomach or gizzard gone due to being heavily damaged or liced.
- Bait: Squid or fish clearly cut into pieces, occasionally dyed, (distinctive from naturally-sourced fish or squid).

- Offal and/or discards: whole or partial digested fish or squid or fish frames, fish or squid guts, fish bones, bulk otoliths, bulk scales, and/or fish and squid eyeballs. Occasionally human food waste (bulk fat, meat, etc.).
- Natural: fish or squid (not associated with bait), crustaceans (krill, crab, etc.), and/or fish roe.
- Worms: parasitic worms, often with associated worm growth in stomach lining.
- Proventricular oil: natural dietary lipids in the proventriculus (associated with breeding for feeding chicks).
- Miscellaneous: stones (may haven ingested to help with buoyance or to break down food in the gizzard), barnacles, shell, algae, etc.
- Anthropogenic: plastic (all types, colours, shapes), twine,
- Unknown: unable to be evaluated as bird was deceased and discarded overboard or released alive.

2.1.5 Data

Each specimen 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, and DOC (email: csp@doc.govt.nz).

2.2 Observer photo-identification of seabirds

Each individual seabird was allocated a unique number. The photograph(s) or video(s), information from the observers, and any other information observed in the photograph or COD extract were entered into a Microsoft Access database.

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 specimens released alive, mortalities where a specimen was not returned for necropsy for unknown reasons, and any images of birds that had no associated observer data (i.e., missing from COD extracts).

Each bird was separated as follows:

- *Photo (photo and extract)*: seabird photographed/videoed by observer, image/footage provided, and interaction recorded in COD.
- *Photo (image not received to date)*: seabird interaction record in the COD annotated as photographed/videoed by observer but not received to date.
- *Photo (not in extract to date)*: image/video of seabird received but interaction record not listed in COD to date.

Photographs were provided in electronic format with associated observer 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 identifying the trip number, station, and sample number, making it easy to correlate to the 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.

Colour and morphology of the bill and head 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 and in that case it was recorded as the lowest possible taxonomic level. Where possible, the age, sex and provenance of the photographed seabirds were also determined.

2.3 Interaction only (non-photographed) seabirds

These specimens relate to reported interactions in the COD extract with no corresponding image, including non-capture interactions.

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

Each individual seabird was allocated a unique identification number. The information from the observers, and any other information listed in the COD extract were entered into a Microsoft Access database. For any interaction-only records, observer comments in the COD database were used to determine the likely cause of death or condition if released alive. Correct species identification as entered by the observer could not be verified as there was no image, video or returned specimen to confirm.

2.4 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 of all interactions

A total of 475 seabird interactions were recorded as with New Zealand commercial fishing vessels within the New Zealand EEZ between 1 July 2022 and 30 June 2023 (Table 2). These were categorised in to 29 species and 16 genus (Table 2).

All interactions had end status recorded, with 216 seabirds (46.5%) classed as alive and 259 seabirds (54.5%) as deceased (Table 2). The end status was further split into the type of interaction involved (photo, interaction-only or necropsy) (Table 2). Percentages of alive or deceased seabirds were recorded against each type of vessel interaction and then by the overall total number of seabird interactions (Table 2).

3.1.1 Alive specimens

Of the 216 interactions classed as alive, interaction-only (non-photographed) records accounted for 206 seabirds (95%) whereas photographed interactions accounted for only 10 seabirds (4.6%) (Table 2). It should be noted that within the alive category interactions two specimens were released alive, but considered terminal (i.e., unlikely to survive) (one Buller's/Pacific albatross and one sooty shearwater).

3.1.2 Deceased specimens

Of the 259 deceased specimens, interaction-only (non-photographed) accounted for 24 seabirds (9%), photographed interactions accounted for 87 seabirds (34%), and those returned for necropsy accounted for 148 seabirds (57%) (Table 2).

Table 2: *Number of seabirds interactions with commercial fishing vessels within the New Zealand Exclusive Economic Zone between 1 July 2022 and 30 June 2023, grouped by end status (alive/dead). Records are classified as interaction-only (I) if no photograph was obtained, photographed interaction (P) if a photograph was obtained, and necropsy (N) if the whole specimen was retained for necropsy.*

Species	End Status							Overall Total
	Alive			Deceased				
	I	P	Total	I	P	N	Total	
Albatross (unidentified)	8		**8**	3	1		**4**	**12**
Black (Parkinson's) petrel	1		**1**	1			**1**	**2**
Black-bellied storm petrel	1		**1**					**1**
Black-browed albatross (unidentified)	2		**2**					**2**
Buller's albatross		1	**1**		1	18	**19**	**20**
Buller's and Pacific albatross	4		**4**	2			**2**	**6**
Campbell albatross						1	**1**	**1**
Cape petrels	2		**2**					**2**
Chatham Island albatross						1	**1**	**1**
Common diving petrel	3	1	**4**			6	**6**	**10**
Fairy Prion					1			**1**
Flesh-footed shearwater	7	1	**8**					**8**
Fluttering shearwater	2		**2**					**2**
Giant petrel (unidentified)	2		**2**					**2**
Great albatross (unidentified)	3		**3**					**3**
Great-winged (Grey-faced) petrel						1	**1**	**1**
Grey petrel						1	**1**	**1**
Grey-backed storm petrel						1	**1**	**1**
Mid-sized petrel & shearwater (unidentified)	1		**1**					**1**
Mottled petrel						2	**2**	**2**
New Zealand white-capped albatross	36	3	**39**	4	15	19	**38**	**77**
Northern giant petrel	1		**1**			1	**1**	**2**
Otago shag					1	4	**5**	**5**
Pacific albatross						1	**1**	**1**
Petrel (unidentified)	2		**2**					**2**
Petrels, prions, and shearwaters (unidentified)	21		**21**					**21**
Prion (unidentified)	41		**41**					**41**
Procellaria petrel (unidentified)	10		**10**					**10**
Royal albatross (unidentified)	2		**2**					**2**
Salvin's albatross	10		**10**	1	8	27	**36**	**46**
Seabird (large)				1	1		**2**	**2**
Shearwater (unidentified)	1		**1**					**1**
Small albatross (unidentified)	3		**3**	2	1		**3**	**6**
Snares Cape petrel						1	**1**	**1**
Sooty shearwater	5	1	**6**	5	15	14	**34**	**40**
Southern royal albatross		1	**1**			3	**3**	**4**
Spotted shag						1	**1**	**1**
Stewart Island shag						1	**1**	**1**
Storm petrel (unidentified)	1		**1**					**1**
Wandering (Snowy) albatross						1	**1**	**1**
Wandering albatross (unidentified)						1	**1**	**1**
Westland petrel	2		**2**		3	10	**13**	**15**

	End Status							Overall Total
	Alive			Deceased				
	I	P	Total	I	P	N	Total	
White-bellied storm petrel		1	**1**					**1**
White-chinned petrel	33	1	**34**	5	41	29	**75**	**109**
Yellow-eyed penguin						4	**4**	**4**
TOTAL	**206**	**10**	**216**	**24**	**87**	**148**	**259**	**475**
Average (%) for status category	95.3	4.6		9.3	33.6	57.1		
Average (%) overall	43.4	2.1	**45.5**	5.1	18.3	31.2	**54.5**	

3.2 Seabirds returned for necropsy

3.2.1 Species prevalence in necropsied seabirds

A total of 148 seabirds comprised from 23 species were returned for necropsy, from 40 vessels, between 1 July 2022 and 30 June 2023 (Table 3).

The five most prevalent seabird species returned for necropsy were:

1. Karetai kauae mā/white-chinned petrel (n=29, 20%)
2. Toroa/Salvin's albatross (n=27, 18%)
3. Toroa/New Zealand white-capped albatross (n=19, 13%)
4. Toroa/Southern Buller's albatross (n=18, 12%)
5. Tītī/sooty shearwater (n=14, 10%)

Combined, these five species accounted for 73% of all seabirds returned for necropsy.

3.2.2 Banded deceased seabirds

For all seabirds banded in New Zealand, details (i.e., age banded, date banded, location banded) were obtained either by contacting the DOC Banding Office or online via the DOC Falcon Bird Banding System (https://birdbanding.doc.govt.nz/). For seabirds banded overseas, each relevant banding office was contacted for details (i.e., age banded, date banded, location banded).

There were two banded birds with uniquely numbered metal band and three birds with unique Radio Frequency Identification (RFID) tags within those captured and returned between 1 July 2022 and 30 June 2023. One male Buller's albatross (O-29191) had been banded on Toru Islet, Western Chain, The Snares as a breeding adult on 7 October 2010. The other banded bird was a female northern giant petrel (1709586) banded by the British Antarctic Survey team on Bird Island, South Georgia as a chick in March 2022. Three yellow-eyed penguins uniquely identified with RFID tags were returned; one male banded as a chick in 2021 at Papanui, Otago Peninsula, one female banded as a chick in 2021 at Highcliff, Otago Peninsula and one male banded as an adult in 2017 in Fuchsia Gully, Otago Peninsula. Banded specimens provide valuable longevity and survival data.

3.2.3 Monthly distribution of deceased seabirds

The monthly distribution of returned specimens was not evenly spread across the period analysed in this study (Table 3). For example, in 2023 the three months with the most returned birds were; February (n=25, 17%), April (n=21, 14%), and June (n=15, 10%).

3.2.4 Sex composition of deceased seabirds

Males represented the majority of birds returned for necropsy (n=93, 63%) (Figure 1). Eight seabirds (5%) could not have sex confirmed due to either incomplete carcasses (i.e., heavily damaged by vessel/gear interaction), or the bird had been heavily liced and reproductive organs had been eaten.

3.2.5 Age distribution of deceased seabirds

The vast majority of seabirds returned for necropsy were adults (n = 131, 89%). All other age categories were much lower in comparison with less than 10 specimens returned (Figure 2).

3.2.6 Breeding status of deceased seabirds

Of the 148 birds returned for necropsy, 131 adults were evaluated for their breeding status, juveniles or sub-adults were not part of the breeding status analysis. Of those, breeding birds equated to 73 (56%), non-breeding 19 (15%), and 39 (30%) were unknown (Figure 3). Unknown sexes were primarily associated with specimens which had been categorised as an adult, but had no distinction between breeder, non-breeding, or unknown, or the specimen was heavily liced or in a decomposed state upon inspection.

3.3 Vessel type and target fishery of necropsy seabirds

The bycatch seabirds returned for necropsy were caught in a range of Fishery Management Areas (FMA 3, 4, 5, 6, 7, 8 and 9). General positions are shown in Figure 4.

For the study period 1 July 2022 to 30 June 2023, there were 210 observed trips on 86 vessels (H. McGovern, DOC CSP, pers. comm.; MPI Observer data, unpublished). A total of 39 vessels (45% of observed vessels) are known to have returned seabirds for necropsy during this period from 78 observed trips (37% of all observed trips).

Seabirds returned for necropsy by fishing type included trawl (n=116, 78%), longline (n=16, 11%), set net (n=10, 7%) and purse seine (n=6, 4%) (Table 4).

Of the 116 seabirds were returned from trawl fisheries (78% of total necropsy returns) with trawlers targeting *Nototodarus* squid species (n=39 seabirds, 34%) and hoki (*Macruronus novaezelandiae*) (n=34 seabirds, 29%) (Table 4). There was a total of 12 target fish species from the bottom/midwater trawl vessels.

Of the 16 seabirds were returned from longline vessels (bottom and surface longline, 11% of total returns) with bottom longline accounting for 13 seabirds (9% of total returns) and surface longline accounting for three (2% of total returns). Longline vessels targeting southern bluefin tuna (*Thunnus maccoyii*) returned 3 (19%) of all longline specimens, and those targeting ling (*Genypterus blacodes*) returned 13 (81%) of the longline specimens (Table 4).

A total of ten seabirds were returned from set net vessels (7% of total returns), with vessels targeting school shark (*Galeorhinus galeus*) accounting for 50% of set net returns (n = 5) (Table 4).

The remaining six seabirds were caught on purse seine vessels (4% of total returns), with half caught on vessels targeting jack mackerel (either *Trachurus declivis*, *T. murphyi*, or *T. novaezelandiae*) (Table 4).

Table 3: Number of seabirds of each species returned for necropsy from observed fishing vessels between 1 July 2022 and 30 June 2023, by month of capture.

SPECIES	2022 MONTH						2023 MONTH						TOTAL	Total necropsy returned seabirds (%)
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Buller's albatross	2	5	1				1		1	1	2	5	18	12.2
Campbell albatross		1											1	0.7
Chatham Island albatross					1								1	0.7
Common diving petrel											3	3	6	4.1
Great-winged (grey-faced) petrel			1										1	0.7
Grey petrel				1									1	0.7
Grey-backed storm petrel							1						1	0.7
Mottled petrel											1	1	2	1.4
New Zealand white-capped albatross	2	1				1	2	7	1	2	2	1	19	12.8
Northern giant petrel										1			1	0.7
Otago shag									1	1	2		4	2.7
Pacific albatross					1								1	0.7
Salvin's albatross			6	1	4	5	2	6	3				27	18.2
Snares Cape petrel											1		1	0.7
Sooty shearwater				1	1		1	5		6			14	9.5
Southern royal albatross			1							1		1	3	2.0
Spotted shag							1						1	0.7
Foveaux shag					1								1	0.7
Wandering (Snowy) albatross										1			1	0.7
Wandering albatross (unidentified)												1	1	0.7
Westland petrel				6	1							3	10	6.8
White-chinned petrel					2	3	4	7	2	8	3		29	19.6
Yellow-eyed penguin					2				2				4	2.7
TOTAL	**4**	**7**	**9**	**9**	**13**	**9**	**12**	**25**	**10**	**21**	**14**	**15**	**148**	
MONTHLY TOTAL (%)	**2.7**	**4.7**	**6.1**	**6.1**	**8.8**	**6.1**	**8.1**	**16.9**	**6.8**	**14.2**	**9.5**	**10.1**		

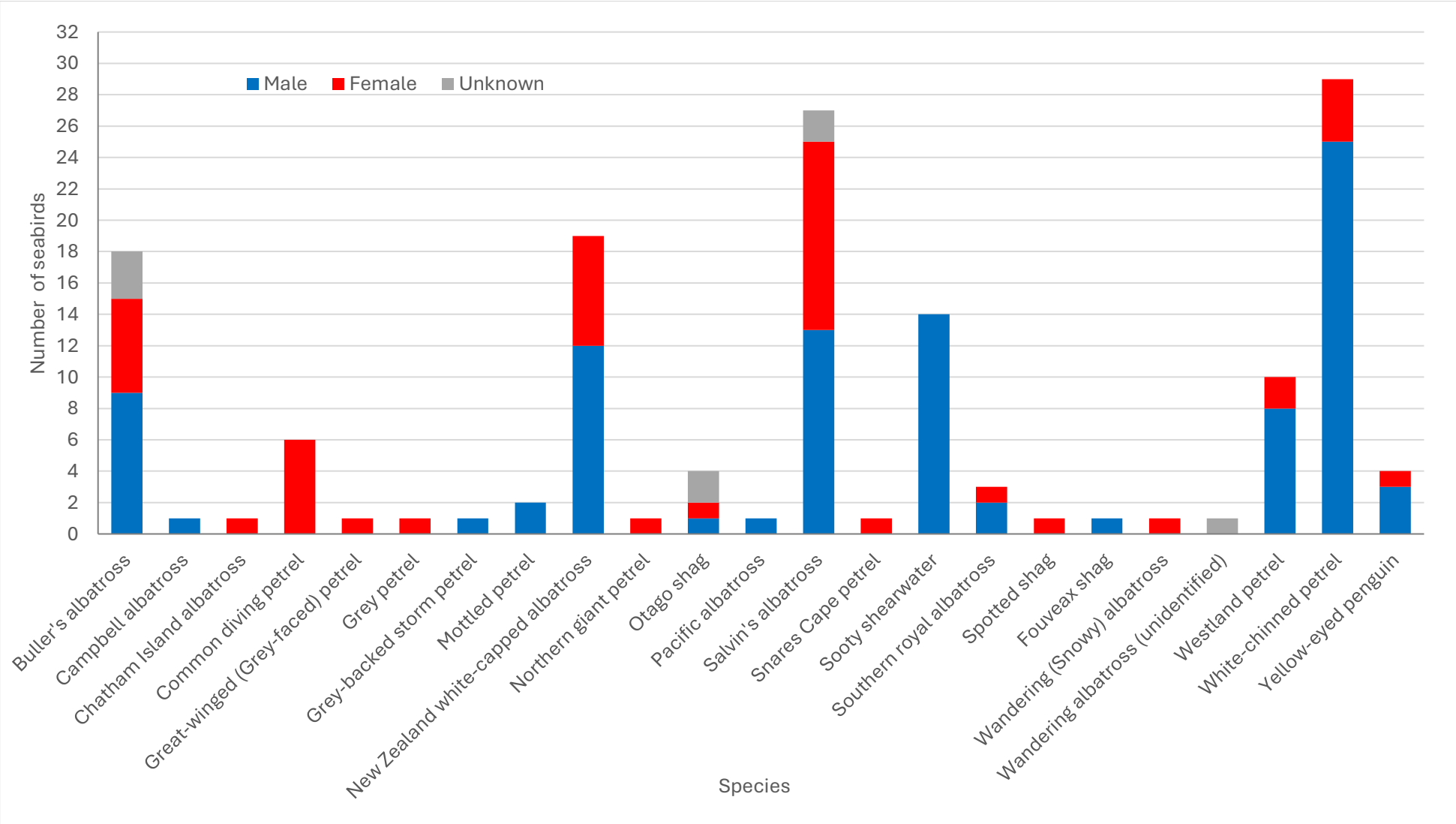

Figure 1: *Number of deceased seabirds returned from observed fishing vessels between 1 July 2022 and 30 June 2023, by species and sex (male (n=93), female (n=47), and unknown (n=8)).*

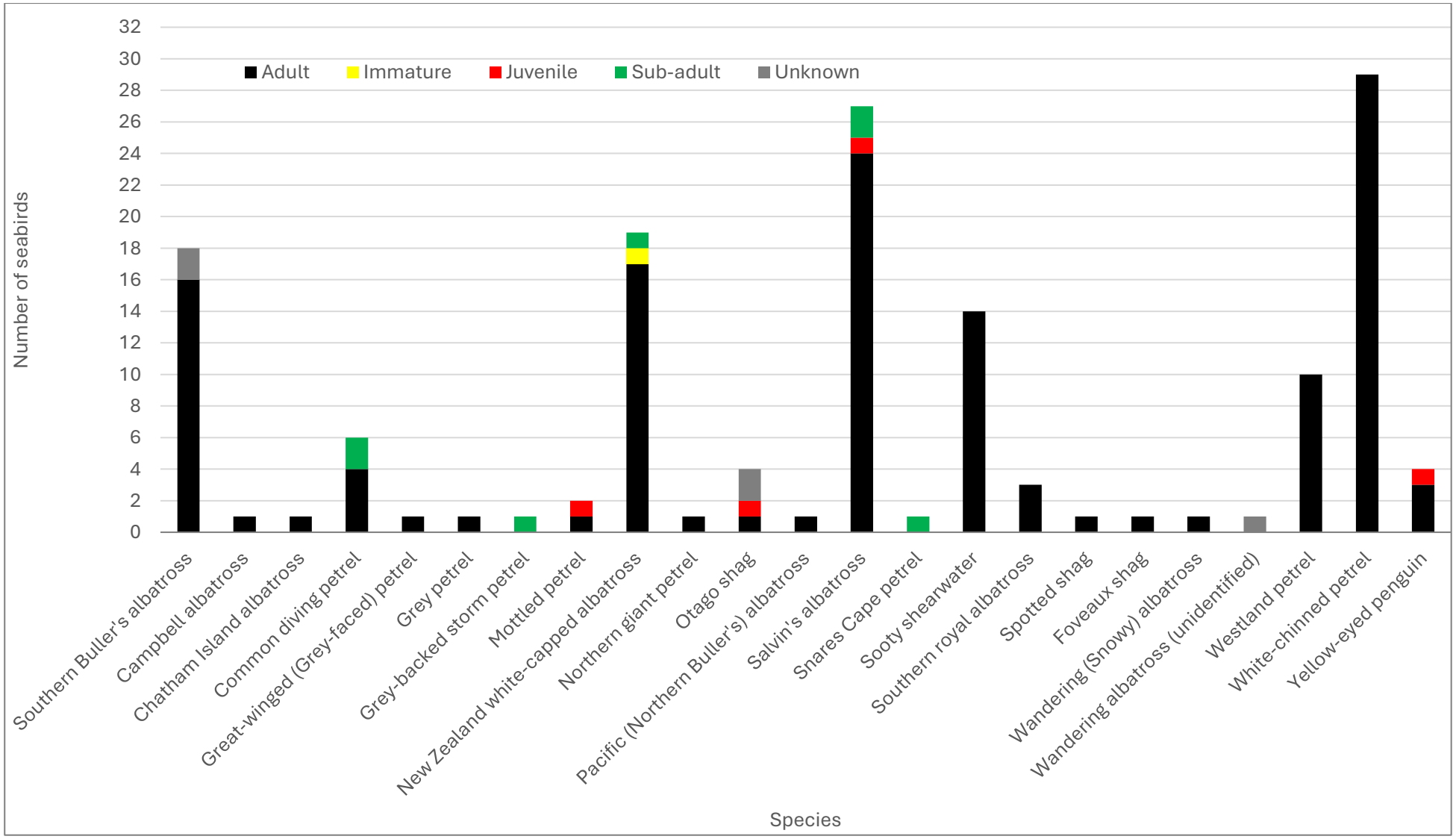

Figure 2: Numbers of deceased seabirds returned from observed fishing vessels between 1 July 2022 and 30 June 2023, by species and age class (adult (n=131), immature (n=1), juvenile (n=4), sub-adult (n=7), and unknown (n=5).

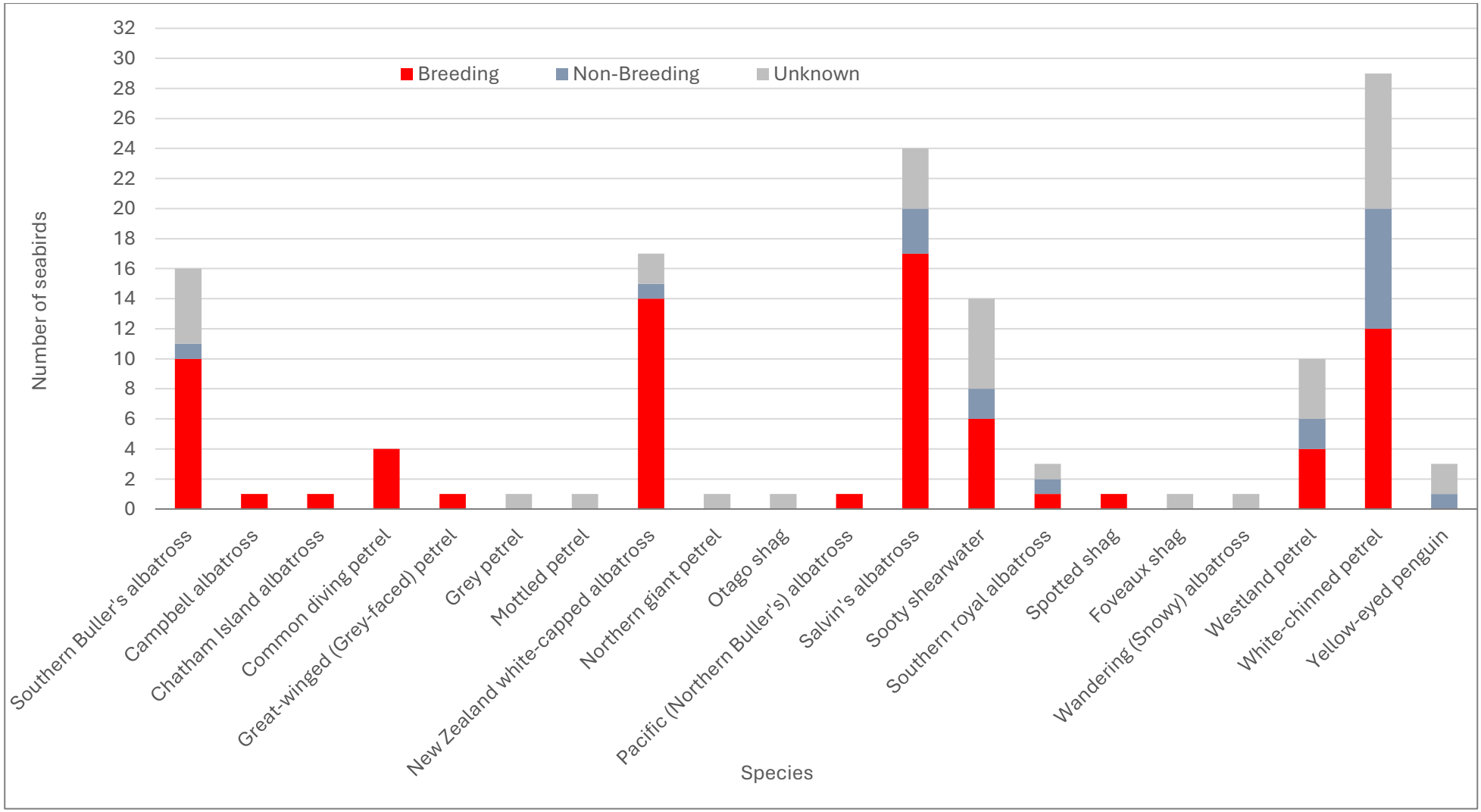

Figure 3: Numbers of deceased adult seabirds (n=131) returned from observed fishing vessels between 1 July 2022 and 30 June 2023, by species and breeding class (breeding (n=73), non-breeding (n=19), and unknown breeding status (n=39)).

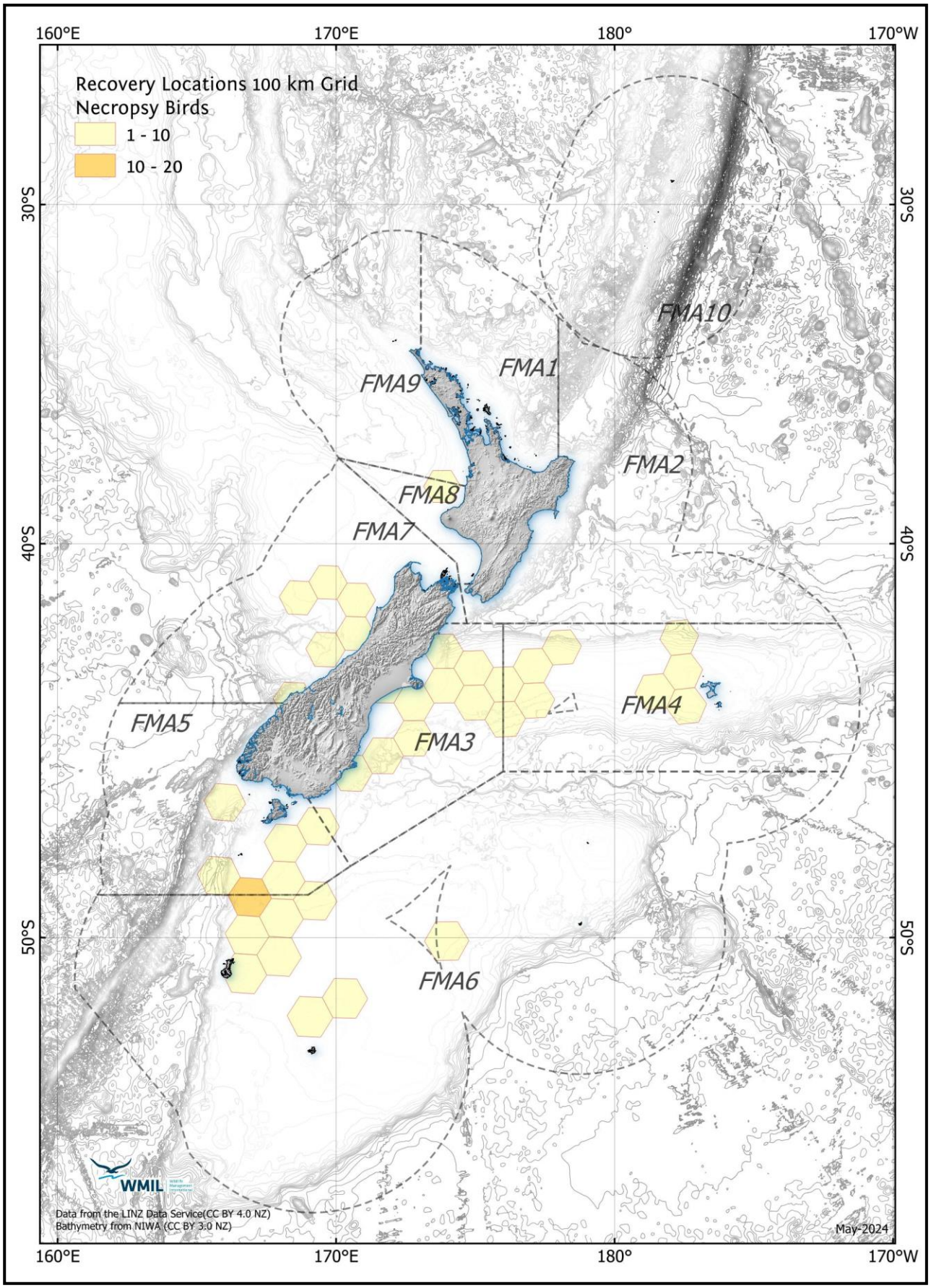

Figure 4: Grouped catch locations of all bycatch seabirds returned in New Zealand fisheries for necropsy between 1 July 2022 and 30 June 2023.

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Table 4: *Number of seabirds of each species returned from observed trawl, longline, setnet and purse seine fishing vessels between 1 July 2022 and 30 June 2023 by fishing target species.*

Species	Purse Seine	Bottom/Midwater Trawl						Longline			Set net			Total
		Squid	Hoki	Ling	Other species[1]	Target species not recorded	Total	Southern blue fin tuna	Ling	Total	School shark	Other species[2]	Total	
Southern Buller's albatross		5	9	2	2		**18**							**18**
Campbell albatross					1		**1**							**1**
Chatham Island albatross					1		**1**							**1**
Common diving petrel	**6**													**6**
Grey-winged (grey-faced) petrel						1	**1**							**1**
Grey petrel					1		**1**							**1**
Grey-backed storm petrel		1												**1**
Mottled Petrel						2	**2**							**2**
New Zealand white-capped albatross		8	3	1	6		**18**	1		**1**				**19**
Northern giant petrel		1					**1**							**1**
Otago shag											3	1	**4**	**4**
Pacific (Northern Buller's) albatross					1		**1**							**1**
Salvin's albatross		4	10	4	5		**23**		4	**4**				**27**
Snares Cape petrel											1		**1**	**1**
Scoty shearwater		7	2	2	3		**14**							**14**
Southern royal albatross					2		**2**	1		**1**				**3**
Spotted shag					1		**1**							**1**
Foveaux shag												1	**1**	**1**
Wandering (Snowy) albatross					1		**1**							**1**
Wandering albatross (unidentified)					1		**1**							**1**
Westland petrel			3				**3**		7	**7**				**10**
White-chinned petrel		13	7	2	4		**26**	1	2	**3**				**29**
Yellow-eyed penguin											1	3	**4**	**4**

[1] Other species include Cardinal Fish, *Epigonidae* spp. (n=1); Barracouta, *Thyrsites atun* (n=7); Jack mackerel, *Trachurus* spp. (n=1); Orange roughy, *Hoplostethus atlanticus* (n=4), Southern blue whiting, *Micromesistius australis* (n=2); Scampi, *Metanephrops challengeri* (n=7); Silver warehou, *Seriolella punctata* (n=1), Elephant fish, *Callorhinchus milii* (n=1) and Tarakihi, *Nemadactylus macropterus* (n=1).
[2] Blue nose, *Hyperoglyphe antarctica* (n=3); Elephant fish, *Callorhinchus milii* (n=2).

Total	6	39	34	11	28	3	116	3	13	16	5	5	10	148
% of each fishery type		33.6	29.3	9.5	24.1	2.6		18.8	81.2		50	50		
% of total necropsy returns	4.1						78.4			10.8			6.8	

Table 5: *Likely cause of death for seabird species returned from commercial longline, trawl, and set net fisheries between 1 July 2022 and 30 June 2023.*

Species	Trawl				Longline Hook found in:			Tangled	Set Net		Purse Seine	Total
	Warp	Net	Other[1]	Impact	Bill, neck, or throat	Wing	Unknown		Net	Tangled		
Southern Buller's albatross	4	11	3									18
Campbell albatross		1										1
Chatham Island albatross		1										1
Common diving petrel											6	6
Great-winged (Grey-faced) petrel				1								1
Grey petrel				1								1
Grey-backed storm petrel				1								1
Mottled petrel				2								2
New Zealand white-capped albatross	10	5	1	2			1					19
Northern giant petrel	1											1
Otago shag									4			4
Pacific (Northern Buller's) albatross		1										1
Salvin's albatross	7	10	6			3	1					27
Snares Cape petrel									1			1
Sooty shearwater		10	4									14
Southern royal albatross	1	1					1					3
Spotted shag		1										1
Foveaux shag									1			1
Wandering (Snowy) albatross				1								1
Wandering albatross (unidentified)		1										1
Westland petrel			3		4	2		1				10
White-chinned petrel		21	5		1			2				29
Yellow-eyed penguin									4			4
Total	**23**	**63**	**22**	**8**	**5**	**5**	**3**	**3**	**10**		**6**	**148**
%total	**15.5**	**42.6**	**14.9**	**5.4**	**3.4**	**3.4**	**2.0**	**2.0**	**6.8**		**4.1**	

[1] Other includes captures in the lengthener, cod-end, and pound.

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Table 6: Injury types recorded for seabirds (n=148) returned from commercial fisheries between 1 July 2022 and 30 June 2023. 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	Open wound or severed body part	Crushed or more than 3 injuries	Grease	Liced	Other	Total
Southern Buller's albatross	2	4	7	6	1		3	3	3	2	1	32
Campbell albatross			1									1
Chatham Island albatross	1	1										2
Common diving petrel	5		1	1								7
Great-winged (Grey-faced) petrel	1											1
Grey petrel					1		1					2
Grey-backed storm petrel									1			1
Mottled petrel	1							1				2
New Zealand white-capped albatross	4	3	10	3	1		2	4	3			30
Northern giant petrel			1									1
Otago shag		4			1		4					9
Pacific (Northern Buller's) albatross		1										1
Salvin's albatross	3	14	12	5		2	2	3	2	2	2	47
Snares Cape petrel	1	1										2
Sooty shearwater	5	12	1	3			1					22
Southern royal albatross	1		1	1			1					4
Spotted shag		1			1							2
Foveaux shag		1		1								2
Wandering (Snowy) albatross			1		1							2
Wandering albatross (unidentified)								1		1	1	3
Westland petrel	4	10		1		6						21
White-chinned petrel	8	18	2	6	3	1	3	1	2		2	46
Yellow-eyed penguin	2	2		1								5
Total	**38**	**72**	**37**	**28**	**9**	**9**	**17**	**13**	**11**	**5**	**6**	**245**
% of returned birds (n=148)	25.7	48.6	25.0	18.9	6.1	6.1	11.5	8.8	7.4	3.4	4.1	
Albatross (%)	**28.9**	**31.9**	**89.2**	**53.6**	**33.3**	**22.2**	**47.1**	**84.6**	**72.7**	**100**	**66.7**	
Non-albatross (%)	**71.1**	**68.1**	**10.8**	**46.4**	**66.7**	**77.8**	**52.9**	**15.4**	**27.3**	**0**	**33.3**	

3.4 Injuries and likely cause of death of necropsied seabirds

Of the 148 seabirds returned for necropsy, cause of death ranged from drowning in trawl or set nets, drowning on a hook, or impact with the warp or vessel itself (Table 5). Many of the birds had multiple injuries; the total number of injuries recorded (n= 245), was higher than the total number of seabirds returned (n=148) (Table 6).

3.4.1 Cause of death and injury type

Of the 116 seabirds returned from trawling vessels, most were caught within the net (internal or external) component (n=63, 54%; 43% of all necropsy seabirds) (

Table 5) often leading to birds drowning from entanglement. When seabirds were reported as caught by the warp (n=23, 20%; 16% of all necropsy seabirds), this often led to severed body parts or crushing injuries likely from the warp block (n=30, 20%) and typically specimens were covered in grease from the warp wire (n=11, 7%) (Table 6).

The condition of the returned birds ranged between 'no obvious or visible injury', 'waterlogged', 'greased' or 'hook present' to 'crushed'. As has been found in previous reports, seabirds caught and returned from trawl fisheries had different injuries from those caught by longline vessels. For example, of the 16 birds returned from longline vessels, most were waterlogged and had hook injuries (Table 6). Salvin's albatross (n=4) and Westland petrels (n=6) had hooks in the wings or bills (Tables 5 and 6). Typically, birds caught on longlines had hook located in various parts of the body (neck, throat, wing) or the bird had become entangled in the line.

Set net captures often led to the seabirds being tangled in the net (n=10, 7%). The most notable species was yellow-eyed penguin, of which all four were caught via this manner (

Table 5).

3.4.2 Injury location and type

There were 38 seabirds with no visible injuries (26% of necropsy specimens), with the majority of species being non-albatross (n=27, 71%) than albatross (n=11, 29%) (Table 6). This may be due to smaller seabirds being caught in the net and only being waterlogged.

Several birds were waterlogged (n=72, 49%), dominated by non-albatross birds (68%). A number of birds had broken wings (n=37, 25%) with 89% being albatrosses. Birds with broken legs and feet (n=28, 19%) were also dominated by albatross species (54%) (Table 6).

Across all other categories for albatross versus non-albatross the most prevalent injuries were hooks (78%), waterlogged (68%), broken bill (67%) and open wounds (53%) in non-albatross species. For albatross the most prevalent injuries were attributed to liced (100%), broken wings (89%), crush injuries (85%) from having gone through a warp block, and grease having hit the warp cable (73%) (Table 6).

Five birds had been liced (3%) and would have encountered this post-mortem while in the net or on the hook. This would occasionally hinder data collection for measures such as sex determination, fat score, or ability to take organ samples (Table 6).

3.5 Body condition of necropsy seabirds

The mean fat scores of returned seabirds for necropsy was marginally higher (1.98 ± 0.08 (SE)) than the previous survey (2021/22 = 1.97 ± 0.07) but was still lower than the previous survey years (2020/21 = 2.09 ± 0.1; 2019/20 = 2.2 ± 0.1) (Table 7,

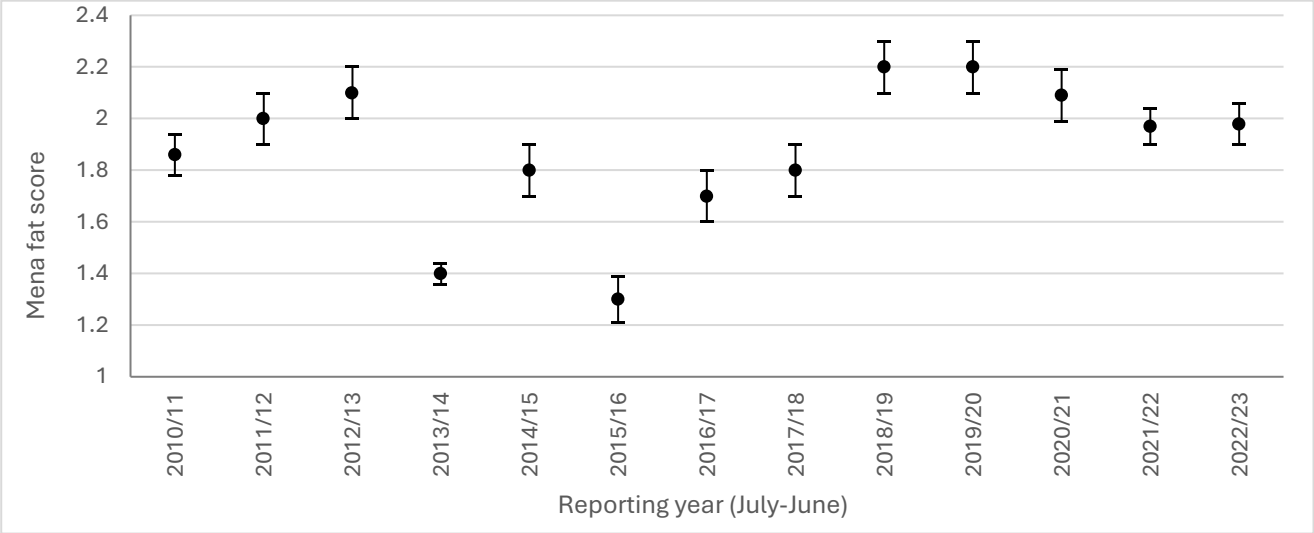

Figure 5). There were eight seabirds that could not have fat score determined. Unknown fat scores were attributed to scores being unable to be determined due to being heavily liced or severely damaged specimens.

Overall, the mean fat score has fluctuated over the past 13 years. For instance, for the last five survey years (2017/18-2022/23) fat scores have remained higher than the previous five years (2012/13-

2017/18) (

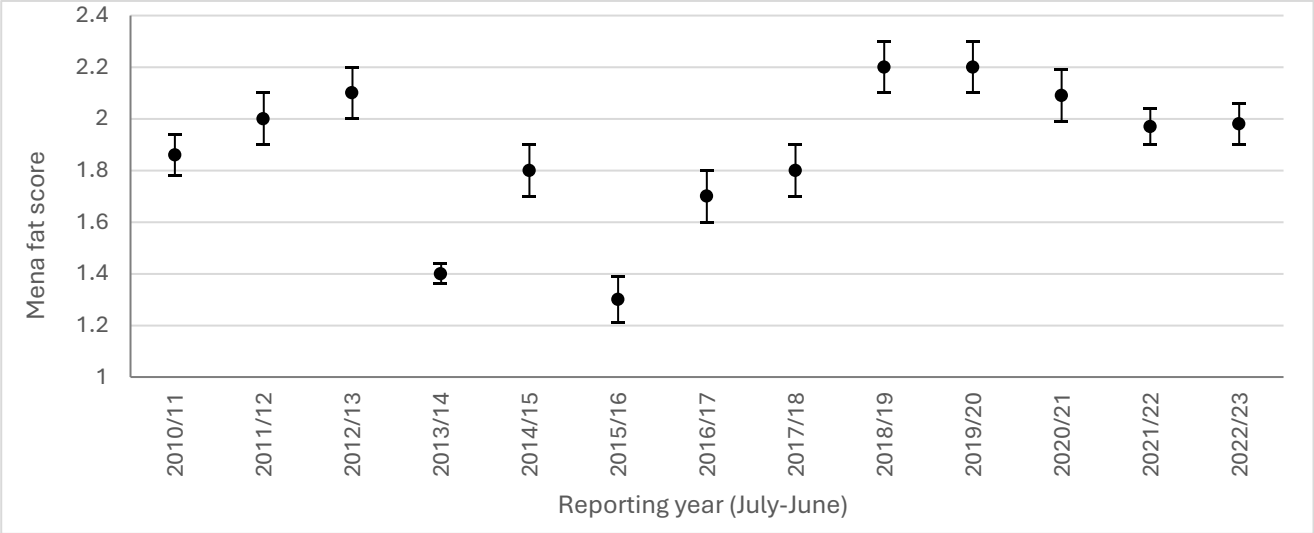

Figure 5) (Bell & Bell 2015, Bell & Bell 2016, Bell & Bell 2017, Bell & Bell 2018, Bell & Bell 2019, Bell 2021, Bell & Larcombe 2022, Bell & Larcombe 2023).

Table 7: *Fat scores of bycatch seabirds returned from commercial fishing vessels between 1 July 2022 and 30 June 2023 (1= no fat; 5 = extremely fat; U = unknown).*

Species	FAT SCORE						Total	Mean Fat Score	SE (±)
	1	2	3	4	5	U			
Southern Buller's albatross	8	4		2	1	2	18	1.93	0.33
Campbell albatross				1			1	4.0	
Chatham Island albatross				1			1	4.0	
Common diving petrel		3	3				6	2.5	0.23
Great-winged (Grey-faced) petrel	1						1	1.0	
Grey petrel	1						1	1.0	
Grey-backed storm petrel			1				1	3.0	
Mottled petrel				1	1		2	4.5	0.5
New Zealand white-capped albatross	5	7	4	1		2	19	2.06	0.18
Northern giant petrel			1				1	3.0	
Otago shag		1	1				2	2.33	0.33
Pacific (Northern Buller's) albatross		1					1	2.0	
Salvin's albatross	11	5	7	2		2	27	1.83	0.09
Snares Cape petrel			1				1	3.0	
Sooty shearwater	4	6	3				13	1.86	0.21
Southern royal albatross	2	1					3	1.33	0.33
Spotted shag	1						1	1.0	
Foveaux shag	1						1	1.0	
Wandering (Snowy) albatross	1						1	1.0	
Wandering albatross (unidentified)						1	1	0	
Westland petrel	6	4					10	1.4	0.16
White-chinned petrel	10	12	6	1			29	1.93	0.09
Yellow-eyed penguin	1	1	1	1			4	2.5	0.65
Total	**53**	**46**	**28**	**10**	**2**	**8**	**148**	**1.98**	**0.08**
Total (%) with fat score	**35.8**	**31.1**	**18.9**	**6.8**	**1.4**	**5.4**			

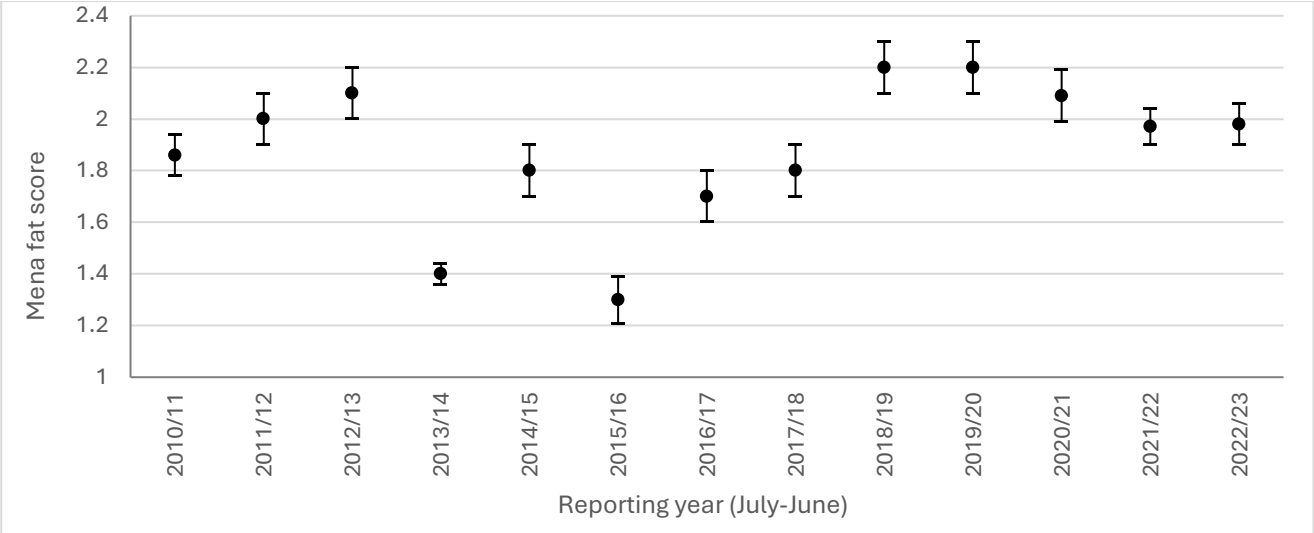

Figure 5: Mean fat scores (and standard error bars) for all bycatch seabirds returned from commercial fishing vessels, per survey year, between 1 October 2010 and 30 June 2023. Note: 1= no fat; 5 = extremely fat; unknown values were omitted from the data analysis and graph.

3.6 Stomach and gizzard contents

Many seabirds had multiple prey items in their stomachs and/or gizzards, resulting in higher stomach and gizzard content totals than the number of seabirds killed and returned (n=148) (Tables 8 & 9).

3.6.1 Stomach analysis

Of the items visually examined from stomach contents, offal or discards (n=113, 76%) and natural items (n=64, 43%) had the highest rate of detection (Table 9). Empty stomachs (n=25, 17%) were also frequently found, and bait attributed to a low rate (n=19, 13%) compared to all other categories (Table 9). No plastics or foreign objects visible to the naked eye were found in the stomachs (Table 9).

3.6.2 Gizzard analysis

Of the items visually examined from gizzard contents, squid beaks (n=60, 41%), otoliths (n=30, 20%), fish or squid eyeballs (n=37, 25%), and fish bones or skin (n=36, 24%) had the highest rates of detection. Plastic, string, or metal was found in eleven gizzards (7%).

3.7 Identification of necropsied birds

Necropsy confirmed that only 69% 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 10). This highlights the importance of the necropsy programme to correctly identify species and raises concerns about the accuracy of species identification on Protected Species Identification reports.

Table 8: Comparison of species identifications (ID) recorded by on-board observers compared with ID from necropsy seabirds returned from commercial fishing boats between 1 July 2022 and 30 June 2023.

Species	ID Correct	ID Correct to Species group*	ID Wrong	Code did not exist	Total
Southern Buller's albatross	6	10	2		18
Campbell albatross		1			1
Chatham Island albatross			1		1
Common diving petrel	6				6
Great-winged (Grey-faced) petrel		1			1
Grey petrel	1				1

Grey-backed storm petrel		1			1
Mottled petrel	2				2
New Zealand white-capped albatross	12	1	4	2	19
Northern giant petrel			1		1
Otago shag	2	2			4
Pacific (Northern Buller's) albatross		1			1
Salvin's albatross	25	2	1		27
Snares cape petrel		1			1
Sooty shearwater	9	1	4		14
Southern royal albatross	1		1	1	3
Spotted shag		1			1
Foveaux shag		1			1
Wandering (Snowy) albatross		1			1
Wandering albatross (unidentified)		1			1
Westland petrel	10				10
White-chinned petrel	24	4	1		29
Yellow-eyed penguin	4				4
Total	**102**	**29**	**15**	**3**	**148**
Total (%)	**68.9**	**20.0**	**10.1**	**2.0**	

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

Table 9: Stomach contents of bycatch seabirds returned from commercial fishing vessels between 1 July 2022 and 30 June 2023.

Species	Empty	Missing	Bait	Offal (or discards)	Natural	Worms	Proventricular oil	Miscellaneous
Southern Buller's albatross	3	3	1	13	7		1	
Campbell albatross				2				
Chatham Island albatross				1				
Common diving petrel					6			
Great-winged (Grey-faced) petrel		1						
Grey petrel	1							
Grey-backed storm petrel	1							
Mottled petrel	2							
New Zealand white-capped albatross	3	1	1	22	11	1		
Northern giant petrel				2	1			
Otago shag		1		5	2	2		
Pacific (Northern Buller's) albatross				1	2			
Salvin's albatross	5	1	3	25	11	1	1	2
Snares Cape petrel	1							
Sooty shearwater	2		3	7	2			1
Southern royal albatross	1		1	1		1		
Spotted shag				1	1			
Foveaux shag				1				
Wandering (Snowy) albatross				2				
Wandering albatross (unidentified)		1						
Westland petrel			3	9	7	1	3	
White-chinned petrel	6		6	19	11		1	
Yellow-eyed penguin			1	2	3	1		2
Total	**25**	**8**	**19**	**113**	**64**	**7**	**6**	**5**
% total stomach contents	**16.9**	**5.4**	**12.8**	**76.4**	**43.2**	**4.7**	**4.1**	**3.4**

Table 10: Gizzard contents of bycatch seabirds returned from commercial fishing vessels between 1 July 2022 and 30 June 2023.

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
Southern Buller's albatross	3	4	5	4	4	6			2	4	
Campbell albatross						1					
Chatham Island albatross					1						
Common diving petrel										6	
Great-winged (Grey-faced) petrel			1								
Grey petrel			1								
Grey-backed storm petrel	1										
Mottled petrel	1		1								
New Zealand white-capped albatross	8	1	2	5	3	4	1				
Northern giant petrel										6	
Otago shag		3									
Pacific (Northern Buller's) albatross								1			
Salvin's albatross	5	1	3	5	5	16	1	2		2	
Snares Cape petrel				1					1		
Sooty shearwater	2		6	4	3	1	4	2			1
Southern royal albatross			1	1	3	1	1	2			
Spotted shag						1			1		
Foveaux shag	1										
Wandering (Snowy) albatross			1								
Wandering albatross (unidentified)		1									
Westland petrel			10	2	8	1	1		3		
White-chinned petrel			29	8	10	5	2	2	13	3	
Yellow-eyed penguin	1						1	1			
Total	**22**	**10**	**60**	**30**	**37**	**36**	**11**	**10**	**20**	**21**	**1**
Total (%) with content	**14.9**	**6.8**	**40.5**	**20.3**	**25.0**	**24.3**	**7.4**	**6.8**	**13.5**	**14.2**	**0.7**

3.8 Photographs and Interactions

3.8.1 Numbers of photographed seabirds or those listed as interactions

There were a total of 327 interactions involving seabirds and fishing vessels that were recorded in the MPI COD extract, either as 'photographed' records, or as 'interaction-only' records (if the seabird interacted with the fishing vessel but was not photographed). This total includes both live and deceased seabirds (Table 11).

Table 11: Number of seabirds reported as photographed or interaction-only on commercial fishing vessels between 1 July 2022 and 30 June 2023.

Species	Photo			Interaction-only			Total
	Alive	Deceased	Total	Alive	Deceased	Total	
Albatross (unidentified)		1	**1**	8	3	**11**	**12**
Black (Parkinson's) petrel				1	1	**2**	**2**
Black-bellied storm petrel				1		**1**	**1**
Black-browed albatross (unidentified)				2		**2**	**2**
Buller's albatross	1	1	**2**				**2**
Buller's and Pacific albatross				4	2	**6**	**6**
Cape petrels				2		**2**	**2**
Common diving petrel	1		**1**	3		**3**	**5**
Fairy Prion		1	**1**	2		**2**	**3**
Flesh-footed shearwater	1		**1**	7		**7**	**8**
Fluttering shearwater				2		**2**	**2**
Giant petrel (unidentified)				2		**2**	**2**
Great albatross (unidentified)				2		**2**	**2**
Mid-sized petrel & shearwater (unidentified)				1		**1**	**1**
New Zealand white-capped albatross	3	15	**18**	36	4	**40**	**58**
Northern giant petrel				1		**1**	**1**
Otago shag		1	**1**			**1**	**1**
Petrel (unidentified)				2		**2**	**2**
Petrels, prions, and shearwaters (unidentified)				21		**21**	**21**
Prion (unidentified)				41		**41**	**41**
Procellaria petrel (unidentified)				10		**10**	**10**
Royal albatross (unidentified)				2		**2**	**2**
Salvin's albatross	2	8	**11**	10	1	**11**	**22**
Seabird (large)		1	**1**		1	**1**	**2**
Shearwater (unidentified)				1		**1**	**1**
Small albatross (unidentified)				3	2	**5**	**5**
Sooty shearwater	1	15	**16**	5	5	**10**	**26**
Southern royal albatross	1		**1**				**1**
Storm petrel (unidentified)				1		**1**	**1**
Westland petrel		3	**3**	2		**2**	**5**
White-bellied storm petrel	1		**1**				**1**
White-chinned petrel	1	41	**42**	33	5	**38**	**80**
Total	**10**	**87**	**97**	**206**	**24**	**230**	**327**
% total (photograph or interaction-only)	**10.3**	**89.7**		**89.6**	**8.3**		
% total (all combined)	**3.1**	**26.6**		**63.0**	**7.3**		

Table 12: Number of seabird interactions (photographed or interaction-only) with fishing vessels between 1 July 2022 and 30 June 2023, by month of incident.

Species	2022						2023						Total	% Total
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Albatross (unidentified)				1	1		2	2	1	1	2	2	12	0.6
Black (Parkinson's) petrel						2							2	0.6
Black-bellied storm petrel								1					1	1.8
Black-browed albatross (unidentified)								1				1	2	0.6
Southern Buller's albatross	1										1		2	1.2
Buller's and Pacific albatross	5	1											6	0.9
Cape petrels			1		1								2	2.4
Common diving petrel										1	1	2	4	0.6
Fairy prion	3												3	0.6
Flesh-footed shearwater				4	2				2				8	0.9
Fluttering shearwater		1	1										2	0.3
Giant petrel (unidentified)			1		1								2	17.7
Great albatross (unidentified)							1			1		1	3	0.3
Mid-sized petrel & shearwater (unidentified)										1			1	0.3
New Zealand white-capped albatross	12			1			2	11	7	4	6	15	58	0.6
Northern giant petrel	1												1	6.4
Otago shag									1				1	12.5
Petrel (unidentified)			1					1					2	3.1
Petrels, prion and shearwaters (unidentified)			3	1				1			15	1	21	0.6
Prion (unidentified)							40			1			41	5.8
Procellaria petrel (unidentified)								2	1	5		2	10	0.6
Royal albatross (unidentified)			1								1		2	0.3
Salvin's albatross			3	1	2		4	2	4	3			19	1.5
Seabird (large)	2												2	8.0
Shearwater (unidentified)								1					1	0.3
Small albatross (unidentified)								1	1	1	1	1	5	0.3
Scoty shearwater				3			1	12	3	5	2		26	1.5
Southern royal albatross								1					1	0.3
Storm petrel (unidentified)									1				1	24.5
Westland petrel	4	1											2	0.6
White-bellied storm petrel											1		1	0.6
White-chinned petrel				1	2		1	27	11	32	5	1	80	1.8

Species	2022						2023						Total	% Total
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Total	28	3	11	12	9	2	51	63	32	55	35	26	327	
%total interaction	8.6	0.9	3.4	3.7	2.8	0.6	15.6	19.3	9.8	16.8	10.7	8.0		

Of these 327 interactions, 230 had no associated photographs taken (i.e., interaction-only) and most (n=206, 90%) were released alive or left the vessel unaided. The remaining 97 interactions were photographed and had corresponding entries in the COD extract (Table 11).

The most prevalent species recorded as photographed or interaction-only seabirds was the white-chinned petrels (n=80, 25%), a 24% decrease from the previous year (2022/23) (Bell & Larcombe 2023). The second most prevalent species was the New Zealand white-capped albatross (n=58,18%), a 59% increase from the previous year (2022/23) (Bell & Larcombe 2023). These two species accounted for 43% of all reported interactions and photographed birds for 2023/24 (Table 11).

As with the monthly records of seabird captures retained for necropsy, the monthly distribution of the 327 interactions (photograph and interaction-only) were not evenly spread across the study time period, with February 2023 (n=63, 19%), April 2023 (n=55, 17%) and January 2023 (n=51, 16%) having the higher interaction rates (Table 12).

3.8.2 Target fishery and vessels of photographed or interaction-only seabirds

The seabirds that were photographed, discarded or released alive, and listed in the COD extract were caught in FMAs 1, 3, 5, 6, and 7 (Figure 6).

The seabirds that were reported as an interaction-only (non-photographed), discarded or released alive, and in the COD extract were caught in FMAs 1, 3, 4, 5, 6, 7, 8 and 9 (Figure 7).

The 327 seabirds that were either photographed or recorded as an interaction were from 46 individual vessels: 20 birds (6%) from five long line vessels, 294 birds (90%) from 35 trawl vessels, eleven birds (3%) from three set net vessels, and two birds (1%) from one purse seine vessel (Table 13).

Table 13: *Number of seabirds photographed or recorded as interaction-only from commercial fisheries vessels between 1 July 2022 and 30 June 2023. The total number of unique vessels on which both photographed and interaction-only were recorded is given.*

Fishery Type	Photograph		Interaction		Total	
	Seabirds	Vessels	Seabirds	Vessels	Seabirds	Vessels
Long Line	10	3	10	5	20	5
Trawl	85	20	209	35	294	35
Set Net	2	1	9	3	11	3
Purse Seine			2	1	2	1
All fisheries combined	**97**	**24**	**230**	**44**	**327**	**44**

There were 210 observed trips on 86 vessels (H. McGovern, DOC CSP, pers. comm.; MPI Observer data, unpublished) within this reporting period. Interactions with seabirds (photographed and non-photographed) were reported from 44 individual vessels (51% of all vessels) over 108 observed trips (51% of all observed trips). Most of these vessels reported relatively low numbers of bird interactions on each trip (≤5 birds reported each trip; n = 30, 68%). There were four trips (4%) that had interactions with ten or more seabirds, including one vessel that recorded 40 interactions on one trip.

3.8.3 Injuries of photographed or interaction-only seabirds

Over half of the 327 interaction-only or photographed seabirds were of seabirds being released alive (n=217, 66%) (Table 14).

Most of the deceased seabirds were recovered (95%), but only 79% were photographed (Table 14). As all these seabirds were discarded, cause of death cannot be confirmed (unless additional information can be seen in the images or videos or observers make additional comments in the COD. The majority (90%) of the photographed birds were caught on trawl vessels (65% entangled in the net and 13% by impact with the warp or vessel itself) (Table 15).

Table 14: *Number of seabird interactions (photographed and interaction-only) from commercial fishing vessels between 1 July 2022 and 30 June 2023.*

Status	Photographed	Interaction-only	Total	Total %
Alive	15	196	**211**	67.4
Alive, terminal injuries		2	**2**	0.6
Not recovered (deceased)	1	5	**6**	1.9
Discarded deceased (marked)	23	8	**31**	9.9
Discarded deceased (unmarked)	57	6	**63**	20.1
Total	**97**	**217**	**313**	

There were a range of injury types recorded against interaction-only and photographed birds (Table 16). Almost half of the birds had no visible injuries (n=147, 45%) (Table 16). Injuries ranged from waterlogged (7%), broken wings (4%), hook wounds (4%) to grease (1%) (Table 16). The injuries for nine birds could not be assessed as those birds were not recovered.

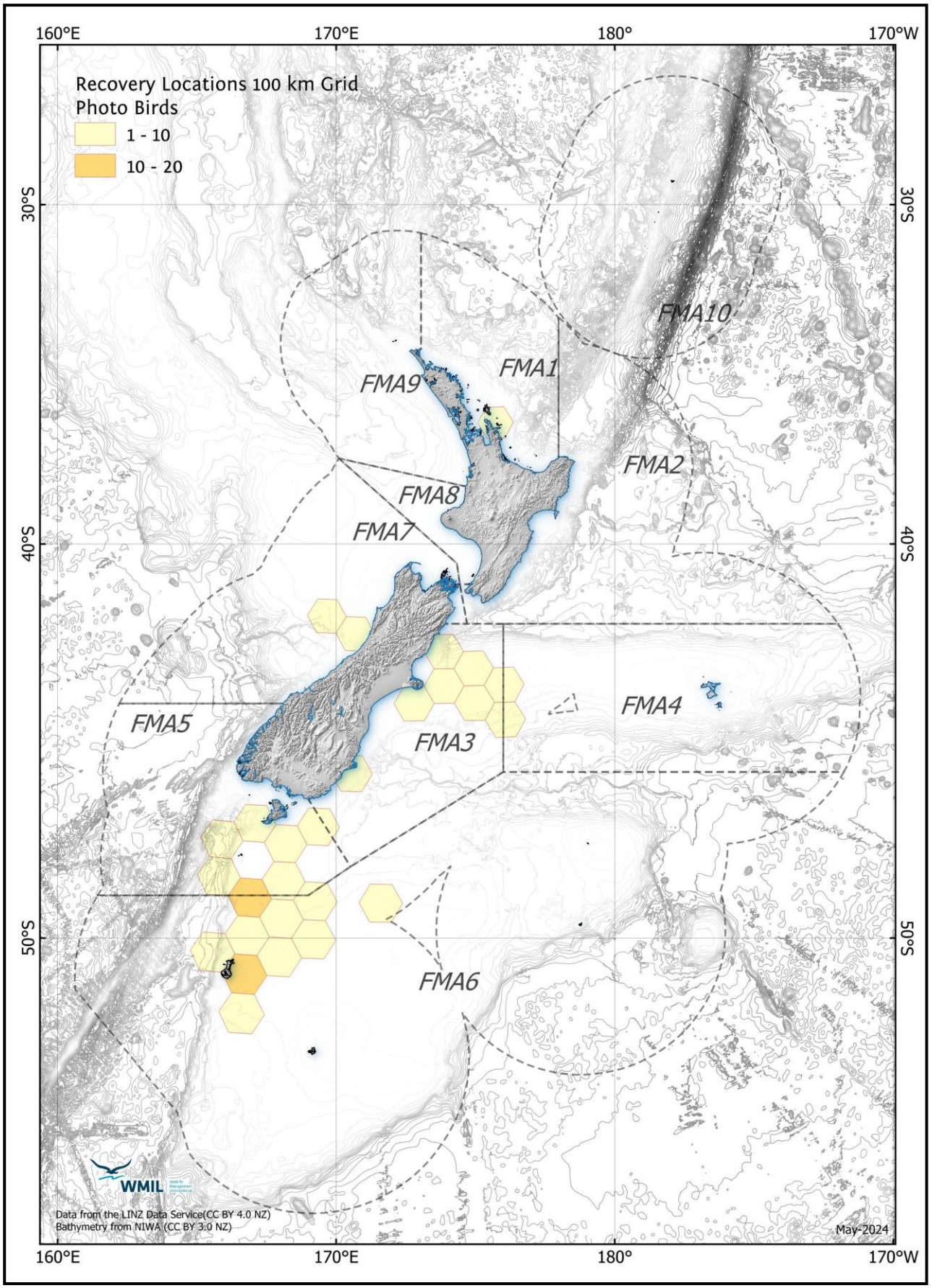

Figure 6: *Grouped catch locations of all seabirds caught and photographed in New Zealand commercial fisheries between 1 July 2022 and 30 June 2023.*

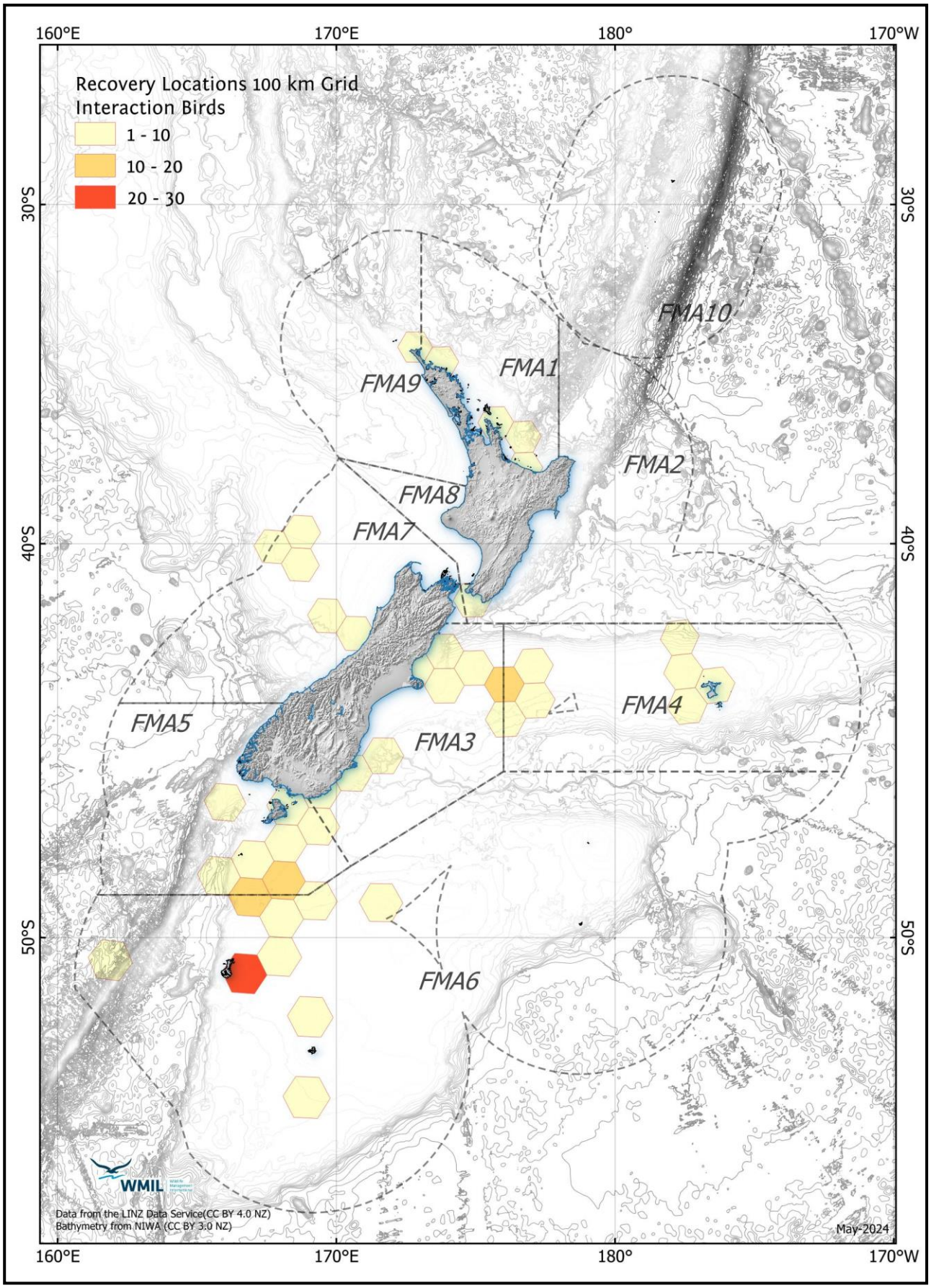

Figure 7: *Grouped catch locations of all seabirds reported as an interaction-only (non-photographed) in New Zealand commercial fisheries between 1 July 2022 and 30 June 2023.*

Table 15: Numbers of photographed seabird interactions with commercial fishing vessels between 1 July 2022 and 30 June 2023, 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				SETNET		Total
	Alive	Deceased	Deceased			Alive	Deceased	Alive	
		Hook	Net	Warp	Impact				
Albatross (unidentified)				1					1
Buller's albatross		1				1			2
Common diving petrel						1			1
Fairy prion					1				1
Flesh-footed shearwater	1								1
New Zealand white-capped albatross		4	4	7		3			18
Otago shag							1		1
Salvin's albatross			4	3	1				8
Seabird (large)				1					1
Small albatross (unidentified)				1					1
Sooty shearwater			15			1			16
Southern royal albatross						1			1
Westland petrel		3							3
White-bellied storm petrel	1								1
White-chinned petrel			40	1				1	42
Total	**2**	**8**	**63**	**13**	**2**	**7**	**1**	**1**	**97**
% total	**2.1**	**8.2**	**64.9**	**13.4**	**2.1**	**7.2**	**1.0**	**1.0**	
Total (per fishery type)	**10**		**85**				**2**		
Albatrosses (%)		62.5	12.7	92.3	50	71.4			33.0
Non-albatross (%)	100	38.5	87.3	7.7	50	28.6	100	100	67.0

Table 16: *Injury types recorded on seabird interactions (photographed and interaction-only) with commercial fishing vessels between 1 July 2022 and 30 June 2023.*

Species	No visible injuries	Waterlogged	Broken wing	Hook	Open wound or severed body part	Crushed or more than 3 injuries	Grease	Other	Unknown (Not recovered)
Albatross (unidentified)	4				1	1		5	1
Black (Parkinson's) petrel	1					1			
Black-bellied storm petrel	1								
Black-browed albatross (unidentified)	2								
Southern Buller's albatross	2			1					
Buller's and Pacific albatross	1		1	1	1			1	4
Cape petrels	2								
Common diving petrel	4								
Fairy prion	2							1	
Flesh-footed shearwater	6			3				3	
Fluttering shearwater	2			1				1	
Giant petrel (unidentified)	2								
Great albatross (unidentified)	2							1	
Mid-sized petrel & shearwater (unidentified)	1								
New Zealand white-capped albatross	37	4	7	5	1	1	2	9	1
Northern giant petrel									1
Otago shag	1								
Petrel (unidentified)	2								
Petrels, prion and shearwaters (unidentified)	5							14	2
Prion (unidentified)								1	
Procellaria petrel (unidentified)	10								
Royal albatross (unidentified)				1	1			1	
Salvin's albatross	9		3	1	5	2	1	1	
Seabird (large)					1				
Shearwater (unidentified)	1								
Small albatross (unidentified)		1			1	1		2	
Sooty shearwater	8	4	1		1	1		4	
Southern royal albatross	1								
Storm petrel (unidentified)	1								

	No visible injuries	Waterlogged	Broken wing	Hook	Open wound or severed body part	Crushed or more than 3 injuries	Grease	Other	Unknown (Not recovered)
Westland petrel	5								
White-bellied storm petrel	1								
White-chinned petrel	34	14	2					9	
Total	**147**	**23**	**14**	**13**	**12**	**7**	**3**	**53**	**9**
% total	45.0	7.0	4.3	4.0	3.7	2.1	0.9	16.2	2.8

3.8.4 Identification of photographed seabirds

Examination of 97 photographed seabird interactions confirmed that observers had accurately identified 75% of seabirds (Table 17). Another 17 seabirds (18%) were identified to the correct species group, but not to species level (Table 17). One common diving petrel, one fairy prion, one sooty shearwaters, and four white-chinned petrels were incorrectly identified (7%; Table 17).

Table 17: *Comparison of 97 observer identifications with expert identifications for photographed captures listed in COD from fishing vessels between 1 July 2022 and 30 June 2023, 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; 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 wrong	Total
Albatross (unidentified)	1			**1**
Buller's albatross	2			**2**
Common diving petrel			1	**1**
Fairy prion			1	**1**
Flesh-footed shearwater	1			**1**
New Zealand white-capped albatross	17	1		**18**
Otago shag	1			**1**
Salvin's albatross	8			**8**
Seabird (large)	1			**1**
Sooty shearwater	14	1	1	**16**
Southern royal albatross	1			**1**
Westland petrel	3			**3**
White-bellied storm petrel	1			**1**
White-chinned petrel	23	15	4	**42**
Total	**73**	**17**	**7**	**97**
% of total	**75.3**	**17.5**	**7.2**	

3.8.5 Quality and number of photographs

The quality of the images obtained by observers continued to vary widely, particularly for live seabirds. 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, often with multiple images focusing on key features.

The usual issues with the imagery (i.e., only one photograph, not all key features being photographed, poor focus, labels being omitted from the photographs, and under- or over-exposure) continues to occur.

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). Many of these images are out of focus or only showing the bird in the distance.

On occasion, cameras used by observers continue to not be programmed with the current date and time. This means metadata of images do not match the data and time recorded in the COD which makes it difficult to link birds to the correct trip and haul in situations where several seabirds were photographed in the same haul and labels unclear.

3.8.6 Recommendations for photograph identification

It is recommended that:

- Wherever possible, all seabird interactions are photographed and recorded. If possible, haul and sample information should be included in the image.
- 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.
- Observers are encouraged to take multiple images of live and dead birds from all angles to enable more accurate identification of specimens. When holding live birds in the hand, images of the head and entire body and wing should be taken.
- 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.
- Photograph numbers are recorded on the observer non-fish bycatch form.
- Photographs (and extracts from the observer logbooks) are provided regularly throughout the fishing year for photo-identification.
- 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. SUMMARY AND RECOMMENDATIONS

The five seabird species retained for necropsy most frequently in 2022/23 (white-chinned petrel, Salvin's albatross, New Zealand white-capped albatross, Southern Buller's albatross and sooty shearwater) were the same most frequently reported species as those reported in the preceding year, and in similar numbers. These five species consistently comprise the vast majority of seabirds caught in New Zealand commercial fisheries.

Where the sex of seabirds retained in 2022/23 could be identified, most of the birds (63%) were males. Almost twice as many males were retained as females, although seven species only returned females (Snares Cape petrel, northern giant petrel, Chatham albatross, common diving petrel, grey-faced petrel, spotted shag and snowy albatross). 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).

New Zealand white-capped albatross, Salvin's albatross, sooty shearwater and white-chinned petrels made up the majority of photographed records of deceased birds. This is likely attributable to observer requirements not necessitating that all specimens of these species be retained. It may also be related to sooty shearwaters and white-chinned petrels often being caught in multiple numbers during one haul. Observer requirements determining the frequency at which each species is retained must be considered when comparing necropsy figures over time.

It would be valuable to compare the observer data with electronic monitoring (cameras on vessels) to determine whether observer coverage provides accurate information on bycatch and seabird interaction.

WMIL recommend that:

- Improved photograph methodology is implemented (see Section 3.8.5 Recommendations for photograph identification).

- Observer training includes additional seabird identification options and refresher training each year prior to deployment on vessels.
- Observers are encouraged to attempt higher level seabird identification.
- Observers are encouraged to provide more notes about the seabird interaction, including injuries, terminal status for birds released "alive", other seabirds present, mitigation being used, weather, etc. to assist with identification and understanding fisheries/seabird interaction.
- Photographed interactions are provided at a regular schedule to enable prompt identification of these birds.
- COD extracts are provided at a regular schedule to enable more prompt analysis of interaction and photographed birds.
- All deceased seabirds are returned whenever possible as this would enable additional data to be collected from these birds.
- When not possible to returned deceased seabirds, these should be photographed, and sampled (i.e., feathers collected), to enable accurate identification.
- Bycatch data is analysed over time to determine how fisheries effort and Observer coverage variation over time affects seabird interaction numbers.
- Electronic monitoring data is compared to Observer data to determine whether accurate levels of seabird interactions are being reported.

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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 (DOC CSP) provided the link between Wildlife Management International Ltd., Department of Conservation and Ministry for Primary Industries Observer Programme and helped provide clarification on any discrepancies with necropsy tag data, photograph and/or video records and COD entries. WMIL staff, Dr Karen Middlemiss (DOC) and Craig Pritchard (Ecovet) assisted with dissecting and collecting samples from seabirds returned for necropsy. WMIL staff also assisted with assessing photographs and video sent through by observers. Alexandra Phelps (WMIL Intern) assisted with data entry. Kelvin Floyd (WMIL) developed and maintained the WMIL necropsy and photo-identification database and produced all maps.

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