

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



1 July 2020 to 30 June 2021

INT2019-02: Identification of seabirds captured in New Zealand fisheries, 1 July 2020 to 30 June 2021

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Cover image: Image of a flesh-footed shearwater (*Puffinus carneipes*) interaction (hook landing) provided by MPI/DOC Government Observer, 13 April 2021.

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ABSTRACT

New Zealand waters support a diverse range of seabird species. Much of the commercial fishing activity in the region overlaps with seabird foraging ranges. The accurate identification of seabirds captured in New Zealand fisheries is vital for determining the impact of fisheries on these seabird populations. Between 1 July 2020 and 30 June 2021, a total of 649 seabirds were reported as incidental interactions with commercial fishing vessels by on-board New Zealand Government observers; of these 192 were returned for necropsy and 457 were interactions ($n = 270$) or photographed ($n = 187$) as dead or alive captures.

There were 192 seabirds comprising 18 taxa incidentally killed as bycatch and returned for necropsy. Birds were returned from 50 longline ($n = 50$ seabirds), 35 trawl ($n = 138$ seabirds) and five set net ($n = 4$ seabirds) vessels and were dominated numerically by five species: white-chinned petrel ($n = 48$, 25%), New Zealand white-capped albatross ($n = 37$, 19.3%), sooty shearwater ($n = 25$, 13%), Salvin's albatross ($n = 20$, 10.4%) and Buller's albatross ($n = 19$, 9.9%). These five species accounted for 77.6% of all returns. All birds returned from longline fisheries had injuries consistent with being hooked in the bill, throat, or wing. In contrast, most birds (75.4%) returned from trawl fisheries were killed through entanglement in the net, cod-end, or pound, with 16.7% likely to have been killed by warp interaction or entanglement. Eleven birds were killed by striking the deck of the trawl vessel. Birds had the same mean fat scores in comparison to birds from the last fishing year, and discards, including offal, appear to continue to be an attractant for many seabirds.

In addition to the seabirds that were returned for necropsy, examination of the Ministry for Primary Industries Central Observer Database (COD) and images provided by Government observers gave a total of a further 457 seabirds that were reported as interactions or photographed (as dead or alive captures) aboard 51 fishing vessels. The majority (65.2%) of the seabirds reported in these interactions and photographs were released alive. Out of these 457 records of seabird interactions, photographs were taken of 187 seabirds consisting of 17 taxa. Image quality varied widely, with poor images being particularly common for birds that were alive and seen on-board for short periods. Images of dead birds have improved with multiple images taken for each specimen. Recommendations are made to improve photo-identifications in the future.

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

1. INTRODUCTION

New Zealand waters support a large and diverse range of seabird species. However, much of the commercial fishing activity within New Zealand waters overlaps with the ranges of these seabirds (Robertson et al. 2003), and seabirds are regularly captured and killed through interactions with fishing gear. Therefore, the accurate identification of seabirds captured in 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 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 programme has been in place since 1996 to accurately determine the taxon (as well as age, sex, diet, and provenance) of specimens recovered dead by observers. Observers present on fishing trips within New Zealand's

Exclusive Economic Zone (EEZ) are generally required to return all seabirds caught and killed as incidental bycatch during fishing operations for necropsy. Additional information such as vessel name, location of capture (latitude and longitude), and date of capture is also recorded. Specific catch locations and vessel names have not been provided in this report on the grounds of commercial sensitivity. All necropsies were performed for the Department of Conservation (DOC) as part of Conservation Services Programme (CSP) project 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 2020 and 30 June 2021. Identifications were based on dead birds caught and returned, or photographs or videos of live or dead birds.

1.1 Objectives

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

The specific objectives of the necropsy programme are to:

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

2. METHODS

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).

2.1 Necropsy

The necropsy methods followed those described by Bartle (2000) and used in autopsies 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).

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

- *Adults* – adult morphology (e.g. body size, bill size, bill colour, plumage colour), but active breeding could not be confirmed

- *Breeding adults* - considered to be actively breeding at the time of capture (e.g. bare brood patch, swollen ovaries, or testes)
- *Non-breeding adults* - identified by feather moult (e.g. downy brood patch, body moult, wing moult) and gonadal evidence (i.e. regressed or small ovaries and testes)
- *Sub-adults (pre-breeders)* – non-adult or near-adult plumage and/or morphology (e.g. bill colour), but no gonadal evidence that they had obtained breeding condition
- *Juveniles* - juvenile plumage and/or morphology (e.g. bill colour, bill size, leg, and foot colour)

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

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

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

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

2.2 Photo-identification

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

Each bird or interaction was separated as follows:

- *Photo (Photo and Extract)*: seabird photographed by observer, image provided, and interaction recorded in MPI COD
- *Photo (Image not received to date)*: seabird apparently photographed by observer but not received to date and interaction recorded in MPI COD
- *Photo (Not in extract to date)*: image of seabird received but interaction not listed in MPI COD to date
- *Interaction*: seabird interaction with vessel (i.e., live or dead capture, warp, or deck strike, etc.) listed in MPI COD, but no image taken by observer

Photographs were provided in electronic format with associated observer MPI COD extracted information (vessel name, type of fishery, date of capture, time of capture etc.) in an Excel spreadsheet.

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

All photographed seabirds were identified to the lowest possible taxon. Various seabird reference books (including Marchant & Higgins 1990, Bartle 2000, Shirihai 2002, Onley & Scofield 2007) were used to confirm identification when necessary.

Table 1. Common and scientific names of seabirds recorded as interacting with fishing vessels between 1 July 2020 and 30 June 2021, 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 | SCIENTIFIC NAME | END STATUS | | | | | | TOTAL | |
|--|--------------------------------------|------------|----|-------|------|----|----|-------|-------|
| | | ALIVE | | | DEAD | | | | |
| | | I | P | Total | I | P | N | | Total |
| Albatross (unidentified) | | 10 | | 10 | 3 | | | 3 | 13 |
| Australasian gannet | <i>Morus serrator</i> | | | | 2 | | | 2 | 2 |
| Black (Parkinson's) petrel | <i>Procellaria parkinsoni</i> | 8 | 1 | 9 | | | 4 | 4 | 13 |
| Black-browed albatross (unidentified) | <i>Thalassarche spp.</i> | 1 | | 1 | | | | | 1 |
| Buller's albatross | <i>Thalassarche bulleri bulleri</i> | 8 | 1 | 9 | | 9 | 19 | 28 | 37 |
| Buller's and Pacific albatross | <i>Thalassarche bulleri</i> | 4 | 1 | 5 | 1 | | | 1 | 7 |
| Buller's shearwater | <i>Puffinus bulleri</i> | 2 | | 2 | | | | | 2 |
| Campbell albatross | <i>Thalassarche impavida</i> | | | | | | 1 | 1 | 1 |
| Cape petrels | <i>Daption spp.</i> | 7 | 1 | 8 | | | | | 8 |
| Common diving petrel | <i>Pelecanoides urinatrix</i> | 9 | 7 | 16 | | | 3 | 3 | 19 |
| Fairy prion | <i>Pachyptila turtur</i> | 3 | 2 | 5 | | | 3 | 3 | 8 |
| Flesh-footed shearwater | <i>Puffinus carneipes</i> | 25 | 27 | 52 | | 2 | 6 | 8 | 60 |
| Foveaux shag | <i>Phalacrocorax stewarti</i> | | | | | | 2 | 2 | 2 |
| Gibson's albatross | <i>Diomedea antipodensis gibsoni</i> | 1 | | 1 | | | | | 1 |
| Great albatross (unidentified) | <i>Diomedea spp.</i> | 2 | | 2 | | | | | 2 |
| Great-winged (Grey-faced) petrel | <i>Pterodroma macroptera</i> | 1 | | 1 | | | | | 1 |
| Grey petrel | <i>Procellaria cinerea</i> | 2 | 1 | 3 | | | 4 | 4 | 7 |
| Grey-backed storm petrel | <i>Garrodia nereis</i> | | | | | | 2 | 2 | 2 |
| New Zealand white-capped albatross | <i>Thalassarche steadi</i> | 58 | 7 | 65 | 5 | 24 | 37 | 66 | 131 |
| Northern giant petrel | <i>Macronectes halli</i> | 2 | | 2 | | | 2 | 2 | 4 |
| Otago shag | <i>Phalacrocorax chalconotus</i> | | | | | 2 | 2 | 4 | 4 |
| Petrel (unidentified) | | 5 | | 5 | | | | | 5 |
| Petrels, prion, and shearwaters (unidentified) | | 6 | | 6 | 4 | | | 4 | 10 |

| COMMON NAME | SCIENTIFIC NAME | END STATUS | | | | | | TOTAL | |
|------------------------------------|-----------------------------------|------------|-----------|------------|-----------|------------|------------|------------|------------|
| | | ALIVE | | | DEAD | | | | |
| | | I | P | Total | I | P | N | | Total |
| Prion (unidentified) | <i>Pachyptila spp.</i> | 3 | | 3 | | | | | 3 |
| Procellaria petrel (unidentified) | <i>Procellaria spp.</i> | 10 | | 10 | | | | | 10 |
| Pterodroma petrel (unidentified) | <i>Pterodroma spp.</i> | 3 | | 3 | | | | | 3 |
| Red-billed gull | <i>Larus scopulinus</i> | 1 | | 1 | | | | | 1 |
| Salvin's albatross | <i>Thalassarche salvini</i> | 12 | | 12 | 1 | 7 | 20 | 28 | 40 |
| Seabird (small) | | | | | 1 | | | 1 | 1 |
| Seabird (unidentified) | | 2 | | 2 | | | | | 2 |
| Shearwater (unidentified) | <i>Puffinus spp.</i> | 5 | | 5 | 1 | | | 1 | 6 |
| Small albatross (unidentified) | <i>Thalassarche spp.</i> | 4 | | 4 | 3 | 1 | | 4 | 8 |
| Snares Cape petrel | <i>Daption capense australe</i> | | | | | | 2 | 2 | 2 |
| Sooty shearwater | <i>Puffinus griseus</i> | 16 | 5 | 21 | 6 | 15 | 25 | 46 | 67 |
| Southern giant petrel | <i>Macronectes giganteus</i> | | | | | 1 | | 1 | 1 |
| Southern royal albatross | <i>Diomedea epomophora</i> | | 2 | 2 | 2 | | 1 | 3 | 5 |
| Storm petrel (unidentified) | | 2 | 1 | 3 | | | | | 3 |
| Wandering albatross (unidentified) | <i>Diomedea exulans spp.</i> | 2 | | 2 | | | | | 2 |
| Westland petrel | <i>Procellaria westlandica</i> | 6 | | 6 | | | 11 | 11 | 17 |
| White-chinned petrel | <i>Procellaria aequinoctialis</i> | 20 | 2 | 22 | 1 | 68 | 48 | 117 | 139 |
| TOTAL | | 240 | 58 | 298 | 30 | 129 | 192 | 351 | 649 |

Bill and head morphology and colour were usually sufficient to allow the identification of albatrosses and larger petrels to species, but other key features (such as size, shape, foot colour and wing markings) were needed to identify smaller species. If key features were not visible in the photograph or the image was out of focus, identification to species was not possible. Where possible, the age, sex and provenance of the photographed seabirds were also determined.

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

3. RESULTS

3.1 Necropsy

3.1.1 Returned seabirds

A total of 192 seabirds comprising 18 taxa were returned from 52 vessels between 1 July 2020 and 30 June 2021 (Table 2, Figure 1).

Seabirds returned were dominated by five species: white-chinned petrel ($n = 48$, 25%), New Zealand white-capped albatross ($n = 37$, 19.3%), sooty shearwater ($n = 25$, 13%), Salvin's albatross ($n = 20$, 10.4%) and Buller's albatross ($n = 19$, 9.9%) (Table 2). These five species accounted for 77.6% of all returned seabirds. Of the remaining eleven taxa, two had only single captures, five had two captures, two had three captures, two had four captures, one had six captures, and one had eleven captures (Table 2).

There were two banded birds with uniquely numbered metal band within those captured and returned between 1 July 2020 and 30 June 2021. One Westland petrel (L-34355) was recovered, but the banding information was not available through the DOC Banding Office and one male Buller's albatross (M-90024) had been banded on North East Island, The Snares as a 10+ year old on 3 March 2019. Banded specimens provide valuable longevity and survival data.

The monthly distribution of returned specimens was not evenly spread across the fishing year with most birds returned being caught in April 2021 ($n = 35$, 18.2%), March 2021 ($n = 33$, 17.2%) and May 2021 ($n = 29$, 15.1%) (Table 2). This pattern reflects the timing of seabird breeding, presence within the New Zealand EEZ, timing and location of all observed fisheries, and observer coverage.

The majority of birds were males ($n = 131$, 68.2%), with common diving petrel, Foveaux shag, grey petrel, Otago shag, Snares cape petrel, and southern royal albatross returning only males (Table 3). Campbell albatross had only females returned (Table 3). Black petrels, flesh-footed shearwaters, grey-backed storm petrels, northern giant petrels and Salvin's albatross had even or mostly even sex captures (Table 3).

Most birds were adults ($n = 170$, 88.5%) (Table 3). Of these adults, 60 (35.3%) were breeding and 12 (7.1%) were non-breeding (Table 3). Twelve birds (6.3%) were pre-breeders (i.e. either sub-adult, immature, or juvenile birds) (Table 3).

Table 2. Number of dead seabirds of each species returned for necropsy from observed fishing vessels between 1 July 2020 and 30 June 2021, by month of capture.

| SPECIES | MONTH | | | | | | | | | | | | TOTAL | % TOTAL NECROPSIED BIRDS |
|------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|-------------|------------|--------------------------|
| | 2020 | | | | | | 2021 | | | | | | | |
| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | | |
| Black (Parkinson's) petrel | | | | | | | | 2 | | 1 | 1 | | 4 | 2.1% |
| Buller's albatross | 1 | | 1 | | 1 | | 3 | | 1 | 1 | 7 | 4 | 19 | 9.9% |
| Campbell albatross | | | | | | | | | | | 1 | | 1 | 0.5% |
| Common diving petrel | | | | 1 | | | | 1 | | 1 | | | 3 | 1.6% |
| Fairy prion | | | | | | | | | 1 | 2 | | | 3 | 1.6% |
| Flesh-footed shearwater | | | | | | | | 2 | | 1 | 3 | | 6 | 3.1% |
| Foveaux shag | | | | 1 | | | | | | 1 | | | 2 | 1.0% |
| Grey petrel | | 1 | 3 | | | | | | | | | | 4 | 2.1% |
| Grey-backed storm petrel | 1 | 1 | | | | | | | | | | | 2 | 1.0% |
| New Zealand white-capped albatross | 3 | | 2 | 1 | | | 4 | 12 | 9 | 3 | 2 | 1 | 37 | 19.3% |
| Northern giant petrel | | | | | | 1 | 1 | | | | | | 2 | 1.0% |
| Otago shag | | | | | | | 2 | | | | | | 2 | 1.0% |
| Salvin's albatross | 1 | | 3 | 2 | 4 | 3 | 2 | 4 | | 1 | | | 20 | 10.4% |
| Snares Cape petrel | | | | | | | 1 | | | | | 1 | 2 | 1.0% |
| Sooty shearwater | | | | | 1 | | | 3 | 12 | 5 | 4 | | 25 | 13.0% |
| Southern royal albatross | | | | | | | | | 1 | | | | 1 | 0.5% |
| Westland petrel | | 1 | 2 | 6 | | | | | | 1 | 1 | | 11 | 5.7% |
| White-chinned petrel | | | | | 1 | 1 | 6 | 3 | 9 | 18 | 10 | | 48 | 25.0% |
| TOTAL | 6 | 3 | 11 | 11 | 7 | 5 | 19 | 27 | 33 | 35 | 29 | 6 | 192 | |
| % TOTAL NECROPSIED BIRDS | 3.1% | 1.6% | 5.7% | 5.7% | 3.6% | 2.6% | 9.9% | 14.1% | 17.2% | 18.2% | 15.1% | 3.1% | | |

Table 3. Species and numbers of seabirds killed and returned from observed fishing vessels between 1 July 2020 and 30 June 2021, by sex (M = male, F = female, U = unknown) and age (A = adult, BA = breeding adult, N = non-breeding adult, SA = sub-adult, I = immature and J = juvenile, U = unknown).

| SPECIES | SEX | | | AGE | | | | | | | TOTAL | % TOTAL NECROPSIED BIRD |
|---------------------------------|--------------|--------------|-------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|------------|-------------------------|
| | M | F | U | A | BA | N | SA | I | J | U | | |
| Black (Parkinson's) petrel | 2 | 2 | | 4 | 3 | 1 | | | | | 4 | 2.1% |
| Buller's albatross | 13 | 4 | 2 | 16 | 12 | | 1 | | | 2 | 19 | 9.9% |
| Campbell albatross | | 1 | | 1 | | | | | | | 1 | 0.5% |
| Common diving petrel | 2 | | 1 | 3 | | 1 | | | | | 3 | 1.6% |
| Fairy prion | 2 | 1 | | 1 | | | 1 | | | 1 | 3 | 1.6% |
| Flesh-footed shearwater | 3 | 3 | | 5 | 1 | | | | | 1 | 6 | 3.1% |
| Foveaux shag | 2 | | | 2 | | | | | | | 2 | 1.0% |
| Grey petrel | 3 | | 1 | 4 | | | | | | | 4 | 2.1% |
| Grey-backed storm petrel | 1 | 1 | | 2 | | | | | | | 2 | 1.0% |
| NZ white-capped albatross | 20 | 12 | 5 | 31 | 15 | 2 | 2 | 1 | | 3 | 37 | 19.3% |
| Northern giant petrel | 1 | 1 | | 2 | | | | | | | 2 | 1.0% |
| Otago shag | 2 | | | 1 | | | 1 | | | | 2 | 1.0% |
| Salvin's albatross | 9 | 7 | 4 | 16 | 7 | 3 | 1 | | | 2 | 20 | 10.4% |
| Snares Cape petrel | 2 | | | 2 | 1 | | | | | | 2 | 1.0% |
| Sooty shearwater | 21 | 4 | | 20 | 2 | 2 | 1 | | 4 | | 25 | 13.0% |
| Southern royal albatross | 1 | | | 1 | 1 | | | | | | 1 | 0.5% |
| Westland petrel | 9 | 1 | 1 | 11 | 1 | | | | | | 11 | 5.7% |
| White-chinned petrel | 38 | 10 | | 48 | 17 | 3 | | | | | 48 | 25.0% |
| TOTAL | 131 | 47 | 14 | 170 | 60 | 12 | 7 | 1 | 4 | 9 | 192 | |
| % TOTAL NECROPSIED BIRDS | 68.2% | 24.5% | 7.3% | 88.5% | 31.3% | 6.3% | 3.6% | 0.5% | 2.1% | 4.7% | | |

3.1.2 Target vessel and fishery of necropsy seabirds

The seabirds killed and returned for necropsy were caught in a range of Fishing Management Areas (FMA 1, 2, 3, 4, 5, 6, 7 and 9) and general positions are shown in Figure 1.

For the fishing period 1 July 2020 to 30 June 2021, there were 293 observed trips on 129 vessels (Observer data, unpublished). Fifty-two vessels (40.3%) returned birds for necropsy during this period from 129 observed trips (44.0%); the average was 3.4 birds (± 0.4) caught and returned from 2.3 observed trips (± 0.2) per vessel. Over three-quarters of these 52 vessels returned relatively low numbers of birds (< 5 birds caught and returned; $n = 43$, 82.7%). Three vessels caught ten or more birds; one bottom longliner caught and returned 17 birds from one observed trip, one trawler caught and returned 14 birds over seven observed trips, and one trawl vessel returned ten birds over four observed trips. The remaining vessels caught and returned between five and nine birds from between one and seven observed trips.

Of those vessels that caught and returned seabirds, 14 were longline vessels (26.9%; 9 bottom and 5 surface longline vessels), three were set-net vessels (5.8%) and 38 were trawlers (73.1%) (Table 4).

Longline vessels returned a total of 50 seabirds (26.0% of total returns; bottom longliner $n = 39$, 78% and surface longliner $n = 11$, 22%), with vessels targeting tuna *Thunnus* spp. accounting for 16% of longline specimens ($n = 8$), those targeting snapper *Centroberyx affinis* accounting for 12% of longline specimens ($n = 6$), those targeting ling *Genypterus blacodes* accounting for 62% of longline specimens ($n = 31$) and the remainder targeting 'other' species (mainly swordfish *Xiphias gladius* and tarakihi *Nemadactylus macropterus*) accounting for 10% of longline specimens ($n = 5$) (Table 4).

Bottom and midwater trawl fisheries combined returned 138 birds (71.9% of total returns), with trawlers targeting squid *Nototodarus* spp. accounting for 39.1% ($n = 54$) of all trawl returns, those targeting hoki *Macruronus novaezelandiae* accounting for 30.4% ($n = 42$), those targeting ling accounting for 1.4% ($n = 2$), those targeting scampi *Metanephrops challengeri* accounting for 2.9% ($n = 4$) and those targeting 'other' species (mainly barracouta *Thyrsites atun*, silver warehou *Seriola punctata*, gurnard *Chelidonichthys cuculus*, tarakihi, and southern blue whiting *Micromesistius australis*) accounting for 26.1% ($n = 36$) (Table 4).

Four seabirds were caught and killed on set net vessels (2.1% of total returns), with vessels targeting school shark (*Galeorhinus galeus*) and other shark species accounting for all set-net returns (Table 4).

3.1.3 Injuries and likely cause of death of necropsied seabirds

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 50 birds from longline vessels, most were waterlogged and had hook injuries and of these, 21 (42%) still had hooks present (ten in the bill/throat/neck and eleven in the wing) (Tables 5 and 6).

Of the 138 birds from trawl vessels, most had been caught in the net or recovered in the pound or cod end (i.e. had drowned, $n = 104$, 75.4%) and were very wet and sandy with crush injuries (Tables 5 and 6). Other birds had injuries suggesting entanglement and crush injuries from the trawl warp and blocks ($n = 23$, 16.7%), 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 (58.2%) while only albatross taxa were affected by warp strikes exhibiting serious wing injuries or lacerations (Tables 5 and 6). There were eleven seabirds returned that had been killed by impacting the trawl vessel (8%) (Tables 5 and 6).

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

Figure 1. Grouped catch locations of all seabirds killed and returned in New Zealand fisheries for necropsy between 1 July 2020 and 30 June 2021.

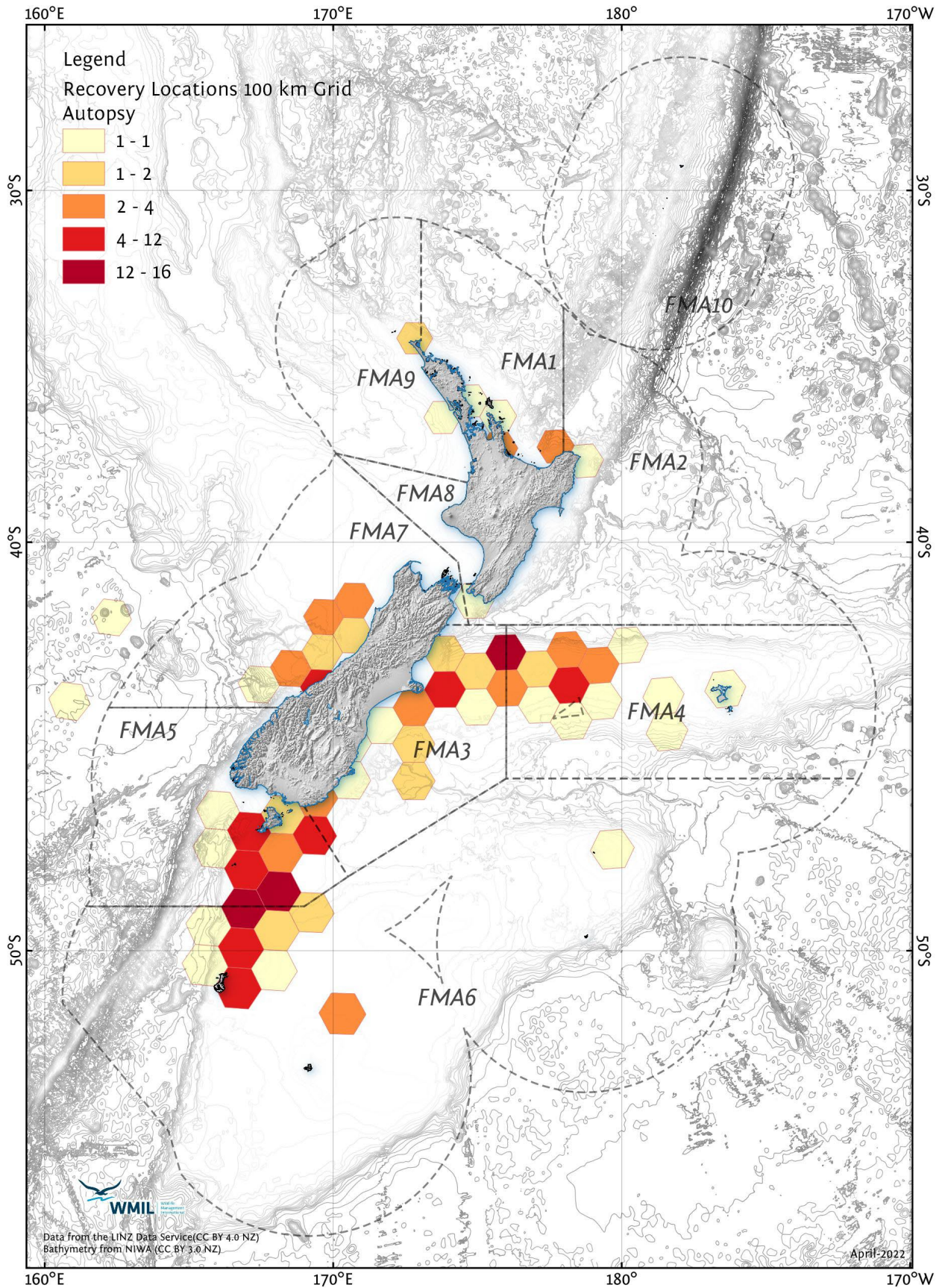


Table 4 Number of seabirds of each species killed and returned from observed fishing vessels between 1 July 2020 and 30 June 2021, by fisheries type.

| Species | Trawl (Bottom/Midwater) | | | | | Longline (Surface/Bottom) | | | | Setnet | Total |
|----------------------------|-------------------------|-------|-------|------|-------|---------------------------|---------|------|-------|--------|-------|
| | Scampi | Squid | Hoki | Ling | Other | Tuna | Snapper | Ling | Other | | |
| Black (Parkinson's) petrel | | | | | 1 | 2 | 1 | | | | 4 |
| Buller's albatross | 2 | 11 | 2 | | 3 | | | | 1 | | 19 |
| Campbell albatross | | | 1 | | | | | | | | 1 |
| Common diving petrel | | 1 | | 1 | 2 | | | | | | 3 |
| Fairy prion | | 1 | 1 | | 1 | | | | | | 3 |
| Flesh-footed shearwater | | | | | | | 5 | | 1 | | 6 |
| Foveaux shag | | | | | | | | | | 2 | 2 |
| Grey petrel | | | | | 3 | | | 1 | | | 4 |
| Grey-backed storm petrel | | | | | 1 | | | 1 | | | 2 |
| NZ white-capped albatross | 1 | 16 | 3 | 1 | 13 | 1 | | | 3 | | 37 |
| Northern giant petrel | | | 1 | | 1 | | | | | | 2 |
| Otago shag | | | | | | | | | | 2 | 2 |
| Salvin's albatross | 1 | 1 | 16 | | 1 | 1 | | | | | 20 |
| Snares Cape petrel | | 1 | 1 | | | | | | | | 2 |
| Sooty shearwater | | 10 | 5 | | 9 | | | 1 | | | 25 |
| Southern royal albatross | | | | | 1 | | | | | | 1 |
| Westland petrel | | | 1 | | 1 | | | 9 | | | 11 |
| White-chinned petrel | | 13 | 11 | | 1 | 4 | | 19 | | | 48 |
| TOTAL | 4 | 54 | 42 | 2 | 38 | 8 | 6 | 31 | 5 | 4 | 192 |
| | 2.9% | 39.1% | 30.4% | 1.4% | 27.5% | 16% | 12% | 62% | 10% | | |
| % TOTAL | 138 | | | | | 50 | | | | 2.1% | |
| | 71.9% | | | | | 26.0% | | | | | |

Table 5. Number of seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2020 and 30 June 2021, by likely cause of death. The proportion of albatross and non-albatross taxa returned is also presented.

| Species | Trawl | | | | | Longline | | | | | | Setnet | Total |
|------------------------------|--------------|--------------|------------------|-------------|---------------|-----------------------|------------|--------------|-------------|------------|---------------|----------|------------|
| | Warp | Net | Pound or Cod-end | Other | Vessel strike | Bill, neck, or throat | Wing | Legs or feet | Not obvious | Tangled | Vessel strike | | |
| Black (Parkinson's) petrel | | 1 | | | | | | | 2 | 1 | | | 4 |
| Buller's albatross | 4 | 6 | 3 | 4 | 1 | | | | 1 | | | | 19 |
| Campbell albatross | | 1 | | | | | | | | | | | 1 |
| Common diving petrel | | 1 | | | 2 | | | | | | | | 3 |
| Fairy prion | | | 1 | | 2 | | | | | | | | 3 |
| Flesh-footed shearwater | | | | | | 2 | 3 | | 1 | | | | 6 |
| Foveaux shag | | | | | | | | | | | | 2 | 2 |
| Grey petrel | | 3 | | | | 1 | | | | | | | 4 |
| Grey-backed storm petrel | | | | | 1 | | | | | | 1 | | 2 |
| NZ white-capped albatross | 11 | 13 | 5 | 3 | | 2 | 1 | | 2 | | | | 37 |
| Northern giant petrel | | 1 | | 1 | | | | | | | | | 2 |
| Otago shag | | | | | | | | | | | | 2 | 2 |
| Salvin's albatross | 7 | 7 | 4 | | 1 | | 1 | | | | | | 20 |
| Snares Cape petrel | | 1 | | | | | | | | 1 | | | 2 |
| Sooty shearwater | | 13 | 5 | 2 | 4 | | | | | 1 | | | 25 |
| Southern royal albatross | 1 | | | | | | | | | | | | 1 |
| Westland petrel | | 1 | | 1 | | 1 | 5 | | 3 | | | | 11 |
| White-chinned petrel | | 19 | 6 | 2 | | 4 | 1 | | 14 | 2 | | | 48 |
| Total | 23 | 67 | 24 | 13 | 11 | 10 | 11 | 0 | 23 | 5 | 1 | | |
| Total (each type) | 138 | | | | | 50 | | | | | | 4 | |
| % of total longline or trawl | 16.7% | 48.6% | 17.4% | 9.4% | 8% | 20% | 22% | | 46% | 10% | 2% | | 192 |
| Albatrosses (%) | 100% | 41.8% | 50% | 61.5% | 18.2% | 20% | 18.2% | | 13% | | | | |
| Non-albatross (%) | | 58.2% | 50% | 38.5% | 81.8% | 80% | 81.8% | | 87% | 100.0% | 100.0% | 100.0% | |

Table 6 Types of injuries recorded on seabirds of each species killed and returned from longline and trawl fisheries between 1 July 2020 and 30 June 2021. The proportion of albatross and non-albatross taxa returned is also presented.

Note: Birds can have multiple injuries resulting in higher figures than the total number of seabirds killed and returned ($n = 192$).

| | No visible injuries | Waterlogged | Broken wing | Broken legs or feet | Broken bill | Hook in bill or throat (including swallowed hook) | Hook in wing | Hook in leg or feet | Tangled | Open wound or severed body part | Crushed, or more than 3 injuries | Greased | Liced |
|----------------------------|---------------------|--------------|--------------|---------------------|-------------|---|--------------|---------------------|-------------|---------------------------------|----------------------------------|--------------|-------------|
| Black (Parkinson's) petrel | | 2 | | | | | | | 1 | 2 | | | |
| Buller's albatross | | 7 | 5 | 3 | 2 | | | | | 7 | 2 | 6 | 2 |
| Campbell albatross | | | 1 | 1 | | | | | | | | | |
| Common diving petrel | 1 | | | | | | | | | | 1 | 1 | |
| Fairy prion | | 1 | | | | | | | | 3 | 1 | | |
| Flesh-footed shearwater | | 2 | | | | 2 | 3 | | | | | | |
| Foveaux shag | | | | 1 | | | | | | 1 | 1 | | 1 |
| Grey petrel | 2 | 3 | | | | | | | | 1 | 1 | 1 | |
| Grey-backed storm petrel | 1 | | 1 | | | | | | | | | | |
| NZ white-capped albatross | | 7 | 10 | 6 | 1 | 3 | 1 | | | 22 | 4 | 11 | 5 |
| Northern giant petrel | 1 | 1 | 1 | | | | | | | | | | |
| Otago shag | | 1 | | | 1 | | | | | | | | |
| Salvin's albatross | 3 | 5 | 9 | 1 | 1 | 1 | | | | 8 | | 3 | 1 |
| Snares Cape petrel | | 2 | 1 | | | | | | | 1 | | | |
| Sooty shearwater | 4 | 17 | 2 | 4 | 4 | | | | 1 | 2 | | 1 | |
| Southern royal albatross | | | | | 1 | | | | | 1 | | 2 | |
| Westland petrel | 2 | | | 1 | | | 5 | | | 1 | | | 1 |
| White-chinned petrel | 7 | 34 | | 8 | 3 | 1 | 1 | | 2 | 2 | | | 1 |
| Total | 21 | 82 | 30 | 25 | 13 | 7 | 10 | 0 | 4 | 51 | 10 | 25 | 11 |
| % Total | 10.9% | 42.7% | 15.6% | 13.0% | 6.8% | 3.6% | 5.2% | | 2.1% | 26.6% | 5.2% | 13.0% | 5.7% |
| Albatrosses (%) | 19% | 24.4% | 86.7% | 44% | 38.5% | 57.1% | 10% | | | 74.5% | 60% | 88% | 72.7% |
| Non-albatross (%) | 81% | 75.6% | 13.3% | 56% | 61.5% | 42.9% | 90% | 100% | | 25.5% | 40% | 12% | 27.3% |

3.1.4 Body condition of necropsy seabirds

Between 1 July 2020 and 30 June 2021, 65.1% of returned birds had fat scores of less than 3, 15.1% of birds had fat scores of 3 and 9.4% of birds had fat scores over 3 (Table 7). This suggests that the mean fat scores of returned birds between 1 July 2020 and 30 June 2021 (mean (\pm SE) = 2.2 ± 0.1) was similar to the last two seasons (2019/2020 = 2.2 ± 0.1 ; 2018/2019 = 2.2 ± 0.1) and higher than the previous fishing years (2017/18 (1.8 ± 0.1), 2016/17 (1.7 ± 0.1), 2015/16 (1.3 ± 0.04)) (Bell 2013, Bell & Mischler 2014, Bell & Mischler 2015, Bell & Bell 2016, Bell & Bell 2017, Bell & Bell 2018, Bell & Bell 2019; Bell 2021). Seventeen birds (8.9%) could not have their fat scores confirmed due to damage (Table 7).

Table 7 Fat scores of seabirds killed and returned from fishing vessels between 1 July 2019 and 30 June 2020 (1= no fat, to 5 = extremely fat; U = unknown).

| SPECIES | FAT SCORE | | | | | | TOTAL | MEAN (\pm SE) |
|----------------------------|--------------|--------------|--------------|-------------|-------------|-------------|------------|---------------------------------|
| | 1 | 2 | 3 | 4 | 5 | U | | |
| Black (Parkinson's) petrel | 1 | 2 | | | | | 4 | 1.7 ± 0.3 |
| Buller's albatross | 1 | 10 | 5 | | | 3 | 19 | 2.3 ± 0.1 |
| Campbell albatross | | 1 | | | | | 1 | 2.0 ± 0.0 |
| Common diving petrel | 2 | 1 | | | | | 3 | 1.3 ± 0.3 |
| Fairy prion | 1 | 1 | | | | | 3 | 1.5 ± 0.5 |
| Flesh-footed shearwater | 3 | 3 | | | | | 6 | 1.5 ± 0.2 |
| Foveaux shag | | 2 | | | | | 2 | 2.0 ± 0.0 |
| Grey petrel | 1 | 2 | | | | 1 | 4 | 1.7 ± 0.3 |
| Grey-backed storm petrel | | | 1 | 1 | | | 2 | 3.5 ± 0.5 |
| NZ white-capped albatross | 11 | 6 | 7 | 6 | | 7 | 37 | 2.3 ± 0.2 |
| Northern giant petrel | 1 | | | 1 | | | 2 | 2.5 ± 1.5 |
| Otago shag | | | 1 | 1 | | | 2 | 3.5 ± 0.5 |
| Salvin's albatross | 5 | 8 | 1 | 1 | 1 | 3 | 20 | 2.1 ± 0.3 |
| Snares Cape petrel | | 1 | 1 | | | | 2 | 2.5 ± 0.5 |
| Sooty shearwater | 10 | 7 | 4 | | 4 | | 25 | 2.2 ± 0.3 |
| Southern royal albatross | | | | 1 | | | 1 | 4.0 ± 0.0 |
| Westland petrel | 1 | 7 | 2 | | | 1 | 11 | 2.1 ± 0.2 |
| White-chinned petrel | 13 | 24 | 7 | 2 | | 2 | 48 | 2.0 ± 0.1 |
| TOTAL | 50 | 75 | 29 | 13 | 5 | 17 | 192 | 2.1 ± 0.1 |
| % TOTAL | 26.0% | 39.1% | 15.1% | 6.8% | 2.6% | 8.9% | | |

The mean fat score has fluctuated over the past ten years (Figure 3), with mean fat scores steadily increasing over the past five fishing 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 2).

Figure 2. The mean fat scores for all seabirds killed and returned in New Zealand fisheries, per fishing year, between 1 October 2010 and 30 June 2021.

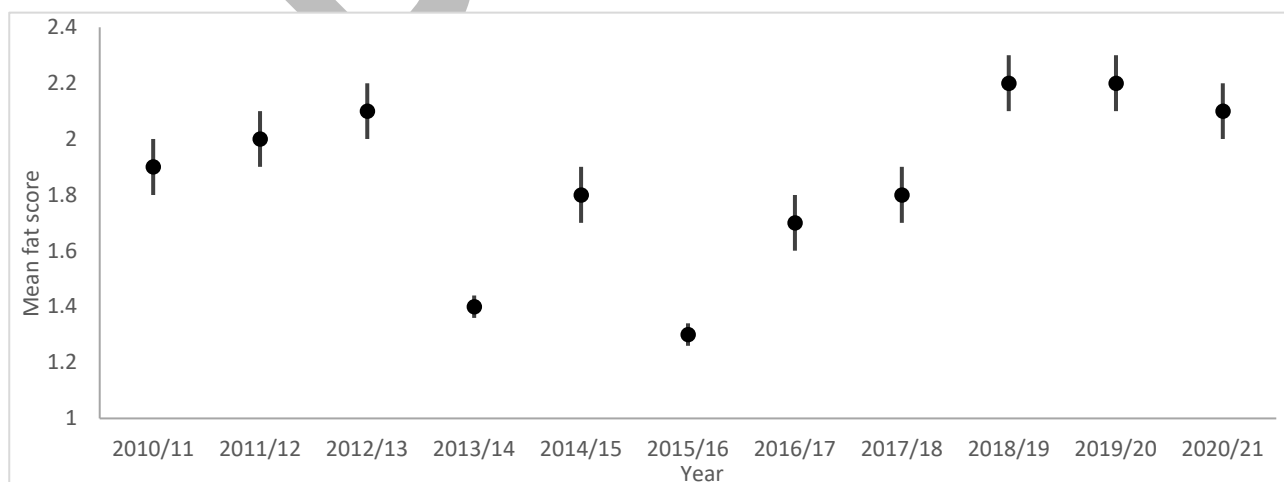


Table 8 Stomach contents of seabirds killed and returned from fishing vessels between 1 July 2020 and 30 June 2021.Note: Birds can have multiple items in the stomachs resulting in higher stomach content figures than the total number of seabirds killed and returned ($n = 192$).

| SPECIES | EMPTY | MISSING | BAIT | OFFAL (OR DISCARDS) | NATURAL | BARNACLES OR SEAWEED | PLASTIC | PROVENTRICULAR OIL | WORMS |
|----------------------------|--------------|-------------|--------------|---------------------|--------------|----------------------|-------------|--------------------|-------------|
| Black (Parkinson's) petrel | 1 | | | 5 | | | | 1 | |
| Buller's albatross | 5 | | 1 | 8 | 1 | | | | |
| Campbell albatross | | | | 2 | | | | | |
| Common diving petrel | 2 | | | | 2 | | | | |
| Fairy prion | 1 | | | 1 | 2 | | | | |
| Flesh-footed shearwater | 4 | | | 2 | | | | | |
| Foveaux shag | | | | 1 | | | | | 1 |
| Grey petrel | 2 | 1 | | 1 | | | | | |
| Grey-backed storm petrel | 1 | | | | | | | 1 | |
| NZ white-capped albatross | 8 | 2 | 1 | 32 | 4 | | | 1 | |
| Northern giant petrel | | | | 1 | | | | | |
| Otago shag | | | | 1 | | | | | 2 |
| Salvin's albatross | 3 | 2 | 3 | 12 | 2 | | 1 | | |
| Snares Cape petrel | 1 | | | | | | | 1 | |
| Sooty shearwater | 11 | | | 15 | 9 | | | 2 | 1 |
| Southern royal albatross | 1 | | | | | | | | |
| Westland petrel | 3 | | 6 | 3 | | | | | |
| White-chinned petrel | 8 | | 11 | 36 | 4 | 1 | | 14 | |
| TOTAL | 51 | 5 | 22 | 120 | 24 | 1 | 1 | 20 | 4 |
| % TOTAL | 26.6% | 2.6% | 11.5% | 62.5% | 12.5% | 0.5% | 0.5% | 10.4% | 2.1% |

Table 9 Gizzard contents of seabirds killed and returned from fishing vessels between 1 July 2020 and 30 June 2021.

Note: Birds can have multiple items in the gizzard resulting in higher figures than the total number of seabirds killed and returned ($n = 192$).

| 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 |
|----------------------------|--------------|-------------|--------------|--------------|------------------------|--------------------|--------------------------|------------------------|--------------|---------------------------------------|
| Black (Parkinson's) petrel | | | 4 | | 2 | 1 | | | | |
| Buller's albatross | 5 | | 4 | 2 | 2 | 5 | | | 2 | |
| Campbell albatross | | | | 1 | | 1 | | | | |
| Common diving petrel | 2 | | | | | | | | | 1 |
| Fairy prion | | | | | | | | 1 | | 2 |
| Flesh-footed shearwater | | | 6 | | | 1 | 1 | 2 | | |
| Foveaux shag | | | | | | 1 | | | 1 | |
| Grey petrel | | | 4 | 2 | | 1 | | | 3 | |
| Grey-backed storm petrel | | | | | | 2 | | | | |
| NZ white-capped albatross | 10 | 3 | 8 | 4 | 4 | 12 | | | 2 | 3 |
| Northern giant petrel | | | | 1 | | | | | | 1 |
| Otago shag | | | | | | 1 | | | | |
| Salvin's albatross | | 2 | 5 | 5 | 7 | 14 | | 1 | 2 | 4 |
| Snares Cape petrel | | | | | 1 | 1 | | | 2 | |
| Sooty shearwater | 3 | | 12 | 3 | | 5 | 7 | 4 | 7 | 6 |
| Southern royal albatross | | | 1 | | | | | 1 | | |
| Westland petrel | | | 10 | 6 | 3 | 5 | | 1 | 2 | |
| White-chinned petrel | | 1 | 46 | 18 | 7 | 32 | 4 | 1 | 26 | |
| TOTAL | 20 | 6 | 100 | 42 | 26 | 82 | 12 | 11 | 47 | 17 |
| % TOTAL | 10.4% | 3.1% | 52.1% | 21.9% | 13.5% | 42.7% | 6.3% | 5.7% | 24.5% | 8.9% |

3.1.5 Stomach and gizzard contents

120 birds (62.5%) had offal or discards in their stomachs and 22 birds (11.5%) had bait in their stomach (Table 8). In addition, 51 birds (26.6%) had empty stomachs. A further five birds (2.6%) had missing stomachs due to interaction with fishing gear or damage due to sea lice. One bird (Salvin's albatross) had plastic in their stomachs during this period (Table 8).

Most of the gizzard contents were natural food items (squid beaks 52.1%, fish bones and skin 42.7%, squid or fish eyeballs 13.5% and otoliths 21.9%), but 6.3% of the birds returned had also ingested plastic, metal, or string and 5.7% had ingested stones or seeds (Table 9). Photographs and samples of plastic content were taken.

In addition, 20 birds (10.4%) had empty gizzards and six birds (3.1%) had missing gizzards due to damage by fishing gear or sea lice. Samples (e.g. squid beaks and otoliths) have been collected for detailed identification to species if required.

3.1.6 Identification of necropsy birds

Necropsy confirmed that the majority (75%) of the seabirds returned between 1 July 2020 and 30 June 2021 were identified correctly by the observers (based on the information provided by observers on the specimen tags) (Table 10).

Table 10. Comparison of identifications (ID) recorded by on-board observers at sea compared with necropsy identification for seabirds killed and returned from observed fishing boats between 1 July 2020 and 30 June 2021.

| Species | ID correct | ID wrong | ID to correct species group* | ID as seabird small, large or albatross* | ID not on label or code did not exist | Total |
|----------------------------|--------------|-------------|------------------------------|--|---------------------------------------|------------|
| Black (Parkinson's) petrel | 3 | | | | 1 | 4 |
| Buller's albatross | 9 | 2 | 8 | | | 19 |
| Campbell albatross | | | | | 1 | 1 |
| Common diving petrel | 2 | 1 | | | | 3 |
| Fairy prion | | 1 | 2 | | | 3 |
| Flesh-footed shearwater | 6 | | | | | 6 |
| Foveaux shag | | | 2 | | | 2 |
| Grey petrel | 3 | 1 | | | | 4 |
| Grey-backed storm petrel | 1 | | 1 | | | 2 |
| NZ white-capped albatross | 34 | 1 | 1 | 1 | | 37 |
| Northern giant petrel | 1 | | 1 | | | 2 |
| Otago shag | | | 2 | | | 2 |
| Salvin's albatross | 12 | 5 | | 3 | | 20 |
| Snares Cape petrel | | | 2 | | | 2 |
| Sooty shearwater | 21 | 2 | 2 | | | 25 |
| Southern royal albatross | 1 | | | | | 1 |
| Westland petrel | 10 | 1 | | | | 11 |
| White-chinned petrel | 41 | 3 | 3 | | 1 | 48 |
| Total | 144 | 17 | 24 | 4 | 3 | 192 |
| % Total | 75.0% | 8.9% | 12.5% | 2.1% | 1.6% | |

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

Twenty-four seabirds (12.5%) were identified to the correct group or size class but were given the wrong species code (although this may relate to changes in the coding system). These included Buller's albatross, fairy prion, Foveaux shag, grey-backed storm petrel, New Zealand white-capped albatross, Otago shag, Snares Cape petrel, sooty shearwater, and white-chinned petrel. A further 17 (8.9%) were identified

incorrectly including the following species: Buller’s albatross, common diving petrel, fairy prion, grey petrel, New Zealand white-capped albatross, Salvin’s albatross, sooty shearwater, Westland petrel, and white-chinned petrel. Three birds (1.6%) did not have an observer identification code on the return label or had a code that did not exist (Table 10).

3.2 Photographs and Interactions

3.2.1 Numbers of photographed seabirds or those listed as interactions

Between 1 July 2020 and 30 June 2021 a total of 457 interactions 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 dead seabirds recorded (Table 11).

Of these, 270 records had no associated photographs taken. Most of the birds that were not photographed were released alive or left the vessel unaided ($n = 240$; Table 11). There were 187 seabird interactions that were photographed and had corresponding entries in the MPI COD extract (Table 11).

Table 11. Number of seabirds of each species reported as photographed or interactions with fishing vessels between 1 July 2020 and 30 June 2021.

| SPECIES | PHOTO | | | INTERACTION | | | TOTAL |
|---|-------|------|-------|-------------|------|-------|-------|
| | Alive | Dead | Total | Alive | Dead | Total | |
| Albatross (unidentified) | | | | 10 | 3 | 13 | 13 |
| Australasian gannet | | | | | 2 | 2 | 2 |
| Black (Parkinson’s) petrel | 1 | | 1 | 8 | | 8 | 9 |
| Black-browed albatross (unidentified) | | | | 1 | | 1 | 1 |
| Buller’s albatross | 1 | 9 | 10 | 8 | | 8 | 18 |
| Buller’s and Pacific albatross | 1 | | 1 | 4 | 1 | 5 | 6 |
| Buller’s shearwater | | | | 2 | | 2 | 2 |
| Cape petrels | 1 | | 1 | 7 | | 7 | 8 |
| Common diving petrel | 7 | | 7 | 9 | | 9 | 16 |
| Fairy prion | 2 | | 2 | 3 | | 3 | 5 |
| Flesh-footed shearwater | 27 | 2 | 29 | 25 | | 25 | 54 |
| Gibson’s albatross | | | | 1 | | 1 | 1 |
| Great albatross (unidentified) | | | | 2 | | 2 | 2 |
| Great-winged (Grey-faced) petrel | | | | 1 | | 1 | 1 |
| Grey petrel | 1 | | 1 | 2 | | 2 | 3 |
| NZ white-capped albatross | 7 | 24 | 31 | 58 | 5 | 63 | 94 |
| Northern giant petrel | | | | 2 | | 2 | 2 |
| Otago shag | | 2 | 2 | | | | 2 |
| Petrel (unidentified) | | | | 5 | | 5 | 5 |
| Petrels, prion and shearwaters (unidentified) | | | | 6 | 4 | 10 | 10 |
| Prion (unidentified) | | | | 3 | | 3 | 3 |
| Procellaria petrel (unidentified) | | | | 10 | | 10 | 10 |
| Pterodroma petrel (unidentified) | | | | 3 | | 3 | 3 |
| Red-billed gull | | | | 1 | | 1 | 1 |
| Salvin’s albatross | | 7 | 7 | 12 | 1 | 13 | 20 |
| Seabird (small) | | | | | 1 | 1 | 1 |
| Seabird (unidentified) | | | | 2 | | 2 | 2 |

| SPECIES | PHOTO | | | INTERACTION | | | TOTAL |
|------------------------------------|--------------|--------------|------------|--------------|--------------|------------|------------|
| | Alive | Dead | Total | Alive | Dead | Total | |
| Shearwater (unidentified) | | | | 5 | 1 | 6 | 6 |
| Small albatross (unidentified) | | 1 | 1 | 4 | 3 | 7 | 8 |
| Sooty shearwater | 5 | 15 | 20 | 16 | 6 | 22 | 42 |
| Southern giant petrel | | 1 | 1 | | | | 1 |
| Southern royal albatross | 2 | | 2 | | 2 | 2 | 4 |
| Storm petrel (unidentified) | 1 | | 1 | 2 | | 2 | 3 |
| Wandering albatross (unidentified) | | | | 2 | | 2 | 2 |
| Westland petrel | | | | 6 | | 6 | 6 |
| White-chinned petrel | 2 | 68 | 70 | 20 | 1 | 21 | 91 |
| TOTAL | 58 | 129 | 187 | 240 | 30 | 270 | 457 |
| % PHOTO or INTERACTION | 31% | 69% | | 88.9% | 11.1% | | |
| % TOTAL | 12.7% | 28.2% | | 52.5% | 6.7% | | |

Similar to the seabirds caught and returned for necropsy, the photograph and interaction seabirds were dominated by four species: white-chinned petrel (n = 91, 19.9%), New Zealand white-capped albatross (n = 94, 20.6%), and sooty shearwater (n = 42, 9.2%) and flesh-footed shearwaters (n = 54, 11.8%) (Table 12). These four species accounted for 61.5% of all reported interaction or photograph birds.

The six species that were most frequently recorded as any type of interactions with commercial fishing vessels are summarised in Table 12. White-chinned petrels make up the highest proportion of all interactions (21.4%), highest proportion of dead birds (33.3%), and the highest proportion returned for necropsy (25%) (Table 12). New Zealand white-capped albatross also have a high proportion of all interactions (20.2%) but also make up a high proportion of the birds being released alive (21.8%). White-chinned petrels were over-represented as a proportion of 'photograph' (dead, non-retained) records (43.4%, n = 90; Table 12), which is due to observer requirements not necessitating that all specimens were retained, and white-chinned petrels being caught in multiple numbers over short time spans.

Table 12. Comparison of the six most frequently reported seabird species for different interaction types with commercial fishing vessels between 1 July 2020 and 30 June 2021.

| Species | All live interactions (n = 298) | All dead interactions (n = 351) | All dead, photographed non-retained, interactions (n = 159) | All retained for necropsy (n = 192) | All interactions (alive/dead, photographed, necropsy) (n = 649) |
|---------------------------|---------------------------------|---------------------------------|---|-------------------------------------|---|
| Buller's albatross | 3% | 8% | 5.7% | 9% | 5.7% |
| Flesh-footed shearwater | 17.5% | 2.3% | 1.3% | 3.1% | 9.2% |
| NZ white-capped albatross | 21.8% | 18.8% | 18.2% | 19.3% | 20.2% |
| Salvin's albatross | 4% | 8% | 5% | 10.4% | 6.2% |
| Sooty shearwater | 7% | 13.1% | 13.2% | 13% | 10.3% |
| White-chinned petrel | 7.4% | 33.3% | 43.4% | 25% | 21.4% |

As with records of seabird captures retained for necropsy, the distribution of photograph and interaction records was not evenly spread across the fishing year. Most bird interactions were reported in April 2021 (n = 108, 23.6%), February and March 2021 (n = 87, 19%), and May 2021 (n = 60, 13.1%) (Table 13). This pattern reflects the timing of seabird breeding, presence within the New Zealand EEZ, timing and location of all observed fisheries, and observer coverage.

Table 13. Number of seabirds recorded as interactions (photographed or non-photographed) with fishing vessels between 1 July 2020 and 30 June 2021, by month of incident.

| SPECIES | 2020 | | | | | | 2021 | | | | | | TOTAL | % TOTAL |
|---|------|-----|------|-----|-----|-----|------|-----|-----|-------|-----|-----|-------|---------|
| | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | April | May | Jun | | |
| Albatross (unidentified) | 1 | | | 1 | | | | 4 | | 2 | 3 | 2 | 13 | 2.8% |
| Australasian gannet | | | | | | | 1 | | | | 1 | | 2 | 0.4% |
| Black (Parkinson's) petrel | | | | 1 | | 1 | 2 | 2 | 2 | 1 | | | 9 | 2.0% |
| Black-browed albatross (unidentified) | 1 | | | | | | | | | | | | 1 | 0.2% |
| Buller's albatross | 2 | 1 | | | | 2 | | | | | 3 | 11 | 19 | 4.2% |
| Buller's and Pacific albatross | | 3 | | | | | | 1 | | 1 | | | 5 | 1.1% |
| Buller's shearwater | | | | | | | 1 | 1 | | | | | 2 | 0.4% |
| Campbell albatross | | | | | | | | | | | 1 | | 1 | 0.2% |
| Cape petrels | | | 2 | | | | | | | 1 | | 4 | 7 | 1.5% |
| Common diving petrel | 2 | | | 2 | 1 | 1 | 1 | | 5 | 2 | 1 | 1 | 16 | 3.5% |
| Fairy prion | 1 | | | | | | | | 2 | | 2 | | 5 | 1.1% |
| Flesh-footed shearwater | | | | | 2 | 1 | 1 | 9 | 6 | 34 | 1 | | 54 | 11.8% |
| Gibson's albatross | | | | | | | | 1 | | | | | 1 | 0.2% |
| Great albatross (unidentified) | | | | | | | | | 1 | | 1 | | 2 | 0.4% |
| Great-winged (Grey-faced) petrel | | | | | | | | | 1 | | | | 1 | 0.2% |
| Grey petrel | | | 1 | | | | | | | | 2 | | 3 | 0.7% |
| New Zealand white-capped albatross | 6 | | | | 3 | 1 | 1 | 24 | 22 | 6 | 24 | 7 | 94 | 20.6% |
| Northern giant petrel | | 1 | | | | | | | | | | 1 | 2 | 0.4% |
| Otago shag | | | | | | 2 | | | | | | | 2 | 0.4% |
| Petrel (unidentified) | | | 1 | | | | | 1 | 3 | | | | 5 | 1.1% |
| Petrels, prion and shearwaters (unidentified) | | | 1 | | 1 | | | 2 | 2 | 2 | 2 | | 10 | 2.2% |
| Prion (unidentified) | 1 | | | | | 1 | | | | | 1 | | 3 | 0.7% |
| Procellaria petrel (unidentified) | | | | | | | | 2 | 3 | 3 | 2 | | 10 | 2.2% |
| Pterodroma petrel (unidentified) | | | | | | | | | | 2 | 1 | | 3 | 0.7% |

| SPECIES | 2020 | | | | | | 2021 | | | | | | TOTAL | % TOTAL |
|------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|-------------|------------|---------|
| | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | April | May | Jun | | |
| Red-billed gull | | | | | 1 | | | | | | | | 1 | 0.2% |
| Salvin's albatross | 2 | 2 | 5 | 3 | 6 | 1 | 1 | | | | | | 20 | 4.4% |
| Seabird (small) | | | | | | | | 1 | | | | | 1 | 0.2% |
| Seabird (unidentified) | 2 | | | | | | | | | | | | 2 | 0.4% |
| Shearwater (unidentified) | | | | | 1 | | | | 1 | | 4 | | 6 | 1.3% |
| Small albatross (unidentified) | 1 | | | | 1 | | 1 | 2 | | 1 | | 2 | 8 | 1.8% |
| Snares Cape petrel | | | | | | | | | | | | 1 | 1 | 0.2% |
| Sooty shearwater | | | | | 2 | | 1 | 5 | 17 | 16 | 2 | | 43 | 9.4% |
| Southern royal albatross | | | | | | | | | 2 | | 2 | | 4 | 0.9% |
| Storm petrel (unidentified) | | | 1 | | | | | | 1 | | 1 | | 3 | 0.7% |
| Wandering albatross (unidentified) | | | | | | | | 1 | 1 | | | | 2 | 0.4% |
| Westland petrel | | | | | 1 | | | | 1 | | 4 | | 6 | 1.3% |
| White-chinned petrel | | | | | 1 | | 2 | 31 | 17 | 37 | 2 | | 90 | 19.7% |
| TOTAL | 19 | 7 | 11 | 7 | 20 | 10 | 12 | 87 | 87 | 108 | 60 | 29 | 457 | |
| % of total | 4.2% | 1.5% | 2.4% | 1.5% | 4.4% | 2.2% | 2.6% | 19.0% | 19.0% | 23.6% | 13.1% | 6.3% | | |

Figure 3 Grouped catch locations of all seabirds caught and photographed in New Zealand fisheries between 1 July 2020 and 30 June 2021.

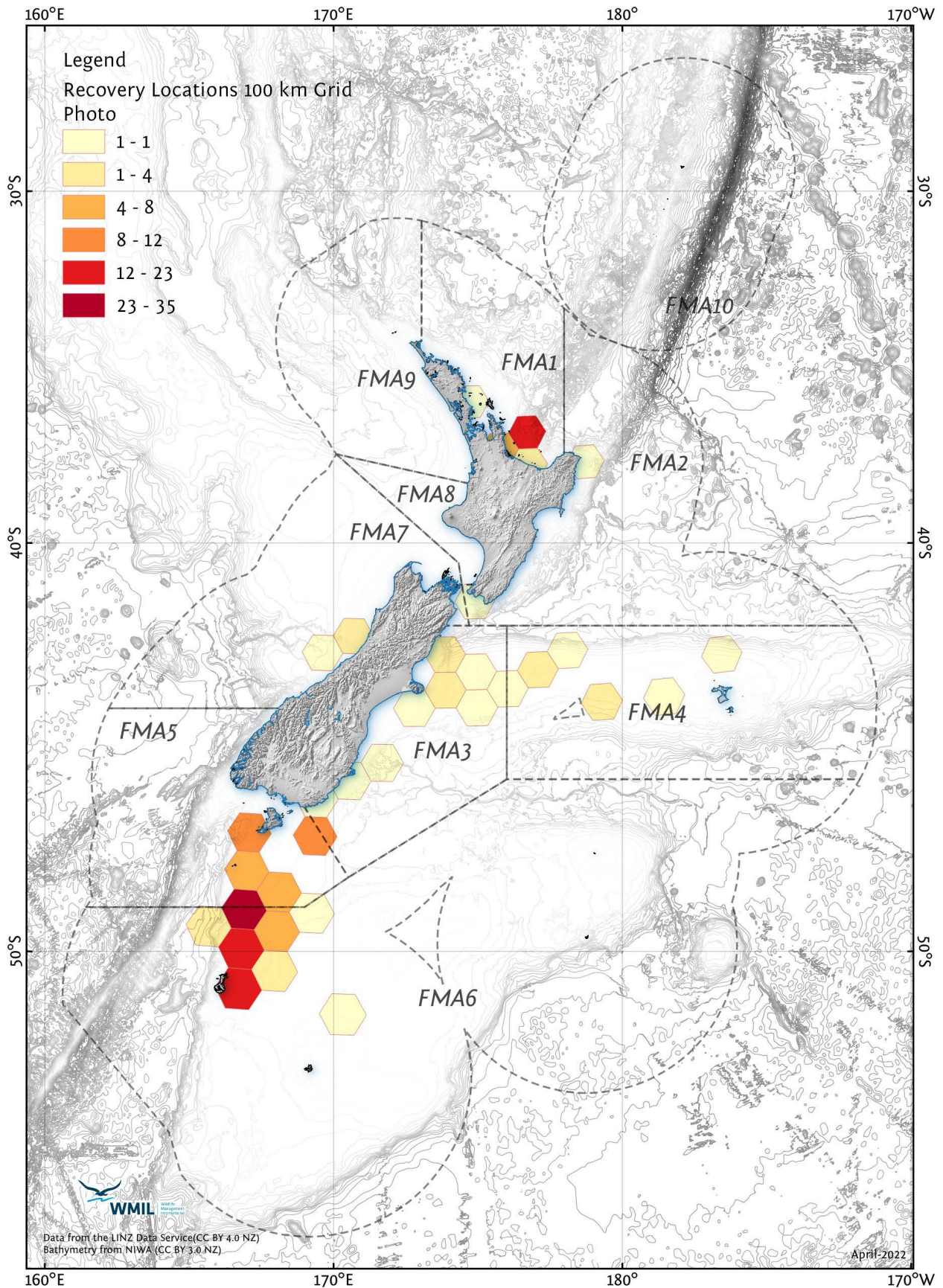
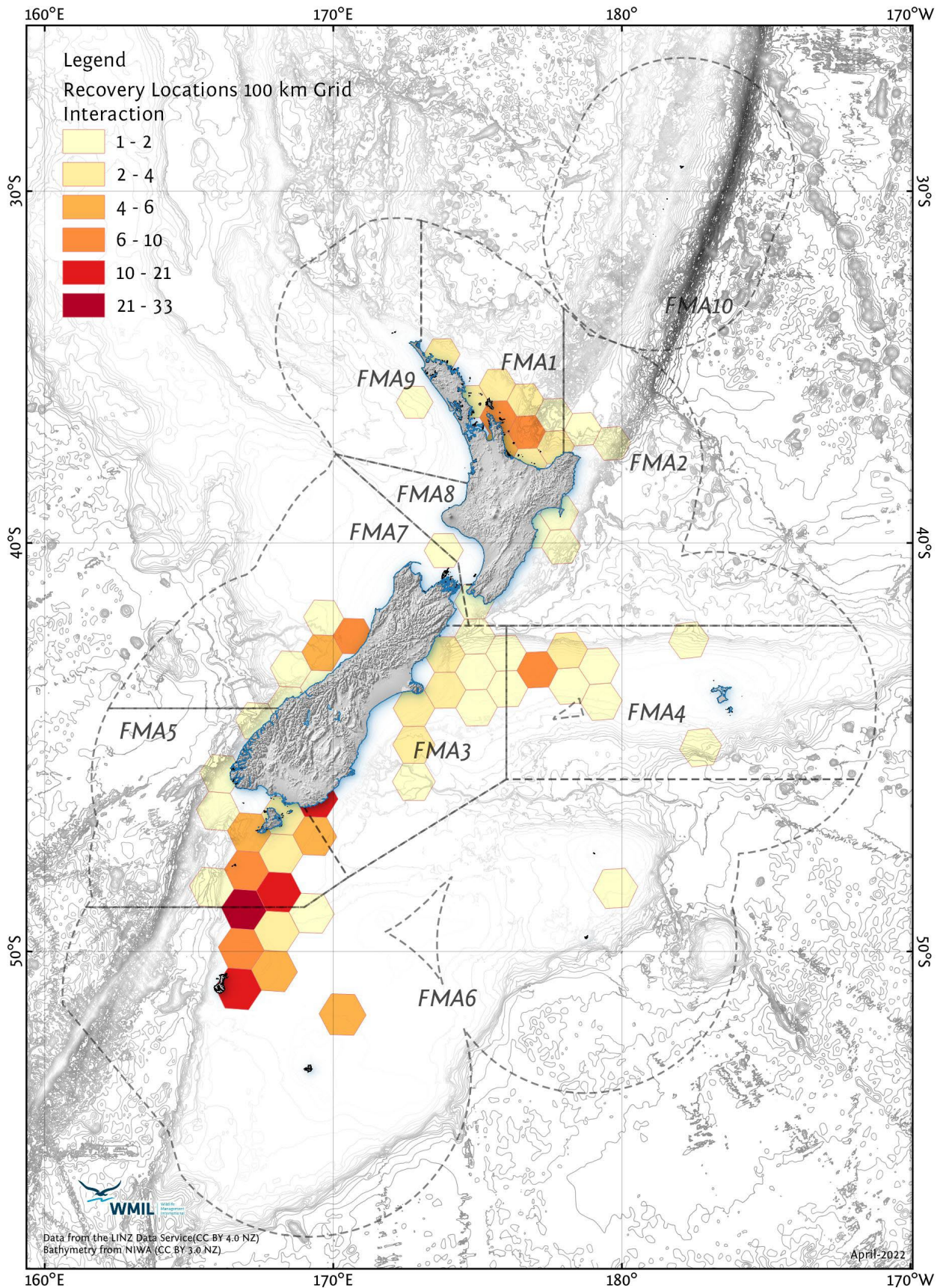


Figure 4. Grouped catch locations of all seabirds reported as an interaction (and not photographed) in New Zealand fisheries between 1 July 2020 and 30 June 2021.



3.2.2 Target fishery and vessels of photographed or interaction seabirds

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

The seabirds that were reported as an interaction in the MPI COD extract but not photographed were caught in a range of Fishing Management Areas (FMA 1, 2, 3, 4, 5, 6, 7, 8 and 9) and general positions are show in Figure 4.

The 457 seabirds that were either photographed or recorded as an interaction were from 62 different vessels: 22 birds (4.8%) on four set net vessels (6.5%), 82 birds (17.9%) on 17 longline vessels (27.4%) and 353 bird (77.2%) on 42 trawl vessels (67.7%) (Table 14).

Table 14. Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2020 and 30 June 2021 (with the number of individual vessels in parentheses).

| | | Photograph seabirds | Interaction Seabirds | Total |
|------------------|---------|---------------------|----------------------|-----------------|
| Longline vessels | Bottom | 29 (3) | 35 (11) | 64 (11) |
| | Surface | | 18 (6) | 18 (6) |
| Trawl vessels | | 155 (29) | 198 (35) | 353 (42) |
| Set net vessels | | 3 (2) | 19 (3) | 4 (22) |
| Total | | 187 (34) | 270 (49) | 457 (62) |

For the fishing period 1 July 2020 to 30 June 2021, there were 293 observed trips on 129 vessels (Observer data, unpublished). Sixty-two vessels (48.1%) reported interactions (photographed and/or non-photographed) with seabirds (Table 14). Nearly half of these 62 vessels reported relatively low numbers of bird interactions (< 5 birds reported; n = 30, 48.4%). There were 13 vessels (21%) that had interactions with 10 or more birds.

When combined with the seabirds that were caught and returned for necropsy, the number of vessels that had live and/or dead interactions with seabirds increased to 80 (62%). Over half of these vessels reported low numbers of interactions or returned low numbers of seabirds (<5 birds; n = 43, 53.8%). Twenty vessels (25%) had interactions with or returned more than 10 seabirds.

3.2.3 Injuries of photographed or interaction seabirds

The majority of the 457 interaction or photographed birds represented live bird interactions (n = 298, 65.2%) (Table 15). Of the birds released alive, only 58 were photographed (19.5%) compared to 240 seabirds being recorded as interactions (Table 15). Most of these interaction birds were released by the crew prior to the observer being able to photograph the birds (as reported by the observer in the notes provided in the MPI COD extract), or left the vessel without requiring human assistance. Seven reported dead birds could not be recovered as they fell off the warp or hook prior to coming aboard (Table 15).

Table 15. Number of seabirds recorded as interactions or photographed from fisheries vessels between 1 July 2019 and 30 June 2020.

| | Photograph seabirds | Interaction Seabirds | Total | % Total |
|----------------------|---------------------|----------------------|------------|---------|
| Alive | 58 | 240 | 298 | 65.2% |
| Dead | 129 | 23 | 152 | 33.3% |
| Not recovered (dead) | | 7 | 7 | 1.5% |
| Total | 187 | 270 | 457 | |

For the 187 seabirds that were photographed, 58 were released alive (although some (at least 3) had injuries that are likely to cause death) and 129 died for a range of reasons (Tables 15, 16 and 17).

Table 16. Number of seabirds of each species that were photographed after vessel interaction from commercial fisheries between 1 July 2020 and 30 June 2021, by likely cause of death. The proportion of albatross and non-albatross taxa returned is also presented.

| Species | Longline | Trawl | | | | | | | Setnet | | Total |
|--------------------------------|------------|-------------|-------------|--------------|-------------|--------------|---------------|-------------|-------------|-------------|------------|
| | | Warp | Net | | Codend | Other | Vessel strike | | Alive | Dead | |
| | Hook | Dead | Alive | Dead | Dead | Dead | Alive | Dead | | | |
| Alive | | | | | | | | | | | |
| Black (Parkinson's) petrel | 1 | | | | | | | | | | 1 |
| Buller's albatross | | 3 | 3 | 6 | | | | | | | 12 |
| Common diving petrel | | | | | | | 6 | | 1 | | 7 |
| Fairy prion | | | | | | | 2 | | | | 2 |
| Flesh-footed shearwater | 26 | 1 | | 1 | | | 1 | | | | 29 |
| Grey petrel | | | | | | | 1 | | | | 1 |
| NZ white-capped albatross | | 11 | 2 | 10 | | 3 | 4 | | | | 30 |
| Otago shag | | | | | | | | | | 2 | 2 |
| Salvin's albatross | | | 1 | 5 | 1 | | | | | | 7 |
| Small albatross (unidentified) | | 1 | | | | | | | | | 1 |
| Snares cape petrel | | | 1 | | | | | | | | 1 |
| Sooty shearwater | 1 | | | 16 | | | 4 | | | | 21 |
| Storm petrel (unidentified) | | | | | | | 1 | | | | 1 |
| Southern royal albatross | | 1 | | | | | | 1 | | | 2 |
| White-chinned petrel | | | 1 | 46 | 1 | 21 | 1 | | | | 70 |
| Total | 28 | 17 | 8 | 114 | 2 | 24 | 20 | 1 | 1 | 2 | 187 |
| % Total | 15% | 9.1% | 4.3% | 59.9% | 1.1% | 12.8% | 10.7% | 0.5% | 0.5% | 1.1% | |
| Total (each type) | 28 | 156 | | | | | | | 3 | | |
| % of total fishery type | 100% | 10.8% | 5.1% | 71.8% | 1.3% | 15.3% | 12.8% | 0.6% | 100% | | |
| Albatrosses (%) | | 94.1% | 75% | 18.8% | 50% | 12.5% | 58.3% | | | | |
| Non-albatross (%) | 100% | 5.9% | 25% | 81.2% | 50% | 87.5% | 41.7% | 100% | 100% | | |

For the 23 seabirds that were recorded dead following an interaction (but not photographed) with the fishing vessel, nine (39.1%) were drowned in the trawl nets, one (4.3%) went through the warp, and 13 (56.5%) were drowned on longline hooks (Tables 16 and 17). Seven (23.3%) could not be recovered after falling off the warp or net prior to coming aboard the vessel (Tables 16 and 17).

Table 17. Types of injuries recorded on seabirds that were photographed or recorded as interactions from fisheries vessels between 1 July 2020 and 30 June 2021.

| | Photograph | | Interaction | | Total | | | % Total |
|--------------------------------|------------|------|-------------|------|-------|------|-----|---------|
| | Alive | Dead | Alive | Dead | Alive | Dead | All | |
| No visible injuries | 57 | 61 | 235 | | 292 | 61 | 353 | 77.2% |
| Disorientated | 1 | | 2 | | 3 | | 3 | 0.7% |
| Waterlogged | | 30 | 1 | | 1 | 30 | 31 | 6.8% |
| Broken wing | | 21 | 2 | 1 | 2 | 22 | 24 | 5.3% |
| Hook in bill or throat | | | | 9 | | 9 | 9 | 2% |
| Hook in wing | | | | 4 | | 4 | 4 | 0.9% |
| Open wound | | 8 | | 6 | | 14 | 14 | 3.1% |
| Severed body part | | 2 | | 2 | | 4 | 4 | 0.9% |
| More than 3 injuries (crushed) | | 6 | | | | 6 | 6 | 1.3% |
| Liced | | 1 | | 1 | | 2 | 2 | 0.4% |
| Unknown (unable to assess) | | | | 7 | | 7 | 7 | 1.5% |
| Total | 58 | 129 | 240 | 30 | 298 | 159 | 457 | |
| | 187 | | 270 | | 457 | | | |

There were a range of injuries on the interaction and photographed birds as shown in Table 17. Most of the birds (n = 353, 77.2%) had no visible injuries and most of these birds were released alive (n = 292, 82.7%).

There were seven interaction birds (2.5%) that could not have injuries assessed by the observer as these birds had been released or discarded by the crew or had fallen overboard before retrieval (Table 17).

3.2.4 Identification of photographed seabirds

There were 15 different seabird taxa that had been photographed by the Observers (Tables 11 and 16).

Examination of 187 photographed seabird interactions received confirmed that observers had accurately identified 78.1% (n = 146) of seabirds (Table 18). One Buller's albatross, four common diving petrels, one flesh-footed shearwater, four New Zealand white-capped albatross, five sooty shearwater, and six white-chinned petrels were incorrectly identified (n = 9, 3%; Table 18).

Table 18. Comparison of 187 observer identifications with expert identifications for observed and photographed captures listed in COD from fishing vessels between 1 July 2020 and 30 June 2021, by species.

Where: 'Confirmed' = photograph identification confirmed the observer identification; 'new, consistent' = photograph identification was to a lower taxonomic group, but consistent with the observer identification; 'new, not consistent' = photograph identification was not consistent with the observer identification (i.e. observer identified the species incorrectly) and to be confirmed = where a photo is still to be provided.

| Species | Confirmed | New, consistent | New, not consistent | To be confirmed (need photo) | Total |
|----------------------------|-----------|-----------------|---------------------|------------------------------|-------|
| Black (Parkinson's) petrel | 1 | | | | 1 |
| Buller's albatross | 8 | 2 | 1 | 1 | 12 |
| Common diving petrel | 3 | | 4 | | 7 |
| Fairy prion | 2 | | | | 2 |
| Flesh-footed shearwater | 25 | | 1 | 3 | 29 |
| Grey petrel | 1 | | | | 1 |
| NZ white-capped albatross | 24 | | 4 | 2 | 30 |
| Otago shag | | 2 | | | 2 |
| Salvin's albatross | 5 | | | 2 | 7 |

| Species | Confirmed | New, consistent | New, not consistent | To be confirmed (need photo) | Total |
|-----------------------------------|--------------|-----------------|---------------------|------------------------------|------------|
| Small albatross (unidentified) | | | | 1 | 1 |
| Snares cape petrel | | 1 | | | 1 |
| Sooty shearwater | 15 | | 5 | 1 | 21 |
| Southern royal albatross | 2 | | | | 2 |
| Storm petrel (unidentified) | 1 | | | | 1 |
| White-chinned petrel | 59 | | 6 | 5 | 70 |
| Total | 146 | 5 | 21 | 15 | 187 |
| % Total (all 295 seabirds) | 78.1% | 2.7% | 11.2% | 8% | |

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 release alive in situations where photos may not have provided enough detail.

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

Issues included only one photograph for some seabirds, not all key features 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). Camera 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.

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