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Tini a Tangaroa

Preparation of data for protected species capture estimation, updated to 2016–17

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E. R. Abraham
K. Berkenbusch

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Assessments of the capture of protected species in New Zealand commercial fisheries rely on observer and fisher-reported data. Fisheries observers onboard commercial fishing vessels document the captures of protected species. These observer records are linked to fisher-reported effort data. The current report presents the preparation of observer and fisher-reported data, to the 2016–17 fishing year, for the Protected Species Captures (PSC) database.

During preparation of the data to the end of the 2016–17 fishing year, the following significant updates were applied to the previous processing of some of the data:

1. Early during the development of electronic reporting by observers (through the handheld Nomad devices), the data were not included in the Centralised Observer Database (COD), and the observer effort was recreated from fisher effort. During the data preparation for the current fishing year, the observer data from these devices were included directly in COD.
2. The linking of observer effort and fisher effort was revised. This revision highlighted that some vessel keys recorded in COD were incorrect, leading to the inclusion of a process that identified observer trips that may have incorrect vessel keys.
3. Some records of seabird captures had been created following review of photographs. Some of these records had no capture method associated with them. Following review of the photographs, some of these records were determined to be deck captures (which are not included in the seabird bycatch estimation).
4. Imputation of the location of set-net data in West Coast North Island harbours was carried out, based on tracking of small vessels undertaken by Trident Systems.

The correction to the way that data from Nomad devices were processed during loading into the PSC database resulted in a decrease in observer effort in the small-vessel fisheries where these devices were used (while maintaining the same number of observed captures). The correction to vessel keys resulted in 27 black petrel captures moving from the East Cape to the Hauraki Gulf areas, with some captures changing from surface longline to bottom longline.

This report outlines the rationale and impact of these changes and updates on the PSC data, including a comparison with the previous data preparation to the 2015–16 fishing year.

1. INTRODUCTION

Estimation of the capture of seabirds, marine mammals and turtles in New Zealand fisheries relies on data collected by fisheries observers (e.g., Abraham & Richard 2018, Abraham et al. 2017, Richard et al. 2017). Observers document captures on non-fish bycatch forms, either on paper forms or through handheld electronic devices, and these data are subsequently entered into the Centralised Observer Database (COD), managed by the National Institute of Water and Atmospheric Research (NIWA). Extracts from this database are made available to researchers by Fisheries New Zealand (previously Ministry for Primary Industries).

To carry out annual estimates of total captures, information on observed fishing effort and total fishing effort is also required. Where possible, each recorded capture is linked to an observed fishing event to determine the location, time, and other characteristics of the fishing associated with the capture. The observed fishing effort is also linked to the fisher-reported fishing effort, aligning the records where possible. This linking allows the fitting of statistical models to the observed data to estimate captures on the unobserved fishing. To facilitate this statistical analysis, the data from Fisheries New Zealand are first loaded into the Protected Species Captures (PSC) database. Summaries of information from this database are made available through the PSC website (see https://psc.dragonfly.co.nz).

The accuracy of estimates of seabird, marine mammal, and turtle captures may be affected by errors in the observer- and fisher-reported data. Errors may occur during the recording of information on paper forms, during data entry from paper forms to digital databases, or through records being lost. Assessment of the datasets, the imputation of missing information, the linking of observer- and fisher-reported effort data, and assessment of the identification of the captured animals involves extensive processing of the data. During preparation of the data to the end of the 2016–17 fishing year, the following significant updates were applied to the previous processing of some of the data:

1. Early during the development of electronic reporting by observers (through the handheld Nomad devices), the data were not included in COD and the observer effort was recreated from fisher effort. During the data preparation for the current fishing year, the observer data from these devices were included directly in COD.

2. The linking of observer effort and fisher effort was revised. This revision highlighted that some vessel keys recorded in COD were incorrect, leading to the inclusion of a process that identified observer trips that may have incorrect vessel keys.

3. Some records of seabird captures had been created following review of photographs. Some of these records had no capture method associated with them. Following review of the photographs, some of these records were determined to be deck captures (which are not included in the seabird bycatch estimation).

4. Imputation of the location of set-net data in West Coast North Island harbours was carried out, based on tracking of small vessels undertaken by Trident Systems.

During the preparation of protected species capture data for the 2016–17 fishing year, there was a focus on addressing these four updates. In this report, the rationale and consequences of these changes are discussed, including a summary of the impact of these changes (and other minor changes) on the data from 2002–03 to 2015–16. This report is not a description of the data preparation process, but emphasises the changes made to the data preparation. The methods used for preparing the observer data of protected species captures are presented in detail by Thompson et al. (2017).

2. METHODS

2.1 Data sources

2.1.1 Observer data

Observer data from COD were extracted on 6 April 2018. The extract included data from all trips where at least one fishing event was recorded between 1 October 1992 and 31 December 2017. All tables from the COD 'x' schema were included, other than those related to conversion factors, biological sampling, fish catch, otoliths, or catch processing. The fisheries observers are managed by the observer programme at Fisheries New Zealand, which assigns observers to fishing trips. The Observer Trip Record (OTR) tables were also provided as an extract from COD (the OTR tables are not part of the 'x' schema).

2.1.2 Capture identifications

Wildlife Management International Limited (WMIL) carried out the necropsy of seabirds that were caught in fisheries, and also identified birds that were recorded in photographs. An extract from the WMIL database of seabird necropsy and identification information was supplied by WMIL on 7 April 2018. This extract included all data from the database for the period from 1 October 2010 to 30 September 2017.

Each year, all cetacean captures that occurred in that year are assessed in collaboration with the Department of Conservation to ensure that the correct identification is recorded.

2.1.3 Fishing effort data

Fishing effort data were supplied by Fisheries New Zealand as an extract from the Warehou database. The extract covered the period 1 October 1992 to 1 October 2017, and included:

- All catch effort (from the effort, fishing event, and trip tables) data for all fishing methods, including data where the method was not recorded.
- Event data for all fisheries management area (FMA), area, and statistical areas, including events with no location available.
- Event data without a trip number, within the same date range.
- Vessel data for all vessels in the above fishing effort.
- All of the non-fish species capture tables (fisher-reported captures), including any records that could not be linked to the fishing effort.

In preparing the final dataset, effort data were restricted to fishing events within the outer boundary of New Zealand's Exclusive Economic Zone (EEZ).

Effort data from observer trips were included in the study unless they:

- were cancelled,
- operated exclusively outside the EEZ,
- were not from Fisheries New Zealand observers,
- were research trips, or
- did not record any fishing effort.

2.1.4 Preparation of effort data

During data loading, the fisher-reported effort data were assessed for a number of discrepancies, with the data preparation including the completion of missing fields and removing implausible data (such as an excessive number of hooks)(see Appendix A, Table A-1 for a short description of each of the data preparation rules that were applied). In some cases, catch effort data was reconstructed from observer data, where it appeared that the fisher reporting was missing these data or was incomplete.

An important part of the data preparation was assigning positions to data collected with form types that did not report positions. This step allowed more of the effort data to be mapped, or to be used in models that require position information. The imputation involved random sampling from similar fishing to obtain catch effort positions, and is described below.

The data preparation was also applied to observer effort; however, fewer rules were required, as the observer effort dataset had fewer apparent discrepancies (Appendix A, Table A-2).

2.2 Observer trip record

To ascertain the completeness of the observer data, all trips that were recorded in the OTR were assessed to identify whether they appeared in the final PSC database. The OTR is an administrative record of the allocation of observers to fishing vessels, maintained by the observer programme. The following reasons were identified for not including observer trips recorded in the OTR in the PSC database:

Cancelled Although there was a record in the OTR, the observer trip did not occur;

Extra-territorial The observer trip was entirely outside New Zealand's EEZ;

No sea days Although the observer was assigned to the vessel, the observer was unable to get time onboard the vessel at sea;

Research trip The observer trip involved research activities and was excluded from the protected species capture database;

Other method The fishing method was not included in COD effort tables (e.g., squid jigging);

In COD loading Data from the trip were in COD loading tables, but could not to be loaded into the version of the COD data used for research (the 'x' tables) for a number of reasons (e.g., incompleteness of the observer's documentation);

Not in COD Data from the trip were missing from the database;

No vessel The fishing vessel was not known (and so the data could not be loaded into the PSC database);

No effort data The observer effort data were missing.

The assessment process included collaboration with the research data management team at Fisheries New Zealand to identify and resolve discrepancies with the trip data, with the aim of maximising the number of observer trips that could be included in the reporting.

2.3 Linking observer effort with catch effort

Consistent with previous years of data preparation, observer effort and fisher-reported effort data were linked at an event level (i.e., fisher-reported events were identified that corresponded with the observer-reported fishing events). Due to differences in the definition of fishing events, missing reporting and other errors, not all fishing effort could be linked between the two sources (see Appendix B for a description of the rules applied to the linking). All linking of observer and fisher-reported effort data required matching the vessel keys in the two datasets.

Changes were made to the linking of observer and effort data.

The linking was tested by requiring that, when grouped by fishing year and vessel size class (large or small) over 96% of observed fishing was linked (for trawl and longline methods). The vessel class cut-off lengths were 28 m for trawl fisheries, 34 m for bottom-longline fisheries, and 45 m for surface-longline fisheries, consistent with the PSC database. For set-net and purse-seine fishing, there was no grouping by vessel size; the requirement for these fisheries was that 97% of the observed events could be linked. Each year, some changes are made to these linking rules in response to discrepancies detected during the data preparation (see Appendix C).

In the protected species capture estimation, fisher-reported information (fishing position, target species, start date and start time, number of hooks or net length) is used in preference to the observer-reported information for linked events. This preference ensures consistency for extrapolating from observed effort to unobserved effort.

When observer-reported effort data were not available but a trip was observed, the observed effort was reconstructed from the fisher-reported catch effort, assuming that all effort on the observed days was observed.

2.4 Incorrect vessels

Linking between observer and fisher-reported data relies on the assumption that the vessel is correctly identified in the observer data. For data that are provided by Fisheries New Zealand to research providers, vessels are identified by an integer-valued vessel key.

During the current data preparation, it became apparent that some vessel keys may not have been correctly assigned within COD (possibly because of misreporting by the observer, or misallocation of the vessel keys). To facilitate searching for mismatched vessel keys, a procedure was calculated to find observer trips where the pattern of matching (by statistical area and date) was best matched by vessels other than the one recorded. For each observer trip, an observed event was considered to have a match in the commercial data if there was fishing by a vessel, with the same method, in the same statistical area and on the same date as recorded by the observer. All vessels were sorted by the number of matches with the observer trip, and the vessel with the highest match was chosen.

A list of trips where the best-matching vessel had more matches than the vessel recorded by the observer was provided to Fisheries New Zealand. There were 36 observer trips where there was no match (by start date and statistical area) between the observer effort and the fisher-reported information from the observer-reported vessel in COD. In total, there were 149 trips where a vessel other than the observed vessel had a higher match. For many of these trips, the reason for the mismatch was relatively minor, such as errors in the reporting of statistical areas or the use of incorrect method codes.

2.5 Nomad data

Nomad units are handheld electronic devices that were used by observers, primarily on inshore vessels. When the devices were first introduced, there was a delay before the data from the devices were available in COD. To account for observed data from trips using Nomad devices, all fisher-reported effort by these vessels was initially assumed to have been observed, i.e., between the start and the end of the observer trip. Since then, the Nomad-derived data have become available through COD. During the current data preparation, the COD data were used directly, without the above assumption about observer effort on trips where data were recorded with Nomad devices.

In inshore fisheries, observers often join a vessel repeatedly, with breaks in between time at sea. Sometimes these breaks can be relatively long (months). When considering the entire trip as observed when the Nomad devices were used meant that all the fishing was considered as observed, even when the observer was not onboard the vessel. For this reason, the previous handling of data from Nomad devices

Table 1: Imputation groups used for imputing net-fishing locations in West Coast North Island harbours. For each imputation group, the table provides the number of pseudo events, the number of distinct vessels and the number of distinct dates in the source dataset. The code for the impute group is a combination of Statistical Area (042: Raglan; 043: Manukau; 044: Kaipara) and target fishery ("FLAN": flatfish and yellow-bellied flounder net; "SHAN": rig and dogfish net; "MULN": mullet and other target net).

Impute group	Pseudo events	Vessels	Days
042	445	2	55
043-FLAN	212	10	86
043-MULN	381	16	124
043-SHAN	106	6	35
044-FLAN	451	19	123
044-MULN	435	22	123
044-SHAN	62	6	28

meant that observer coverage in these small-vessel fisheries had been overestimated. By using the COD data directly, a more accurate record of the observed fishing effort was obtained.

2.6 Imputation of the location of fishing effort

An imputation process was used to locate fishing effort that did not have a position recorded. The imputation allowed the located fishing effort to be included in spatial analyses. Typically, this imputation was carried out by randomly sampling from other fishing effort.

2.6.1 Set-net, ring-net, and drift-net fishing in West Coast North Island harbours

The most specific position imputation was of net-fishing in West Coast North Island harbours (Statistical Areas 042, 043, and 044: Raglan, Manukau, and Kaipara harbours, respectively). During 2017 and 2018, net-fishing vessels in these areas carried GPS (Global Positioning System) loggers on behalf of Trident Systems. Using the vessel tracks from the GPS loggers, possible fishing events were identified as times of low vessel speed. These "pseudo events" were matched to records in Catch Effort Landing Return (CELR) forms from the vessels on the same day. Data from the CELR forms were used to to assign a fishing method (either set net, drift net, or ring net) and target species (most frequently flatfish, mullet, rig, dogfish, or yellow-bellied flounder) to the pseudo events.

To impute the location of set-net, ring-net and drift-net fishing, the pseudo events were randomly sampled, based on matching by an imputation group (Table 1). Three imputation groups were defined, based on the target species: flatfish species (including yellow-bellied flounder), mullet species (both grey mullet and yellow-eyed mullet) and shark species (rig and dogfish). There was some fishing targeting other species (such as trevally): during imputation these minor target species were grouped with the mullet species. All net-fishing methods were treated together, based on an initial exploration of the data, which suggested that the target species determined the spatial distribution of the fishing (with flatfish being targeted in the shallowest water, mullet at intermediate depths, and rig in deeper areas). There were some pseudo events in other statistical areas, but their data were insufficient to be used for imputation, and so these pseudo events were not included. There were also some pseudo events reported in areas where set-net fishing was restricted. These pseudo events were assumed to not represent true fishing events and were not included in the imputation.

All pseudo events in Statistical Area 042 (Raglan Harbour) were targeting yellow-bellied flounder. During imputation, all fishing in 042 was treated as equivalent.

2.6.2 Flatfish and mullet set net elsewhere

The position of set-net fishing targeting flatfish and mullet species in other statistical areas was imputed following a similar method used previously by Abraham et al. (2017). In the previous project, the imputation was applied to data collected on both CELR and NCE (Netting Catch, Effort and Landing Return, referred to as NCE within the Warehou database) forms. For the current data preparation, the imputation was only applied to data reported on CELR forms; this approach provided consistency with the imputation of net fishing locations in West Coast North Island harbours. Effort on NCE forms (which was also previously imputed) is reported with a position. The Land Cover Database (LCDB v4.1[1]) was used to identify estuarine habitat, and New Zealand bathymetry data (Mitchell et al. 2012) were used to identify water less than 10 m depth. Harbours were manually identified using Geographic Information Systems (GIS) software. A grid of points (spaced at 250 m) was then generated for each month of the year, across shallow water within estuaries or harbours, to provide candidate points for flatfish and mullet effort. A shapefile of set-net restrictions provided by Fisheries New Zealand was used to exclude points where set-net fishing was prohibited (the use of a set of points for each month allowed for seasonal exclusions to be considered). Flatfish and mullet set-net fishing effort without a location was then allocated by randomly sampling from this grid of points, within each statistical area and month. Set-net effort that could not be allocated was not included in the imputation (for example, some effort was reported from Statistical Area 001, which is offshore). Set netting for flatfish and mullet targets in the South Canterbury Statistical Area 022 without location information was assumed to be in Lake Ellesmere, and not allocated a position. All other potential fishing habitat in this area is covered by a set-net restriction.

2.6.3 Other fishing without position

The location of other fishing without a recorded position was imputed following procedures that have been used previously in protected species estimation projects. The imputation proceeded iteratively. Fishing events were randomly sampled from matching fishing effort, where the matching criteria were progressively loosened if no matching fishing was found at the closer match level:

1. Month, fishing year, vessel, gear, statistical area, target species, method.
2. Fishing year, vessel, gear, statistical area, target species, method.
3. Vessel, gear, statistical area, target, method.
4. Size, gear, statistical area, target, method.
5. Class, gear, statistical area, target, method
6. Gear, statistical area, target species, method.

If matching effort was found, then the position of the randomly sampled event was used. If the data were missing other fields (such as the start time of the event), then this information was also obtained from the sampled event.

2.7 Protected species capture review

For many seabird captures, expert identification was carried out. The identification was either based on photographs taken by observers, or on necropsy of retained birds. Since 2011, these identifications were carried out by Wildlife Management International (WMIL), with the results stored in an identification database that is maintained by WMIL. During data preparation, these records were merged with data from COD. For some identifications, there was no matching record in COD, and a capture record was added to the PSC database.

[1] https://lris.scinfo.org.nz/layer/423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/

Previously, capture records that were based on identifications from photographs were added with an unknown capture method (or with the capture method suggested in the identification database). An initial review of these additional records was carried out by Fisheries New Zealand, by viewing the original photographs. This review found that many of the records that were added to the database were deck captures or deck landings (birds that had flown onto the vessel, rather than being captured by the fishing). Deck captures were included in the PSC database, but not treated as fishing-related captures. Following this initial review, Fisheries New Zealand carried out a review of all captures in the WMIL identification database and of all captures that had been added to the PSC database that were not in the COD reporting tables.

During review, photographs and trip diaries were used, where necessary, to determine whether the capture should be added to the PSC database and to provide additional information about the capture (such as determining the capture method).

2.8 The PSC database

The PSC database is a PostgreSQL database that is built by processing input data provided by Fisheries New Zealand (and from some other ancillary sources, such as WMIL). All the processing is carried out by scripts, so that the database can be re-built whenever the source data is updated, or when the data preparation rules are modified. At the end of the process, tests are run to assess the integrity of the database. For example, tests can assess that the number of protected species captures in the final database matches the number expected from the source data.

The scripts for maintaining the database are kept in a Git repository. Git is a version-control system that allows differences in scripts to be compared between any two times. A continuous record of all changes to these scripts has been kept since October 2011. The Git repository is lodged with Fisheries New Zealand data management, with a full download of the PostgreSQL database.

A brief summary of all changes made to the database between January 2018 (the last changes to data from the 2015–16 version of the data) and July 2018 is provided in Appendix C. At this time, the database was largely finalised, but as its maintenance is an ongoing process, some changes may also have occurred since then.

3. RESULTS

3.1 Observer fishing effort data

There were a total of 302 potential observer trips that started during the 2016–17 fishing year (Table 2). Of these trips, two trips were cancelled, one trip did not result in any sea days, and 19 trips were entirely outside of New Zealand's EEZ. In addition, there were four trips that started during 2016–17, but that had no data in COD. These trips were likely to be trips that were not completed in time to be included in the COD extract. In other years, trips were not included because they used other methods (such as squid jig fishing), or because they were research trips. The most recent research trip was a trip during 2014–15 where the observer carried out seabird bycatch mitigation experiments (Goad & Williamson 2015). This trip did not involve the collection of fishing effort data or observations of non-fish bycatch, and so was not included in the PSC database. In previous years, there have been some trips in the COD loading tables (trips may be unable to progress from the loading tables if the paperwork is incomplete). In the current extract, no trips had this status.

Two trips had missing vessel identifications in the OTR, and there were no records of observed fishing from these trips in COD.

A similar reconciliation was carried out for data up to the 2014–15 fishing year (Thompson et al. 2017), allowing comparisons between analyses. Considering the difference between the number of observer trips in each year in the PSC database from the earlier analysis and the current analysis revealed an

Table 2: Number of trips reconciled from the observer trip record database in the data preparation of protected species captures. The number of trips with records in the Protected Species Capture (PSC) database, including the current database and the database to the end of the 2015–16 fishing year (Thompson et al. 2017). Trips were classified according to reasons for not including them or for missing information. Cancelled: observer trip did not occur; extra-territorial: observer trip was entirely outside New Zealand's Exclusive Economic Zone; no sea days: the observer was unable to get time onboard the vessel; research trip: observer trips that involved research activities and did not report protected species captures; other method: the fishing method was not included (i.e., no trawl, longline, set net, or purse seine on the trip); in COD (Centralised Observer Database) loading: data in loading tables but not in the main COD; not in COD: data missing from the database; no vessel assoc.: fishing vessel not known; no catch effort: missing observer effort data.

				Not included					Missing			
	Observer trip record	PSC	PSC (2015–16)	Cancelled	Extra-territorial	No sea days	Research trip	Other method	In COD loading	Not in COD	No vessel assoc.	No effort data
2002–03	122	107	107		13					2		
2003–04	164	154	154		7		1			2		
2004–05	155	146	146		6			1		1	1	
2005–06	134	124	124		10							
2006–07	181	174	172		6			1				
2007–08	176	163	162		11		1				1	
2008–09	233	215	214	2	14	1		1				
2009–10	221	200	198	2	16			3				
2010–11	186	167	162	4	15							
2011–12	184	169	167	3	11	1						
2012–13	274	254	245		14	3	3					
2013–14	326	296	298	6	14	4		6				
2014–15	270	251	251	1	13	2	1	2				
2015–16	281	257		2	18	3		1				
2016–17	302	276		2	19	1				4		

increase in the number of trips included in the PSC database (Table 2). Data to the 2014–15 fishing year included 2400 observed trips in the database for the period between 2002–03 and 2014–15. In the current analysis, the total number of observed trips increased to 2420. The increase in the number of trips was mainly due to the inclusion of trips recorded using Nomad devices directly from COD. In previous analyses, trips with Nomad devices were only reconstructed in the PSC database if fishing was with longline, trawl, or set-net methods (Thompson et al. 2017).

3.2 Incorrect vessels

A total of 36 trips were detected where there was no overlap between the statistical area, date, vessel, and method, between observer and fisher-reported data. Review by Fisheries New Zealand and NIWA staff found that for five of these trips, the lack of overlap was due to the use of different vessel keys in the OTR and in the reporting tables in COD. These trips all occurred before the year 2000. This discrepancy was addressed by ensuring consistency between the OTR and other tables in COD (using the 'x_trip' table as the authoritative source). For five of the trips, it was found that the fisher and the observer had reported different fishing methods, leading to a correction to the observer-reported method. For two trips, the statistical area used by the fisher was incorrect. For four trips, there was an incorrect vessel key associated with the trip in COD, and the vessel key was corrected in the PSC database.

One of the four trips with an incorrect vessel key was a trip that caught 27 black petrel (not including a black petrel recorded by the observer as washing onto the deck). These captures were incorrectly associated with a vessel that carried out bottom-longline and surface-longline fishing in the East Cape area. When the Nomad data were used directly from COD, and the vessel key was corrected, these captures were found to have occurred in the Hauraki Gulf area during bottom-longline fishing. The incorrect data were previously used in seabird risk assessments (Richard & Abraham 2015, Richard et al. 2017).

The other trips with incorrect vessel keys were two bottom-longline trips and one trawl trip. Two seabird captures were reported on these three trips.

3.3 Linking of observer effort to catch effort

Applying the linking rules (see Appendix B) to associate observer effort with catch effort led to the successful linking of over 98% of the observer records with fisher-reported effort in each year and for each method (see also summary of the number of records linked using each rule in each fishing year in Appendix B). For most of the fishing methods, two or three of the rules linked most of the observer effort, and in general the most restrictive rule (the 'A' rules) linked the most events. For some methods, such as set-net fishing, the rules used changed as new forms were introduced to the fishery. For example, for set netting, there was a transition from CELR to NCE forms between 2006–07 and 2010–11.

In each of the summaries, a rule 'O' is shown, indicating that effort data was added to Warehou, as the data from the vessel was otherwise well linked, but there were no records in the catch effort data corresponding with the observer fishing effort.

Discrepancies in the dates recorded by either the observers or the fishers can hinder the linking of records. Out of 242 599 linked observed fishing events, 8433 (3.6%) events were linked to fisher records that started on a different day. Similarly, of the 240 959 linked records where both the fisher and the observer recorded a location or a statistical area, 7 237 (3%) records report the fishing from different statistical areas. In some cases, these discrepancies are likely to be due to the fishing being close to the boundary of statistical areas, but in other cases, they are due to errors by either the fisher or the observer in recording the location of the fishing.

3.4 Set-net, ring-net, and drift-net fishing in West Coast North Island harbours

Set-net, drift-net, and ring-net fishing methods were used in West Coast North Island harbours (Raglan, Manukau, Kaipara harbours). Only a small number of net-fishing events in these harbours had positions recorded in fisher reporting (Table 3). By using positions from GPS data from Trident Systems, all records were assigned a location. When positions were imputed, flatfish net fishing was typically located in the upper reaches of the harbours, with mullet fishing also extending into more open water, and rig and dogfish being targeted in deeper water (Figure 1). For Raglan Harbour, a single impute group was used for all species, resulting in similar maps across the different species.

In the marine mammal risk assessment (Abraham et al. 2017), the fishing effort was located by uniform sampling within all water in the harbours that was less than 10 m deep (and outside of excluded areas). Changing the imputation method resulted in the fishing effort being concentrated away from the harbour entrances.

3.5 Protected species capture review

A total of 175 capture records were added to the PSC database, in addition to records that were in COD reporting tables (Table 4). These additional records were a small number compared with a total of 20 714 capture records in the PSC database, including 12 826 records from the period between 2002–03 and 2016–17. The added records included captures that were made by expanding observer comments (i.e.,

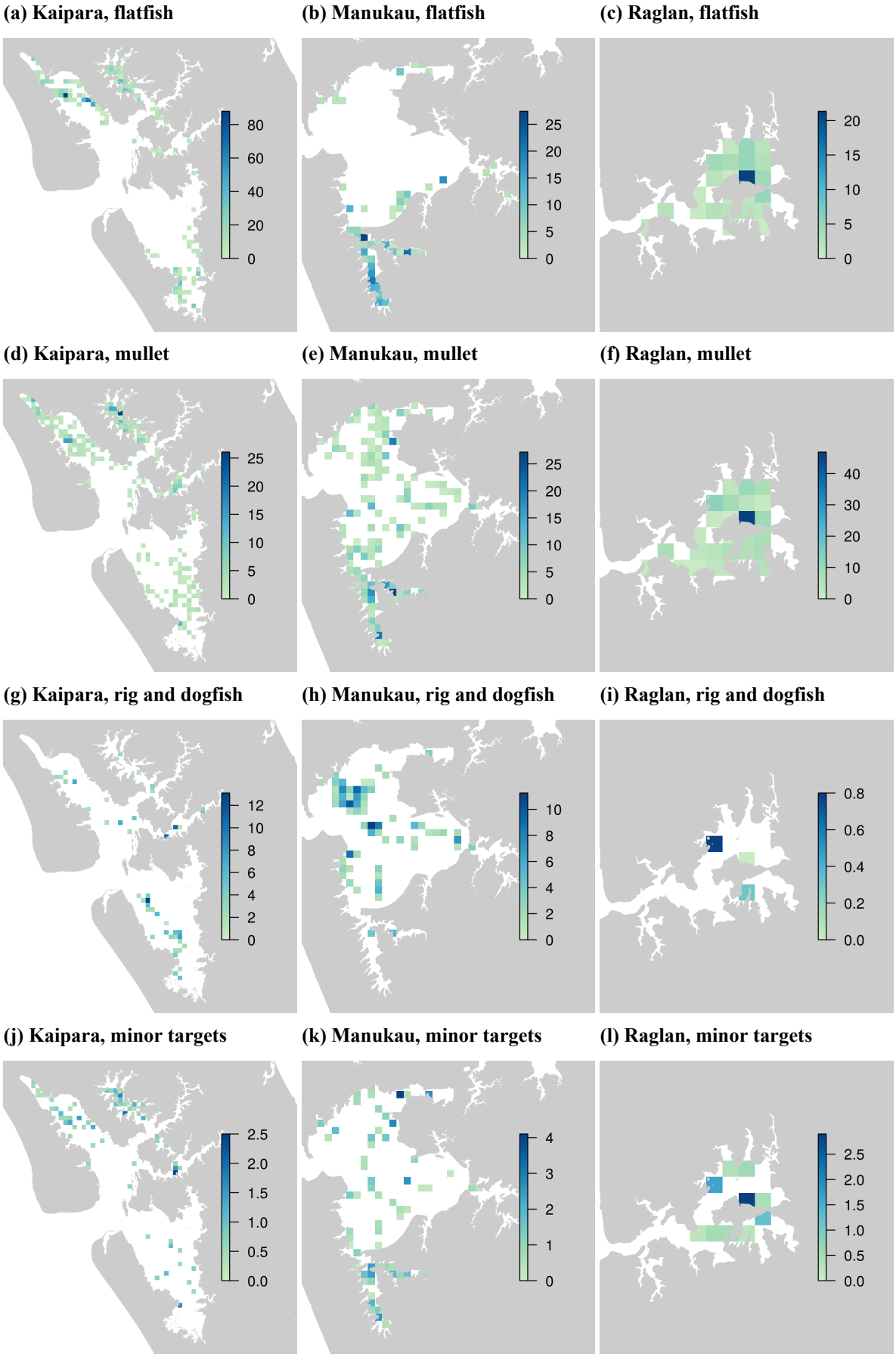

Figure 1: Net fishing (set net, ring net, and drift net) in West Coast North Island harbours by target species. The maps show the length of net (km) set during the 2016–17 fishing year within 1-km cells. Positions are derived from fisher reporting and imputation.

Table 3: Number of fisher-reported effort records in the Protected Species Captures (PSC) database for net-fishing methods in West Coast North Island harbours between 2002–03 and 2016–17. The table shows the number of records that were reported with a latitude and longitude position.

Harbour	Method	Total records	Located records
Kaipara	Set net	60 569	3 977
	Ring net	8 681	0
	Drift net	348	0
Manukau	Set net	33 367	693
	Ring net	13 639	0
	Drift net	28	0
Raglan	Set net	7 553	427
	Ring net	2 282	0
	Drift net	1 862	6

where the observer had noted three captures, but only used a single row on the form); captures from the COD loading tables; and captures that were recorded during photograph identification or necropsy, but that had no formal record in COD. There were 12 captures that were reviewed by Fisheries New Zealand staff, but not added to the PSC database: seven of these captures were duplicates of captures that were already included; four captures had incorrect metadata and their correction revealed that these captures matched already existing captures; and one capture was a capture from a squid-jigging trip, with insufficient information to be included in the PSC database.

Of the captures that were added, 52 captures were seabird captures that were marked as deck strikes (or deck landings), six captures were marked as not bycatch (these captures included two coral captures, a bird that was tangled in the mitigation device, but freed itself, and a fairy prion that was inside the stomach of a blue shark).

3.6 Nomad effort

The key change in the current data preparation was treating the data collected from Nomad devices in the same way as other observer data. Nomad devices were first used during the 2008–09 fishing season as part of a programme collecting data on interactions between Hector's dolphin and fisheries. Between 2008–09 and 2015–16, there were 297 observer trips that had data collected on Nomad devices. When the processing for these trips was updated, there were marked decreases in the number of fishing events treated as observed (Table 5). The largest decrease was for set-net fishing on the Stewart-Snares shelf. The number of set-net events observed decreased from 3281 to 2198, a decrease of 33% (events observed in the PSC database correspond to the number of nets set, as reported by fishers where the observations are linked to fisher effort). This decrease corresponded with a decrease from 297 to 204 of the number of days treated as observed. There were also decreases in the observed number of set-net events observed in other areas.

There were also marked decreases in the number of trawl tows treated as observed, in some areas. In the West Coast North Island area, the number of tows recorded on Nomad devices decreased from 2580 to 1505, a decrease of 42%. This fishing was on both large vessels (> 28 m length) and small vessels. For other fishing methods, the changes were variable, with some increases and some decreases in the number of observed events.

3.7 Changes in effort between versions of the database

The change in treating data from Nomad devices required further updates to the rules used for linking observed effort with fisher-reported effort. Considering all changes combined, aggregated by fishing

Table 4: Summary of captures (by species) that were added to captures in the Centralised Observer Database (COD) during the current data preparation. These additional captures resulted from the expanding of multiple capture events that were initially recorded as single captures (Expanded), from non-fish bycatch forms that were available in the COD loading tables (COD load tables), and from necropsy or photograph identifications that had no corresponding record in COD.

Species	Expanded	COD load tables	Identifications		Total
			Necropsy	Photographs	
Sooty shearwater	10	26	1	4	41
NZ white-capped albatross		5	1	18	24
Antarctic prion				19	19
Spine-tailed devil ray	12				12
Fairy prion	3	1		8	12
White-chinned petrel		2		7	9
Common diving petrel	2			5	7
Southern Buller's albatross		5		1	6
NZ fur seal		4			4
Buller's shearwater		3		1	4
Salvin's albatross			2	2	4
Southern black-backed gull		3			3
Black petrel		2		1	3
Black-bellied storm petrel		1		2	3
Grey-backed storm petrel		1		2	3
Fulmars, petrels, prions and shearwaters		1	1		2
Broad-billed prion	2				2
Shearwaters		2			2
NZ white-faced storm petrel		1		1	2
White-headed petrel				2	2
Bottlenose dolphin		1			1
Flabellum coral		1			1
Solitary bowl coral		1			1
Albatrosses		1			1
Wandering albatross				1	1
Cape petrels		1			1
Flesh-footed shearwater			1		1
Cook's Petrel		1			1
Prions				1	1
Spotted shag				1	1
Westland petrel		1			1
All species	29	64	6	76	175

Table 5: Changes (△) in observed effort associated with 297 observer trips that collected data on Nomad devices for the period between 2008–09 and 2015–16, between the previous and current version of the Protected Species Capture (PSC) database. The table is restricted to methods and areas that had 50 or more fishing events in either version of the database.

Method	Area	Previous	Current	△
Bottom longline	Northland and Hauraki	709	550	-159
	Taranaki	325	376	51
	Bay of Plenty	151	102	-49
	East Coast North Island	93	115	22
	West Coast North Island	39	61	22
Dahn line	East Coast South Island	8	78	70
Pot	East Coast South Island	94	261	167
Set net	East Coast South Island	3252	2789	-463
	Stewart Snares Shelf	3281	2198	-1083
	Taranaki	2057	2055	-2
	West Coast South Island	384	353	-31
	Fiordland	332	315	-17
	Cook Strait	108	68	-40
	West Coast North Island	123	44	-79
Trawl	West Coast North Island	2580	1505	-1075
	East Coast South Island	1923	1448	-475
	West Coast South Island	1150	875	-275
	Stewart Snares Shelf	801	812	11
	Taranaki	564	457	-107
	East Coast North Island	516	356	-160
	Northland and Hauraki	473	327	-146
	Bay of Plenty	408	265	-143
	Chatham Rise	62	0	-62
Troll	Taranaki	2	95	93

method and vessel size, the changes in overall observer coverage were minor for surface-longline and purse-seine fishing when comparing the previous and current version of the PSC database (Figure 2; and see Appendix D). In large-vessel trawl fisheries, the two versions of the database were comparable for total effort for all years other than 2015–16: in that year the current version of the PSC database had less observer effort than the previous version. For set-net, small-vessel bottom longline, and small small-vessel trawl fisheries, some years, especially between 2009–10 and 2014–15, there were differences between the versions of the database (with the observer effort data in the current version of the PSC database typically being lower than in the previous version). These differences were largely due to changes in the processing of the Nomad data.

There was a marked decrease in annual-average observed effort for some fisheries and areas, particularly for small-vessel fisheries (Table 6; the changes are shown for each year between 2002–03 and 2015–16 in Appendix D). The largest percentage decreases were in the Bay of Plenty and Northland and Hauraki areas for small-vessel bottom longline; in the East Coast South Island and Stewart Snares Shelf areas for set-net fishing; in the West Coast North Island area for large vessel trawl; and in the West Coast South Island and East Coast South Island areas for small-vessel trawl. There were also changes in set-net effort in the Taranaki area. In part, this change was due to the re-running of the imputation of the location of set-net fishing, reported on CELR forms within statistical areas that span PSC area boundaries (for example, Statistical Area 039, which crosses the Taranaki and Cook Strait areas).

3.8 Changes in protected species captures between versions of the database

There were changes to the number of protected species captures included in the two versions of the PSC database resulting from the current data preparation (Table 7). Significant changes included the removal of 22 captures of Antarctic prion from the dataset. These were capture records that had been created based on expert identification, but were subsequently classed as deck landings when the captures were reviewed. The decrease by 22 New Zealand white-capped albatross captures also included 16 captures that were re-classified as deck captures during the preparation of data to the end of 2016–17 fishing year.

Changes in the number of seabirds caught may be caused by changes in the imputation of species identity. The increase of 22 captures in the number of Salvin's albatross was partly related to increases in the number of captures (from 48 to 60) that were identified as this species during the species imputation. Captures in the current year may affect imputation in past years. The imputed Salvin's albatross captures were mainly on the east coast of South Island (36 captures), with 15 imputed captures in the Chatham Rise area. Variation in the number of captures assumed for each species, resulting from repeating the species imputation with different random initialisation revealed relatively large variation in the number of imputed captures of Salvin's albatross (Figure 3). This variation was associated with errors by observers in identifying Salvin's albatross.

The increase of eight captures in the number of spine-tailed devil ray captures was due to the expansion of multiple-capture records, where the observer had noted multiple captures in the comments on the form, but had not completed a row for each capture. (Note that although records of shark and ray captures that were reported by observers are maintained in the PSC database, they are not reported on the PSC website. The shark and ray capture data are considered to be an incomplete record as many of of these species are reported by observers as fish bycatch, rather than using the protected species captures form.)

An additional bottlenose dolphin capture (from an inshore trawl tow targeting tarakihi in the Bay of Plenty area, on 9 June 2010) was loaded into the current dataset from the COD loading tables. This capture was one of a total of five captures recorded since 2002–03, and one of seven bottlenose dolphin captures in the PSC database.

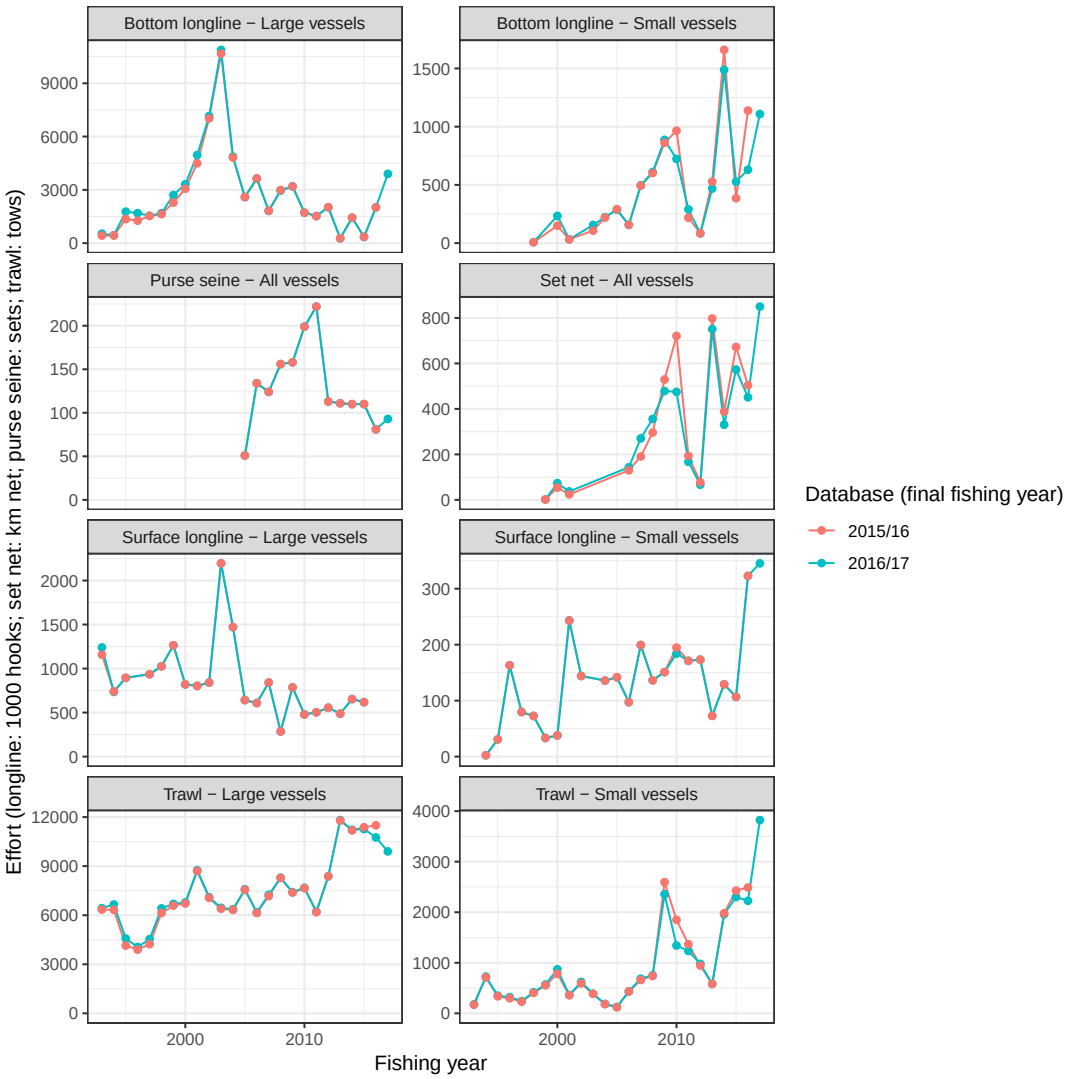

Figure 2: Comparison of the data preparation of observer effort for the current version of the Protected Species Capture (PSC) database (to the end of the 2016–17 fishing year) and the previous version (to the end of the 2015–16 fishing year). For each method, data shown are the total observed fishing effort in each fishing year.

Table 6: Changes (△) in annual average effort, from 2002–03 to 2015–16, between the previous and current version of the Protected Species Capture (PSC) database. Included for each fishing method, vessel size class and area are fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version of the PSC database, changes resulting from updates in the current data preparation, presented as number and percentage change (△ %). Changes of more than 1 effort unit are shown for the respective fishing methods. Data are only shown for method, vessel size, and area groups with more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	5 748			1 113	4	0.4
		Subantarctic	3 291			1 005	5	0.5
		East Coast South Island	1 300			80		
		Stewart Snares Shelf	1 222			293	5	1.7
	Small vessels	Northland and Hauraki	9 984	5	0.1	180	-42	-18.9
		Chatham Rise	4 071	3	0.1	111	9	8.8
		East Coast North Island	3 582			30	4	15.4
		Bay of Plenty	3 374	-5	-0.1	72	-18	-20.0
		East Coast South Island	1 484			46		
		West Coast South Island	1 436	-3	-0.2	15		
		West Coast North Island	1 017	-4	-0.4	7		
PS	All vessels	Bay of Plenty	514			39		
		Northland and Hauraki	433			36		
		West Coast North Island	139			18		
Surface longline	Large vessels	Fiordland	652			597		
		Kermadec Islands	460			460		
		East Coast North Island	157			147		
	Small vessels	East Coast North Island	1 275			53		
		Northland and Hauraki	726			29		
		Bay of Plenty	430			23		
		West Coast North Island	301			12		
		West Coast South Island	284			22		
Set net	All vessels	Northland and Hauraki	5 947	-7	-0.1	0		
		West Coast North Island	5 935	124	2.1	4		
		East Coast South Island	3 906			89	-14	-13.6
		Taranaki	2 431	-157	-6.1	114		
		Stewart Snares Shelf	1 199			66	-14	-17.5
		Bay of Plenty	1 041			0		
Trawl	Large vessels	Chatham Rise	5 765			1 165	4	0.3
		Stewart Snares Shelf	5 397			1 731	5	0.3
		East Coast South Island	4 719			810	2	0.2
		West Coast South Island	4 567	2	0.0	1 514	3	0.2
		Subantarctic	2 175			836	4	0.5
		Auckland Islands	2 086			747	2	0.3
		East Coast North Island	1 829			85	-4	-4.5
		Taranaki	1 804			690	-5	-0.7
		Cook Strait	1 756			145		
		West Coast North Island	1 716			344	-41	-10.6
	Small vessels	East Coast South Island	12 548	-3	-0.0	120	-31	-20.5
		East Coast North Island	9 763			87	-6	-6.5
		West Coast South Island	7 676	2	0.0	83	-18	-17.8
		Stewart Snares Shelf	7 649			63		
		Taranaki	7 049	6	0.1	33		
		Northland and Hauraki	4 952			156	-5	-3.1
		Bay of Plenty	4 668			200		
		Cook Strait	3 606	-2	-0.1	51		
		West Coast North Island	2 598	-6	-0.2	142	-25	-15.0
		Chatham Rise	1 649			128		

Table 7: Summary of number of protected species captures by taxon for 2016–17 and for 2002–03 to 2015–16. Captures for the 2016–17 fishing year are from the current dataset, whereas the captures from 2002–03 to 2015–16 are shown for both the previous and the current version of the dataset following updates in the data preparation. Also shown is the change in the number of captures of each taxon between the two versions of the dataset following the updates.

Taxon	Scientific name	2016–17	2002–03 to 2015–16		
			Prev.	Curr.	Change
White-chinned petrel	*Procellaria aequinoctialis*	173	1875	1873	-2
Sooty shearwater	*Puffinus griseus*	134	1476	1485	9
New Zealand white-capped albatross	*Thalassarche cauta steadi*	98	1408	1386	-22
Southern Buller's albatross	*Thalassarche bulleri bulleri*	36	811	806	-5
Salvin's albatross	*Thalassarche salvini*	26	464	480	16
Grey petrel	*Procellaria cinerea*	5	177	175	-2
Flesh-footed shearwater	*Puffinus carneipes*	3	170	171	1
Black petrel	*Procellaria parkinsoni*	27	117	119	2
Campbell black-browed albatross	*Thalassarche impavida*	2	73	77	4
Westland petrel	*Procellaria westlandica*	10	58	56	-2
Cape petrel	*Daption capense*		66	67	1
Albatrosses	Diomedeidae		56	56	
Gibson's albatross	*Diomedea antipodensis gibsoni*	1	44	43	-1
Antipodean albatross	*Diomedea antipodensis antipodensis*		37	36	-1
Spotted shag	*Stictocarbo punctatus*		37	36	-1
Common diving petrel	*Pelecanoides urinatrix*	1	37	33	-4
Chatham Island albatross	*Thalassarche eremita*		32	31	-1
Grey-faced petrel	*Pterodroma macroptera gouldi*		32	29	-3
Southern royal albatross	*Diomedea epomophora*	4	26	27	1
Cape petrels	*Daption* spp.	1	23	23	
Antarctic prion	*Pachyptila desolata*		34	12	-22
Fairy prion	*Pachyptila turtur*		17	20	3
Northern giant petrel	*Macronectes halli*	1	17	17	
Fulmars, petrels, prions and shearwaters	Procellariidae	1	14	15	1
Snares Cape petrel	*Daption capense australe*	1	14	13	-1
Buller's shearwater	*Puffinus bulleri*		15	13	-2
New Zealand white-faced storm petrel	*Pelagodroma marina maoriana*	1	12	13	1
Giant petrels	*Macronectes* spp.		12	12	
Yellow-eyed penguin	*Megadyptes antipodes*		12	12	
Wandering albatrosses	*Diomedea exulans* & *D. antipodensis* sspp.		12	11	-1
Grey-backed storm petrel	*Garrodia nereis*	1	10	8	-2
Prions	*Pachyptila* spp.		10	9	-1
Fulmar prion	*Pachyptila crassirostris*		9	9	
Southern black-backed gull	*Larus dominicanus dominicanus*	2	8	6	-2
Black-browed albatross	*Thalassarche melanophris*		9	8	-1
Fluttering shearwater	*Puffinus gavia*		9	8	-1
Little penguin	*Eudyptula minor*		8	8	
Short-tailed shearwater	*Puffinus tenuirostris*		7	9	2
Antipodean and Gibson's albatrosses	*Diomedea antipodensis*		7	7	
Large seabirds			6	6	
Wandering albatross	*Diomedea exulans*		6	6	
Mid-sized petrels & shearwaters	*Pterodroma*, *Procellaria* & *Puffinus* spp.		9	1	-8
Petrels, prions, and shearwaters	Hydrobatidae, Procellariidae & Pelecanoididae		5	5	
Smaller albatrosses	*Thalassarche* spp.		5	5	
Small seabirds			5	4	-1
Stewart Island shag	*Leucocarbo chalconotus*	1	3	3	
Pied shag	*Phalacrocorax varius varius*		4	4	
Shearwaters	*Puffinus* spp.		4	4	
Storm petrels	Hydrobatidae		4	4	
Australasian gannet	*Morus serrator*		3	4	1
Fiordland crested penguin	*Eudyptes pachyrhynchus*		3	3	
Black-browed albatrosses	*Thalassarche melanophris* & *T. impavida*		3	3	
Royal albatrosses	*Diomedea sanfordi* & *D. epomophora*	2	1	1	
Seagulls	*Larus* spp.		3	3	
Great albatrosses	*Diomedea* spp.		3	2	-1
Northern royal albatross	*Diomedea sanfordi*		2	3	1
White-headed petrel	*Pterodroma lessonii*		3	2	-1
Gadfly petrels	*Pterodroma* spp.		2	2	
Northern Buller's albatross	*Thalassarche bulleri platei*		2	2	
Red-billed gull	*Larus novaehollandiae scopulinus*		2	2	
Southern giant petrel	*Macronectes giganteus*		2	2	
Black-bellied storm petrel	*Fregetta tropica*		2	1	-1

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Table 7 – continued from previous page

Taxon	Scientific name	2016–17	2002–03 to 2015–16		
			Prev.	Curr.	Change
Broad-billed prion	*Pachyptila vittata*		2	1	-1
Light-mantled sooty albatross	*Phoebetria palpebrata*		2	1	-1
Buller's albatross	*Thalassarche bulleri*		1	1	
Indian Ocean yellow-nosed albatross	*Thalassarche carteri*		1	1	
Cormorants and shags	Phalacrocoracidae		1	1	
Crested penguins	*Eudyptes* spp.		1	1	
Grey-headed albatross	*Thalassarche chrysostoma*		1	1	
Seabirds			1	1	
Eurasian blackbird	*Turdus merula*		1		-1
Wilson's storm petrel	*Oceanites oceanicus*			1	1
New Zealand fur seal	*Arctocephalus forsteri*	116	1939	1940	1
New Zealand sea lion	*Phocarctos hookeri*	3	151	151	
Elephant seal	*Mirounga leonina*		1	1	
Leopard seal	*Hydrurga leptonyx*		1	1	
Seals and Sealions	Phocidae and Otariidae (Families)		1	1	
Spine-tailed devil ray	*Mobula japanica*	7	47	55	8
Basking shark	*Cetorhinus maximus*	4	16	13	-3
White pointer shark	*Carcharodon carcharias*	4	8	8	
Porbeagle shark	*Lamna nasus*		2	2	
Manta ray	*Manta birostris*	1			
Common dolphin	*Delphinus delphis*	3	216	215	-1
Pilot whale long-finned	*Globicephala melas*		18	18	
Dusky dolphin	*Lagenorhynchus obscurus*		11	11	
Hectors dolphin	*Cephalorhynchus hectori*	1	7	7	
Bottlenose dolphin	*Tursiops truncatus*	1	4	5	1
Beaked whales	*Mesoplodon* spp.	2	2	2	
Whale (unspecified)			2	2	
Porpoise			1	1	
Leatherback turtle	*Dermochelys coriacea*	2	17	17	
Turtle	*Chelonioidea*		5	5	
Green turtle	*Chelonia mydas*		4	4	

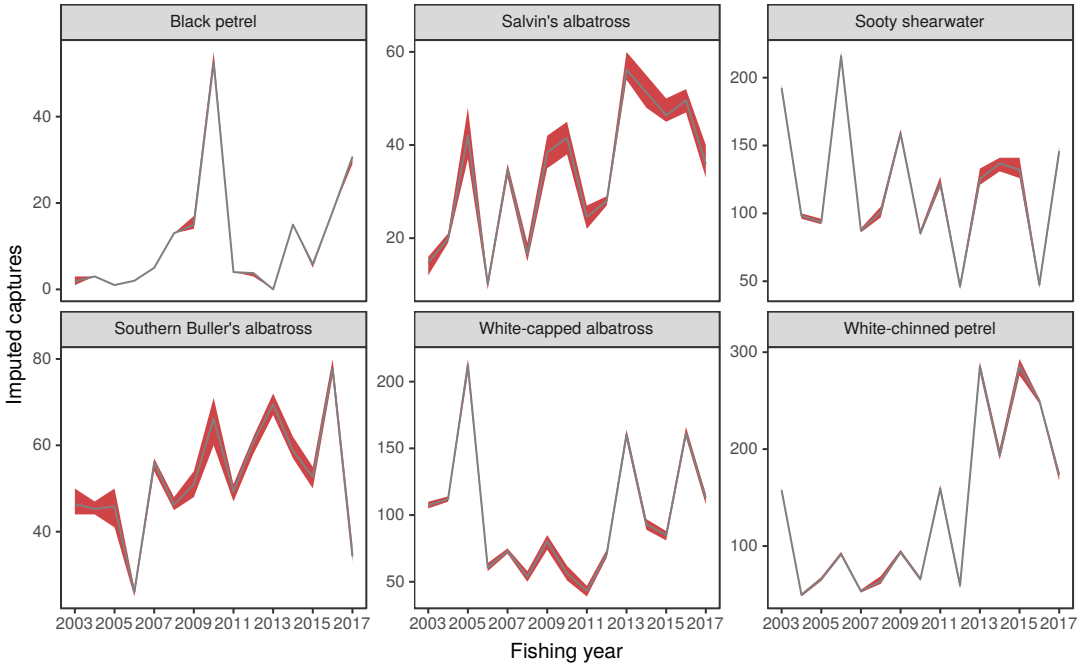

Figure 3: Variation in the number of captures, caused by repeating the species imputation with different random initialisation. Shown are for each of the six selected seabird species the number of captures included in the current dataset (grey line), and the range (red) of the number of captures in each fishing year, resulting from repeating the species imputation 100 times.

4. DISCUSSION

4.1 Comparison between data sources

The preparation of observer data for the PSC database supports their use in the analysis of protected species captures, which in turn, provides information for the management of interactions between fisheries and protected species in New Zealand waters. An important requirement of the data preparation is that it is robust and reliable. At the same time, the dataset of fisheries and observer data from throughout New Zealand covers a period of over twenty years and is complex, making the transformation of these data into the format needed for the estimation of protected species captures challenging.

To provide an overall assessment of the observer data in the PSC database, the data can be compared with data directly from COD and with fisher-reported data from Warehou (on the assumption that all effort is observed on vessels fishing on days that are recorded in the PSC database as observed). In general, fishing effort information from the three data sources was similar for bottom-longline and purse-seine fishing (but there was some fishing effort reported by purse-seine fishers during 2013–14 that was not reported as observed, even though observers were on the vessel on the same day).

There are some missing set-net data in COD, where the observed events did not have an associated net length recorded. This lack of information means that the COD data are underestimating the total net length observed in 2005–06 and 2006–07, and to a lesser extent in 2013–14, 2015–16, and 2016–17 (Figure 4). As the PSC database uses net-length data from fisher-reported events, where observer records can be linked to fisher records, it is possible to obtain the missing net length information from the fisher data.

In surface-longline fisheries, observers record both hooks observed and hooks set. Across all observed surface-longline fishing between 2002–03 and 2016–17, 87.6% of the total number of hooks set on observed sets were recorded as observed. In the PSC database, the number of observed hooks in surface-longline fisheries corresponds with the number of hooks set (Figure 4). The reporting of protected species captures by observers does not distinguish between animals caught on observed hooks, or on unobserved hooks on observed sets, and crew may retain animals that are caught when the observer is not present. There is also likely to be a difference between hooks set and hooks observed in bottom-longline fisheries, particularly on autoliners that set tens of thousands of hooks per day; however, information on the number of hooks observed is not available from COD (the hooks observed field is empty).

Across trawl fisheries, the number of tows recorded by the observers and by the fishers on observed fishing days closely corresponded, with the exception of some discrepancy in the 1992–93 fishing year.

With the exceptions noted above, when summed by method and year, the observer record of fishing activity in COD is consistent with fisher reporting.

4.2 Implications for protected species capture estimation

The updates that have been made in the PSC database, particularly the revised treatment of the Nomad data, the reassignment of vessel keys and changes to some protected species captures, will affect the estimation of protected species captures. For inshore fisheries, such as set-net fisheries, which had a marked proportion of the observer records on Nomad devices, the decrease in the observed effort will result in an increase in the observed capture rate. This increase in capture rate may result in an increase in the estimated total number of captures when it is extrapolated across the unobserved fishing effort.

Black petrel is the species that has been estimated to have the highest risk of population impact as a result of fisheries mortalities (e.g., Richard et al. 2017). Correcting the vessel key in the current update to the PSC database resulted in a change to the location of 27 black petrel captures from the East Cape area to the Hauraki Gulf area. The captures also moved from bluenose bottom-longline and bigeye surface longline-fishing effort to only bluenose bottom longline. The captures were originally considered to have occurred towards the edge of the range of black petrel. With the vessel key corrected, these captures

shifted to locations close to Great Barrier Island, where black petrel are breeding. When the seabird risk assessment is updated, it is expected that the estimated capture of black petrel in the East Cape area will decrease. This decrease in turn, may reduce the estimated risk of fishing to the black petrel population. At the same time, however, there will be more observed captures in the centre of the distribution of this species.

In summary, the current updates to the data used for the estimation of protected species captures resulted in a number of changes. These changes and an additional year of observer data mean that updating the estimation of protected species captures will be required to understand the impact of these changes.

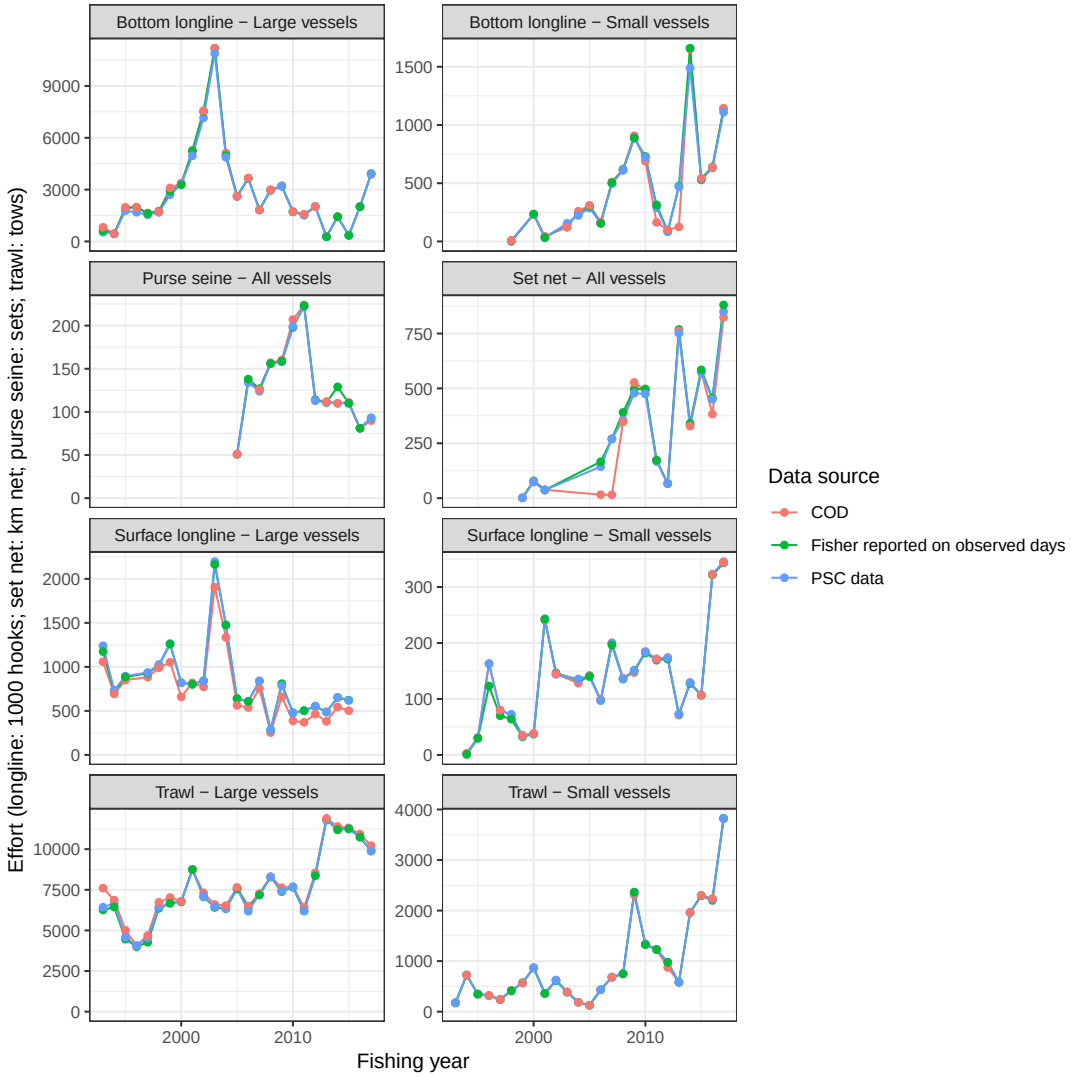

Figure 4: Comparison of observer effort between three different sources: directly from the Centralised Observer Database (COD), for all observed trips that remained in the Protected Species Capture (PSC) dataset; directly from the Warehou database for all days on which the fishing was observed (selected by vessel and start or end date of the fishing); and from the PSC data. For each fishing method, the total observed fishing effort is shown, starting in the 1992–93 fishing year. Data are from the current version of the PSC database. Cut-off lengths for small and large vessels were 28 m for trawl fisheries, 34 m for bottom-longline fisheries, and 45 m for surface-longline fisheries.

5. ACKNOWLEDGMENTS

Many thanks to David Goad at Vita Maris who detected the errors in the vessel keys. Thanks also to David Middleton of Trident Systems for providing the data needed to impute set net positions in harbours.

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6. REFERENCES

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APPENDIX A: DATA PREPARATION RULES APPLIED TO RAW DATA

Table A-1: Summary of data preparation rules applied to fisher-reported effort data.

Code	Description
START_LONGITUDE_FROM_DCF	Start longitude copied from other events with the same form key.
END_LONGITUDE_FROM_DCF	End longitude copied from other events with the same form key.
START_LATITUDE_FROM_DCF	Start latitude copied from other events with the same form key.
END_LATITUDE_FROM_DCF	End latitude copied from other events with the same form key.
MANUAL_POSITION	Manual update to position.
MANUAL_START_DATETIME	Manual correction to start date and start date-time.
MANUAL_END_DATETIME	Manual correction to end date and end date-time.
FISHING_YEAR_FROM_TRIP	Fishing year determined from other events on the trip.
PRIMARY_METHOD_FROM_DCF	Primary method determined from other events with the same dcf_key.
STATAREA_FROM_START_POINT	Start statistical area determined from start point.
STATAREA_FROM_DCF	Start statistical area determined from other events with the same dcf_-key.
MANUAL_STATAREA	Manual correction to the statistical area.
IMPUTED_METHOD	Imputed primary method.
TARGET_FROM_DCF	Target species determined from other events with the same form key.
EFFORT_NUM_FROM_DCF	Effort number determined from other events with the same form key.
HOOKS_FROM_DCF	Hooks determined from other events with the same form key.
NET_LENGTH_FROM_DCF	Net length determined from other events with the same form key.
MANUAL_YEAR	Incorrectly entered year in start date, corrected manually by examining other events from the same trip recorded in Warehou.
EFFORT_NUM_UNDEFINED	Effort number of 1 added to records from form types where it is un-defined.
EFFORT_NUM_MISSING_OTHERWISE_ONE	Effort number of 1 added to records where it is missing, from form types where it is otherwise 1.
EFFORT_NUM_ZERO	Effort number zero, but positive catch weight.
EFFORT_NUM_MORE_THAN_HOOKS_SWAP	Effort number on longline sets is more than the hook number, so swap them.
EFFORT_NUM_MORE_THAN_NET_LENGTH_SN_SWAP	Effort number on set net sets is less than the net length.
EFFORT_NUM_TOO_HIGH_LONGLINE	Effort number on longline records is too high (over ten sets).
HOOK_NUM_TOO_LOW	Longline hook number is too low (less than 100 hooks).
HOOK_NUM_TOO_HIGH_SLL	Surface-longline hook number is too high (more than 10 000 hooks).
HOOK_NUM_TOO_HIGH_BLL	Bottom-longline hook number is too high (more than 50 000 hooks).
EFFORT_NUM_TOO_HIGH_TRAWL	Effort number on trawl records is too high (ten or more events).
EFFORT_NUM_MORE_THAN_NET_LENGTH_SN	Effort number on set-net records is higher than the net length.
EFFORT_NUM_TOO_HIGH_SN	Effort number on set-net records is too high (over 50 events).
EFFORT_NUM_TOO_HIGH_PS	Effort number on purse-seine records is too high (eight or more events).
NET_LENGTH_TOO_HIGH_PS	Net length on purse-seine records is too long (4000 m or more).
NET_LENGTH_TOO_HIGH_SN	Net length on set net records is too long (10 000 m or more).
MANUAL_NET_LENGTH	Manual update to net length.
NET_LENGTH_UNREASONABLE_SN	Net length on set-net records is unreasonable.
EFFORT_DIFFERENT_FROM_SURROUNDING	Effort number is higher than surrounding values.
IMPUTED_HOOKS_PREVNEXT	Hooks imputed from previous or next event.
IMPUTED_NET_LENGTH_PREVNEXT	Net length imputed from previous or next event.
IMPUTED_EFFORT_NUM_PREVNEXT	Effort number imputed from previous or next event.
IMPUTED_HOOKS_VESSEL	Hook number imputed from other events on same vessel.
IMPUTED_NET_LENGTH_VESSEL	Net length imputed from other events on same vessel.
IMPUTED_EFFORT_NUM_VESSEL	Effort number imputed from other events on the same vessel.
IMPUTED_HOOKS_SIMILAR_VESSEL	Hook number imputed from other events on similar vessels.
IMPUTED_NET_LENGTH_SIMILAR_VESSEL	Net length imputed from other events on similar vessels.
IMPUTED_EFFORT_NUM_SIMILAR_VESSEL	Effort number imputed from other events on similar vessels.
NET_LENGTH_REMOVED	Net length removed on non-netting method.
HOOKS_REMOVED	Hooks removed on non-lining method.
IMPUTED_VESSEL_SIZE	Imputed vessel size.
IMPUTED_TARGET	Imputed target species.
IMPUTED_FISHERY	Imputed fishery.
IMPUTED_POSITION_WCNI_HARBOURS	Position imputed in west coast North Island harbours from GPS tracked vessels.
IMPUTED_POSITION_FLATFISH_MULLET_SETNET	Position imputed, flatfish and mullet set net.
IMPUTED_POSITION	Position imputed from similar events.
MISSING_EFFORT	Unreported or missing catch effort data filled in from observer report.
MANUAL_GEAR	Manual correction to gear type.

Table A-2: Summary of data preparation rules applied to observer-reported effort data.

Code	Description
MANUAL_VESSEL	Manually updated vessel key.
MANUAL_METHOD	Manually updated fishing method.
MANUAL_SLED	Manually added Sea Lion Exclusion Device (SLED) mitigation.
MISSING_OBSERVERS	Observers filled in manually.
STATAREA_FROM_START_POINT	Start statistical area determined from start point.
START_POINT_ON_BOUNDARY	Randomly choose statistical area for start point on boundary.
MANUAL_DATE	Manually correct date.
MANUAL_FISHERY	Manually correct fishery.
MANUAL_TARGET	Manually correct target species.
DATE_IN_SEQUENCE	Update the date to fit in sequence, based on trip number and station number.
AREA_FROM_TRIP_DATE	Fill in missing areas when all located events on the same trip and day are in a unique area.
MISSING_EFFORT	Missing observer effort data filled in from fisher reporting.

Table A-3: Summary of data preparation rules applied to protected species captures data.

Code	Description
ADDED_FROM_Z_TABLE	Capture added from Centralised Observer Database (COD) loading tables.
EXCLUDED_OBS_LFS	Excluded value from obs_lfs table in 2013-06-27 project.
EXCLUDED_OBS_STATION	Excluded value from obs_station table in 2013-06-27 project.
BLANK_SPECIES	Empty string or null species code.
MISSING_STATION_PS	Update purse-seine stations to nearest fishing event.
MANUAL_STATION_NUMBER	Replace bad station number with a station on the event date.
MISSING_STATION	Missing station number, use station with closest date, not considering the method.
CREATED_FOR_ID	Additional capture created for necropsy or photo identification.
EXPANDED_MULTIPLE_CAPTURE_RECORD	Capture added during expansion of one COD record describing multiple captures.
SPECIES_FROM_PHOTO_ID	Species code updated from photo identification.
SPECIES_FROM_NECROPSY	Species code updated from necropsy.
CAPTURE_METHOD_FROM_NECROPSY	Capture method updated from necropsy.
MANUAL_SPECIES_OBS	Manually corrected observer species code.
MANUAL_SPECIES	Manually corrected species code.
MANUAL_ALIVE	Manually updated alive code.
MANUAL_CAPTURE_METHOD	Manually corrected capture method.
MANUAL_NOTBYCATCH	Manually set record not to be counted as bycatch.
MANUAL_LOST	Animals that were caught, but not recovered onto the vessel.
MANUAL_INCLUDED	Manually changed excluded flag so that the capture is included.
MANUAL_EXCLUDED	Manually excluded.
AUTOPSIED_ALIVE	Correct record where animal is marked as both autopsied and alive.
IMPUTED-AREA-SPECIES	Model species code imputed.
IMPUTED-FISHERY-METHOD-AREA-SPECIES	Model species code imputed.
IMPUTED-METHOD-AREA-SPECIES	Model species code imputed.
IMPUTED-OBSERVERS-FISHERY-METHOD-AREA-SPECIES	Model species code imputed.
IMPUTED-YEAR-OBSERVERS-FISHERY-METHOD-AREA-SPECIES	Model species code imputed.
IMPUTED-TRIP-YEAR-OBSERVERS-FISHERY-METHOD-AREA-SPECIES	Model species code imputed.
IMPUTED-SHY-TO-WHITE-CAPPED	Replace shy albatross with white-capped albatross, unless confirmed by necropsy.

APPENDIX B: LINKING OF OBSERVER AND CATCH EFFORT DATA

B.1 Linking rules for trawl effort

A The observer start time is within 10 minutes of the fisher start time. The observer end time is within 10 minutes of the fisher end time.

B The observer start time is within 30 minutes of the fisher start time. The observer end time is within 30 minutes of the fisher end time. Where both observer and fisher have reported start positions, or both have reported end positions, those positions are within 2 km of each other.

C Either:

- the fisher start time is up to two hours before the observer start time, and the fisher end time is between 70 and 50 minutes before the observer end time; or
- the fisher start time is between 70 and 50 minutes before the observer start time, and the fisher end time up to two hours before the observer end time.

Where both observer and fisher have reported start positions, or both have reported end positions, those positions are within 1.5 km of each other.

D Either:

- the observer and fisher start times are within ten minutes of each other, and start points are within 1.5 km; or
- the observer and fisher end times are within ten minutes of each other, and end points are within 1.5 km.

F Where both observer and fisher have a single unlinked tow at most one day apart, and the unlinked tows are surrounded by previously linked (by rules A–E) tows, fill in the gap by linking the unlinked tows, using the pre-defined ordering over fisher events. This rule is also applied in cases where the unlinked tow is first or last in the ordering.

G Link runs of previously unlinked tows of the same length in both datasets when the runs in both datasets are followed by pair of tows that are linked, where the fisher and observer start and times on each tow are both within 12 hours of one another.

H Link runs of previously unlinked tows of the same length in both datasets when the runs in both datasets are preceded by pair of tows that are linked, where the fisher and observer start and end times on each tow are within 12 hours of one another.

I On days with more than event and the same number of events recorded by the observer and the fisher, link the observer and fisher events on each day, with observer events ordered by time and station number, and fisher events ordered by time, provided events have the same target species.

K For fishing reported on CEL (Catch Effort Landing Return) forms, link all observer events on a day to the fishing event on the same day with the same target species.

L For fishing reported on TCP (Trawl Catch Effort Processing Return) forms, link all remaining unlinked observer events to the closest remaining unlinked fishing event within one day of the observer event.

O Effort missing in Warehou filled in using observer data.

The time differences in rule C attempt to account for differences in DST (daylight saving time) adjustments of the reported event times.

B.2 Linking rules for bottom-longline effort

CEL A For each fishing event on CEL (Catch Effort Landing Return) forms, attempt to match one or more observer events on the same day, where the number of fisher-reported hooks is approximately equal to the sum of the observed hooks, or the fisher-reported effort number is equal to the number of linked observer records.

CEL B For each fishing event on CEL forms, attempt to match one or more observer events one day out, where the number of fisher-reported hooks is approximately equal to the sum of the observed hooks, or the fisher-reported effort number is equal to the number of linked observer records.

CEL C Link previously unlinked observer and fishing events on the same day in order of start time, for all days with more than one unlinked observed event and more than one unlinked fishing event.

CEL D Link remaining unlinked observer events to the closest fishing event on the same day, or up to one day out.

LCE A For each fishing event, attempt to match one or more observer events on the same day or one day out, where the number of fisher-reported hooks is approximately equal to the sum of the observed hooks.

LCE B Link unlinked observer and fisher events, where start times or end times are within ten minutes of one another, and the start points are within 2 km.

LCE C Link unlinked observer and fisher events, where the fisher has reported a haul start time, the observer and fisher start times are within ten minutes of one another, or the fisher haul start time is within ten minutes of the observer end time.

LCE D Link unlinked observer and fisher events, where the observer start time is 50 to 70 minutes after the fisher start time, or the observer end time is 50 to 70 minutes after the fisher haul start.

LTC A For each fishing event, attempt to match one or more observer events on the same day or one day out, where the number of fisher-reported hooks is approximately equal to the sum of the observed hooks.

LTC B When the number of fisher and observer events is the same, link the two record sets in order, provided the start dates of each linked pair are at most one day different, and the number of hooks on each linked pair are similar.

LTC C Link remaining unlinked observer events to the closest fisher event within one day.

O Effort missing in Warehou filled in using observer data.

The time differences in rule LCE D attempt to account for differences in DST (daylight saving time) adjustments of the reported event times.

B.3 Linking rules for surface-longline effort

A The observer start time is within ten minutes of the fisher start time. The observer end time is within ten minutes of the fisher end time.

B The observer start time is within 60 minutes of the fisher start time. The observer end time is within 60 minutes of the fisher end time.

C Either:

- the fisher start time is up to two hours before the observer start time, and the fisher end time is between 70 and 50 minutes before the observer end time; or

– the fisher start time is between 70 and 50 minutes before the observer start time, and the fisher end time up to two hours before the observer end time.

Where both observer and fisher have reported start positions, or both have reported end positions, those positions are within 1.5 km of each other.

D Either:

– the observer and fisher start times are within 30 minutes of each other, and start points are within 1.5 km; or
– the observer and fisher end times are within 30 minutes of each other, and end points are within 1.5 km; or
– the observer and fisher start times are within 30 minutes of each other, and end points are within 1.5 km; or
– the observer and fisher end times are within 30 minutes of each other, and start points are within 1.5 km.

E Either:

– the fisher start time is missing and observer and fisher end times are within ten minutes of each other; or
– the fisher end time is missing and observer and fisher start times are within ten minutes of each other.

Both observer and fisher have either reported start points within 1.5 km of each other, or end points within 1.5 km of each other.

F Where both observer and fisher have a single unlinked event at most one day apart, and the unlinked events are surrounded by previously linked (by rules A–E) events, fill in the gap by linking the unlinked events, using the pre-defined ordering over fisher events. This rule is also applied in cases where the unlinked event is first or last in the ordering.

G Link runs of previously unlinked events of the same length in both datasets when the runs in both datasets are followed by pair of events that are linked, where the fisher and observer start and times on each event are both within six hours of one another.

H Link runs of previously unlinked events of the same length in both datasets, when the runs in both datasets are preceded by pair of events that are linked, where the fisher and observer start and end times on each event are within six hours of one another.

M A special case for linking some difficult events on one trip.

O Effort missing in Warehou filled in using observer data.

The time differences in rule C attempt to account for differences in DST (daylight saving time) adjustments of the reported event times.

B.3.1 Linking rules for set-net effort

CEL A For each fishing event on CEL (Catch Effort Landing Return) forms, attempt to match one or more observer events on the same day, where the fisher-reported net length is approximately equal to the sum of the observed net length, or the fisher-reported effort number is equal to the number of linked observer records.

CEL B For each fishing event on CEL forms, attempt to match one or more observer events one day out, where the fisher-reported net length is approximately equal to the sum of the observed net length, or the fisher-reported effort number is equal to the number of linked observer records.

CEL C Link previously unlinked observer records to the closest unlinked CEL fisher record, where the start dates are within one day of one another.

NCE A For each fishing event, attempt to match one or more observer events on the same day or one day out, where the fisher-reported net length is approximately equal to the sum of the observed net length.

NCE B Link previously unlinked observer records to the closest unlinked NCE (Trawl Catch Effort Processing Return) fisher record where the start dates are within one day of one another.

O Effort missing in Warehou filled in using observer data.

B.3.2 Linking rules for purse-seine effort

CEL A For each fishing event on CEL forms, attempt to match one or more observer events on the same day or one day out, where the fisher-reported effort number is equal to the number of linked observer records.

CEL B Link previously unlinked observer records to the closest unlinked NCE fisher record on the same day.

O Effort missing in Warehou filled in using observer data.

Table B-4: Linking of trawl effort by fishing year.

Year	Events			Rule									
	Observed	Linked	% Linked	A	B	C	D	F	G	H	I	K	L	O
1998–99	7262	7148	98.4	5976	221	189	211	388	81	13	8	3	58	0
1999–00	7648	7556	98.8	6310	237	161	162	290	92	7	6	252	39	0
2000–01	9115	9047	99.3	7958	345	217	207	236	41	6	2	5	30	0
2001–02	7719	7666	99.3	6922	239	129	139	72	54	3	3	91	14	0
2002–03	6840	6784	99.2	6182	172	161	133	83	43	3	0	0	7	0
2003–04	6549	6517	99.5	6051	184	64	128	46	12	1	2	21	8	0
2004–05	7712	7677	99.5	7118	215	95	133	75	5	1	2	31	2	0
2005–06	6619	6576	99.4	6039	213	74	163	51	20	2	8	0	6	0
2006–07	7925	7818	98.6	6995	209	112	158	100	81	13	3	138	9	0
2007–08	9049	9015	99.6	8163	303	189	173	106	65	4	0	7	5	0
2008–09	9762	9681	99.2	7030	434	797	177	208	851	120	22	34	8	0
2009–10	9019	8955	99.3	7599	259	315	122	85	470	93	10	0	2	0
2010–11	7447	7395	99.3	6406	510	86	131	92	105	23	20	0	22	0
2011–12	9354	9331	99.8	8110	435	60	197	80	34	3	24	0	2	25
2012–13	12398	12371	99.8	11257	521	75	265	99	67	8	0	0	2	77
2013–14	13184	13136	99.6	11897	590	86	316	127	104	5	3	0	2	0
2014–15	13567	13496	99.5	12162	698	92	269	122	66	11	18	0	31	27
2015–16	12983	12927	99.6	11266	1049	69	256	152	97	13	4	0	4	17
2016–17	13724	13690	99.8	11297	1429	190	202	192	130	7	18	0	8	217

Table B-5: Linking of bottom-longline effort by fishing year.

Year	Events			CEL rule				LCE rule				LTC rule			
	Observed	Linked	% Linked	A	B	C	D	A	B	C	D	A	B	C	O
1998–99	473	473	100.0	99	85	59	230	0	0	0	0	0	0	0	0
1999–00	508	491	96.7	235	193	22	41	0	0	0	0	0	0	0	0
2000–01	837	817	97.6	570	81	82	84	0	0	0	0	0	0	0	0
2001–02	1092	1088	99.6	629	304	22	133	0	0	0	0	0	0	0	0
2002–03	1609	1580	98.2	899	520	41	120	0	0	0	0	0	0	0	0
2003–04	918	916	99.8	462	146	1	115	187	3	0	0	0	0	0	2
2004–05	561	561	100.0	225	22	1	25	286	2	0	0	0	0	0	0
2005–06	664	661	99.5	76	0	0	12	562	10	1	0	0	0	0	0
2006–07	523	523	100.0	108	79	0	14	316	5	1	0	0	0	0	0
2007–08	624	623	99.8	8	12	0	4	452	5	0	1	132	4	5	0
2008–09	862	862	100.0	0	0	0	0	479	9	0	0	240	26	96	9
2009–10	715	715	100.0	0	0	0	0	197	0	0	0	441	4	45	9
2010–11	493	491	99.6	0	0	0	24	301	10	3	0	75	2	76	0
2011–12	332	332	100.0	0	0	0	0	230	0	0	0	82	2	18	0
2012–13	284	284	100.0	0	0	0	0	11	0	0	0	83	0	93	0
2013–14	856	853	99.6	0	0	0	0	212	7	0	0	567	7	60	0
2014–15	431	430	99.8	0	0	0	0	53	0	0	0	182	0	195	0
2015–16	779	777	99.7	0	0	0	0	299	5	0	0	357	3	113	0
2016–17	881	881	100.0	0	0	0	0	359	3	1	0	435	0	83	0

Table B-6: Linking of surface-longline effort by fishing year.

Year	Events			Rule								
	Observed	Linked	% Linked	M	A	B	C	D	E	F	G	H	O
1998–99	450	447	99.3	0	347	46	16	20	0	13	3	2	0
1999–00	303	300	99.0	0	246	41	1	7	0	4	0	1	0
2000–01	464	458	98.7	3	307	105	1	15	0	15	8	2	2
2001–02	398	395	99.2	0	296	60	3	22	0	10	1	3	0
2002–03	610	602	98.7	0	533	38	0	25	0	4	1	1	0
2003–04	549	547	99.6	0	463	65	0	15	0	2	1	1	0
2004–05	333	328	98.5	0	258	39	0	27	0	1	0	0	3
2005–06	264	263	99.6	0	211	32	0	19	0	1	0	0	0
2006–07	446	440	98.7	0	349	64	0	11	0	2	2	0	12
2007–08	218	214	98.2	0	170	30	0	14	0	0	0	0	0
2008–09	384	382	99.5	0	299	38	0	42	0	3	0	0	0
2009–10	337	335	99.4	0	285	26	0	14	0	1	1	0	8
2010–11	323	320	99.1	0	240	52	1	21	0	4	0	2	0
2011–12	338	334	98.8	0	272	41	0	16	0	3	0	2	0
2012–13	233	233	100.0	0	180	18	0	23	0	1	0	0	11
2013–14	343	341	99.4	0	246	59	2	20	0	1	0	0	13
2014–15	304	304	100.0	0	234	40	2	26	0	2	0	0	0
2015–16	342	336	98.2	0	222	78	0	31	0	5	0	0	0
2016–17	379	375	98.9	0	247	75	1	26	0	6	0	0	20

Table B-7: Linking of set-net effort by fishing year.

Year	Events			CEL rule			NCE rule		
	Observed	Linked	% Linked	A	B	C	A	B	O
1998–99	1	1	100.0	0	1	0	0	0	0
1999–00	65	65	100.0	43	6	7	0	0	9
2000–01	24	23	95.8	22	1	0	0	0	0
2005–06	192	192	100.0	110	80	2	0	0	0
2006–07	303	301	99.3	0	6	0	219	56	0
2007–08	586	586	100.0	30	0	0	545	11	0
2008–09	1080	1077	99.7	112	9	29	771	156	0
2009–10	963	963	100.0	148	0	7	763	45	0
2010–11	475	463	97.5	11	10	15	396	31	0
2011–12	103	103	100.0	0	0	0	99	4	0
2012–13	870	866	99.5	8	1	0	808	49	0
2013–14	428	425	99.3	3	0	5	392	25	0
2014–15	608	608	100.0	0	0	8	561	39	0
2015–16	375	375	100.0	0	0	0	335	40	0
2016–17	472	472	100.0	0	0	0	429	43	0

Table B-8: Linking of purse-seine effort by fishing year.

Year	Events			CEL rule		
	Observed	Linked	% Linked	A	B	O
2004–05	51	50	98.0	50	0	0
2005–06	135	135	100.0	132	3	0
2006–07	126	126	100.0	126	0	0
2007–08	157	156	99.4	155	1	0
2008–09	160	160	100.0	150	3	7
2009–10	207	206	99.5	193	8	5
2010–11	224	222	99.1	219	3	0
2011–12	114	114	100.0	113	1	0
2012–13	112	112	100.0	107	1	4
2013–14	110	110	100.0	108	2	0
2014–15	111	111	100.0	110	1	0
2015–16	81	81	100.0	81	0	0
2016–17	90	90	100.0	90	0	0

APPENDIX C: CHANGES BETWEEN PSC DATABASE VERSIONS 2017V1 AND 2018V1

- Latest commit on 2018v1 (7 February, 2019): 2d58fa0ea4
- Latest commit on 2017v1 (29 January, 2018): 887f025363f

C.1 General changes

- Remove the snap-to-grid of the observer and catch effort points. All points were mapped to 0.05 degree for anonymisation. Require this aspect to be handled in any display of the data, rather than in the database.
- Export of database for Fisheries New Zealand includes a full download, and a Git checkout of all the code.
- Use ST_SnapToGrid PostGIS function for rounding the data.
- Change the way configuration is carried out (such as changing the end_fishing_year), to use an SQL function.
- Distance function updated to use spherical geometry, rather than transforming to New Zealand Transverse Mercator.
- Add a function for consistent standardisation of fishing method codes between thenCentralised Observer database (COD), Warehou, and the Protected Species Captures (PSC) database.
- Correct the name of the 'MINN' method to 'minor species set net'.
- Change description of update codes for improved display.
- Introduce function to recognise targets as the similar (currently only recognises OEO=BOE).
- A script is included for extracting data for loading into interactive event-level visualisation.
- Database build scripts are updated to reflect other changes (database version and Git branch are 2018v1)
- Add more indices to the database to improve query performance.
- Changes to data load scripts to reflect changes to source data (the load scripts do not transform the data).
- Export the West Coast North Island harbours imputation into the data provided to Fisheries New Zealand.
- Ensure a seed is set before any random number generation.

C.2 Observer data

- Remove special handling of Nomad trips (but still identify these trips through the use of codes 31 through 34, so that they can be tracked).
- Create table of vessel key updates, by trip, and ensure the updates are correct in the groomed Observer Trip Record (OTR; affects four observed trips).
- Create a table for tracking updates to observer effort.
- Vessel key in observer data is taken from COD x_trip, not from the OTR.
- Add changes in vessel key to the table that tracks changes to observer data (unless the vessel key change is an update based on NIWA vessel key de-duplication).
- Add a note field to the groomed mitigation code table.
- Manually correct the fishing method, for at least some effort on eight observer trips.
- Record change to Sea Lion Exclusion Device (SLED) use for trip 4198 (this change has been previously applied, following discussion with Fisheries New Zealand).
- Manually add missing observers (this addition is tracked through the MISSING_OBSERVERS update).
- Record random jitter of start point of observer data to make statistical area unique.
- Manually correct the start date of two stations on trip 4387.
- Manual delete single station with zero fishing effort (from trip 3517).
- Manually update fishery and target species from selected observed fishing with missing target species.

- Fill in missing areas in observer effort when all located events on the same trip and day are in a unique area, and the areas are otherwise missing.
- Improve collation of observer remarks, including comments from the COD fishing events tables (such as x_setnet_effort).
- Change the way trips with missing observer effort are handled, so it can be handled on a trip segment basis (affected records have a MISSING_EFORT update).
- Join observer events to vessel specifications, independently of linking via catch effort.
- Create a groomed.otr_trip table (and observer_trip_record view) that reflects correct vessel key, trip number, and other information (from x_trip), and use this groomed version throughout. The grooming also de-duplicates some trips.
- Some corrections to station numbers are still required (see the MANUAL_STATION_NUMBER update).
- Change test that all observer effort is accounted for to reflect other changes (groomed.observer_-effort has the same number of rows as cod x_fishing_event, apart from events that were added, and the single event that was deleted).
- Create a summary of observer effort on each trip, and test that sufficient fishing effort is observed on observed fishing days.
- Create a list of observer trips where there is no matching effort by statistical area, date, vessel, and method, and assess each trip manually.
- Reduce the number of out of sequence observer stations (where the date order and the station order do not match).
- Change the way that missing areas are filled in for observer effort data.
- Correct records on all observer trips that appear to be more than six months long..
- Correct the haul date and haul time for surface-longline data.
- Make changes to the grooming of locations of the COD data.

C.3 Fisher effort data

- Update missing gear codes for trawl fishing (specific vessels and fishing years in 2016–17, including fishing with Precision Seafood Harvest gear, see the MANUAL_GEAR update).
- Change the way missing catch effort is added to allow for partial missing trips.
- Add missing catch effort from observer data for some stations on around 25 trips.
- Generate trip number and event keys for the effort data that have been created.
- Avoid selecting null methods when imputing the primary method.
- Manual update of missing start date-times for three bottom-longline trips (catch effort) (see MANUAL_-START_DATETIME updates).
- Add yellow-eyed mullet to mullet set net fishing group (as was done in the marine mammal risk assessment).
- Add in imputation of position of net fishing effort in Statistical Areas 042, 043, 044, reported on CEL, using GPS derived pseudo-events from Trident Systems.
- Remove imputation of flatfish and mullet set-net data collected with position on NCE forms (apply this imputation to CEL only).
- Remove set-net effort that was targeting freshwater eel (`EEU',`LFE', or 'SFE').
- Generate a trip key and an event key for fisher effort that was generated from observer effort.

C.4 Captures

- Change to semantic hash used to identify unique captures (in case COD or WMIL (Wildlife Management International Limited) identification changes). This change affected 3976 captures, which meant they needed to be re-reviewed.
- Additional manual correction to one capture record (XWC capture).
- Remove special handling of Nomad trips (which required updating station numbers of some capture records).

- Set records created based on photograph identifications from WMIL to be deck captures, if there is no other information on the capture method.
- Update manual corrections to records of animals that are marked as both autopsied and alive.
- Change WARPLOST code to LOST, as some captures are not recovered on board but are not WARPLOST.
- Review remarks associated with all new captures, and with captures with a changed hash.
- Update bird identifications tables (ident.bird_2018) to include a processing date field.
- Remove importing of old WMIL files (from 2011) as these identification data are already in COD.
- Use bird identifications from WMIL from 2018-04-07 (to the end of September 2017).
- Remove special handling of necropsy record 104661.
- Update inconsistent capture method/fishing method on autopsy 101757 (e-mailed WMIL).
- Remove corrections needed to station numbers that were required in 2017 for captures expanded in COD.
- Replace quotation in species common names with ascii quotation.
- Add more information to species capture updates that are provided as upstream corrections to COD.
- Add COD identification to export of previous imputed species codes (used to ensure stability of the imputation between runs).
- The jittered start point, used on the PSC website for showing captures, is jittered from a snapped point (0.05 degrees).
- Build jittered points form observer data (not from fisher data on linked records).
- Re-run the species imputation.
- Set any species codes from COD that are empty strings or blanks to be null values.
- Check that all MJA (Manta ray) captures recorded as multiple captures by observers are expanded.
- Include information from Fisheries New Zealand review of all added captures, including a test to ensure they are all handled appropriately.
- Mark a bird capture (caught on mitigation, but then freed itself) as 'LOST'.
- Correct name of 'XBM' from `Buller's" to`Southern Buller's" albatross.

C.5 Linking between fisher and observer effort data

- Automatically link between created catch effort data and observer data (match code of FROM_-OBS).
- Remove assumption from BLL ACEL linking rule that first record has station number one.
- When zipping (BLL BCEL) require that there is more than one event on the day, and track the order of Warehou events within the day.
- Restrict bottom longline (BLL) BLCE and CCEL rules to BLL effort.
- Rewrite the BLL ALTC rule, so that the fishing must be on the same date.
- Rewrite the BLL BLTC rule.
- Stop allowing the BLL BLCE rule to be out by one hour (require within ten minutes on start or haul start times).
- Add in BLL CLTC and DLTC rules.
- Remove the BLL match Nomad rule.
- Allow marking of BLL events as unmatchable 'U' (where there is no more catch effort within a day of unmatched observations).
- Require that purse seine (PS) BCEL rules only match PS events.
- Remove assumption from set net (SN) ANCE linking rule that first record has station number one.
- Add a SN BCEL rule that catches remaining non-matched CELR records, if they fall within a day of the observer data.
- Add a SN NCE rule that catches remaining non-matched CELR records, if they fall within a day or the observer data.
- Remove the SN match Nomad rule.
- Allow marking of SN events as unmatchable 'U' (where there is no more catch effort within a day

of unmatched observations).
- Restrict matching of observed surface longline (SLL) events to fisher reported SLL events.
- Change the SLL D rule to be that the times are within 30 minutes (rather than times within ten minutes, and distance within 30 minutes).
- The SLL F rule only matches events within one day of each other.
- SLL rule M, which handles individual trips, is now only needed for one trip (1450).
- Update trawl rules to only match between trawl events.
- Remove the trawl E rule (which was matching few records).
- The trawl F rule is updated to only match up to one day.
- The trawl G and H rules are updated to only match within plus or minus 12 hours.
- Add a trawl I rule, when there are more than one unlinked events on a day, zip events per day when fisher and observer have the same number of unlinked events.
- The trawl K rule matches on targets (using the similar targets function that recognises BOE and OEO as equivalent).
- The trawl rule L is updated to take account of the day difference as well as the time differences (not all events have times).
- Change test that the observer and effort data are sufficiently linked (not including the observer events marked as U - unmatchable), to be by year and vessel class.
- Change pass to be over 96% linked, or fewer than five events and over 75% linked (for trawl, BLL, SLL).
- Manually correct some data to improve the linking, following review by Fisheries New Zealand staff.
- Re-run all the linking with new data and new rules.
- Use the matchcode ‘O’ for linking to fisher effort that was generated from observer effort.
- Change the set net ACEL so that the effort start date must lie on or between the observer start and end date.
- Change the set net ANCE rule so that it only matches on matching start dates.
- Linking of trawl effort update to include all possible trawl codes used in COD (`TWL',`BT’, `MW',`MPT’, `BPT',`PRB’, ‘PRM’).
- Manual date update to improve linking on one observer trip (3408).
- Make a function to display linking diagnostic information for observer trips.

APPENDIX D: CHANGES IN EFFORT BETWEEN DATABASE VERSIONS

Table D-9: Changes (Δ) in effort in the 2002–03 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	6 984			5 079	104	2.1
		Subantarctic	5 510			3 935	39	1.0
		East Coast South Island	1 681			274	13	5.0
		Stewart Snares Shelf	1 644			1 327	58	4.6
	Small vessels	Northland and Hauraki	11 342	-11	-0.1	0		
		Bay of Plenty	3 369	11	0.3	0		
		East Coast North Island	1 582	-15	-0.9	1		
		Chatham Rise	1 289	15	1.2	150	48	47.1
		West Coast North Island	1 143	-15	-1.3	0		
PS	All vessels	Northland and Hauraki	713			0		
		Bay of Plenty	383			0		
		West Coast North Island	121	3	2.5	0		
		Taranaki	117	-3	-2.5	0		
Surface longline	Large vessels	Fiordland	1 053			1 063		
		Kermadec Islands	460			460		
		East Coast North Island	288			310		
		Northland and Hauraki	186			186		
	Small vessels	East Coast North Island	4 592			0		
		Northland and Hauraki	1 925			0		
		West Coast North Island	1 081			0		
		Bay of Plenty	649			0		
		Kermadec Islands	133			0		
Set net	All vessels	West Coast North Island	7 828	128	1.7	0		
		Northland and Hauraki	7 801	-16	-0.2	0		
		East Coast South Island	5 310	-11	-0.2	0		
		Taranaki	2 558	-140	-5.2	0		
		Bay of Plenty	1 315	4	0.3	0		
		Cook Strait	1 313	31	2.4	0		
Trawl	Large vessels	Chatham Rise	9 593			1 208	16	1.3
		East Coast South Island	8 762			707	5	0.7
		West Coast South Island	8 307			1 008	3	0.3
		Stewart Snares Shelf	7 659			1 143	5	0.4
		Subantarctic	3 773			531	2	0.4
		Cook Strait	3 068			115		
		Taranaki	2 723			224		
		Fiordland	2 611			464	3	0.7
		Auckland Islands	2 575			636	2	0.3
		East Coast North Island	2 055			10		
		West Coast North Island	1 549			188	5	2.7
	Small vessels	East Coast South Island	19 859	56	0.3	51		
		East Coast North Island	11 204	5	0.0	99		
		Stewart Snares Shelf	9 434	-51	-0.5	1		
		Taranaki	8 083	-7	-0.1	0		
		West Coast South Island	7 493	27	0.4	0		
		Bay of Plenty	5 422	-10	-0.2	14		
		Cook Strait	4 847	28	0.6	20		
		Northland and Hauraki	4 591	17	0.4	8		
		West Coast North Island	3 136	-18	-0.6	21		

Table D-10: Changes (Δ) in effort in the 2003–04 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Subantarctic	8 336			2 273	36	1.6
		Chatham Rise	7 496			1 804		
		Stewart Snares Shelf	1 863			748	16	2.2
		Fiordland	1 370			46		
		East Coast South Island	1 142			0		
	Small vessels	Northland and Hauraki	10 870	5	0.0	162		
		Bay of Plenty	3 454	-6	-0.2	26		
		Chatham Rise	1 923	7	0.4	0		
		East Coast North Island	1 923	4	0.2	0		
		West Coast South Island	1 051	-4	-0.4	19		
		West Coast North Island	1 011	11	1.1	0		
PS	All vessels	Northland and Hauraki	593			0		
		Bay of Plenty	393			0		
		West Coast North Island	358	8	2.3	0		
		East Coast North Island	131			0		
		Taranaki	112	-8	-6.7	0		
Surface longline	Large vessels	Fiordland	1 126			1 123		
		West Coast South Island	270			267		
	Small vessels	East Coast North Island	3 093			92		
		Northland and Hauraki	1 335			10		
		West Coast North Island	608			7		
		West Coast South Island	423			6		
		Bay of Plenty	346			15		
Set net	All vessels	Northland and Hauraki	7 595	-2	-0.0	0		
		West Coast North Island	7 481	133	1.8	0		
		East Coast South Island	5 053	16	0.3	0		
		Taranaki	2 513	-142	-5.3	0		
		Cook Strait	1 146	2	0.2	0		
		Bay of Plenty	1 045	-5	-0.5	0		
Trawl	Large vessels	Chatham Rise	8 853			884	8	0.9
		Stewart Snares Shelf	7 699			1 232	5	0.4
		West Coast South Island	6 976			1 403	2	0.1
		East Coast South Island	5 986			495	2	0.4
		Auckland Islands	3 772			1 011	2	0.2
		Subantarctic	3 324			603	3	0.5
		Cook Strait	2 929			108		
		West Coast North Island	2 600			287	7	2.5
		Taranaki	1 775			66		
		East Coast North Island	1 239			0		
		Fiordland	1 014			100		
	Small vessels	East Coast South Island	16 693	-14	-0.1	51		
		East Coast North Island	9 549	-10	-0.1	0		
		Taranaki	8 909	32	0.4	0		
		Stewart Snares Shelf	8 753	35	0.4	0		
		West Coast South Island	8 337			0		
		Bay of Plenty	5 905	8	0.1	5		
		Northland and Hauraki	5 529	-11	-0.2	0		
		Cook Strait	5 160	-34	-0.7	23		
		West Coast North Island	3 478	-12	-0.3	0		

Table D-11: Changes (△) in effort in the 2004–05 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (△) and percentage change (△ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	8 788			873		
		Subantarctic	2 262			1 203		
		Stewart Snares Shelf	1 759			96		
		Fiordland	1 739			421		
	Small vessels	Northland and Hauraki	10 428	57	0.5	248	4	1.6
		Chatham Rise	4 143			0		
		Bay of Plenty	3 782	-43	-1.1	12	-11	-47.8
		East Coast North Island	2 199	8	0.4	15		
		West Coast South Island	1 229	28	2.3	0		
		East Coast South Island	1 145	-9	-0.8	11	2	22.2
PS	All vessels	Northland and Hauraki	555			32		
		Bay of Plenty	486			9		
		West Coast North Island	177	-11	-5.9	1		
		Taranaki	126	15	13.5	0		
Surface longline	Large vessels	Fiordland	433			433		
		East Coast North Island	138			138		
	Small vessels	East Coast North Island	1 340			90		
		Northland and Hauraki	617			12		
		Bay of Plenty	541	2	0.4	28		
		West Coast North Island	417			4		
Set net	All vessels	Northland and Hauraki	8 175	-2	-0.0	0		
		West Coast North Island	7 166	210	3.0	0		
		East Coast South Island	4 371	-2	-0.0	0		
		Taranaki	2 756	-248	-8.3	0		
		Cook Strait	1 226	40	3.4	0		
		Stewart Snares Shelf	1 094	14	1.3	0		
Trawl	Large vessels	Stewart Snares Shelf	8 449			1 870	9	0.5
		Chatham Rise	7 254			1 475	14	1.0
		West Coast South Island	5 239			1 251	3	0.2
		East Coast South Island	4 910			420		
		Auckland Islands	3 389			818		
		West Coast North Island	3 218			289		
		Subantarctic	2 848			768	6	0.8
		Cook Strait	2 544			96		
		Taranaki	2 075			349		
		East Coast North Island	1 556			48		
		Fiordland	1 215			154		
	Small vessels	East Coast South Island	17 750	47	0.3	0	-2	-100.0
		East Coast North Island	10 637	5	0.0	0		
		Stewart Snares Shelf	8 854	-35	-0.4	0		
		Taranaki	8 633	25	0.3	0		
		West Coast South Island	8 340	-2	-0.0	0		
		Northland and Hauraki	6 472	-2	-0.0	0		
		Bay of Plenty	6 299	3	0.0	51		
		Cook Strait	3 669	-46	-1.2	45	7	18.4
		West Coast North Island	2 579	-3	-0.1	0		
		Chatham Rise	2 014	4	0.2	30		

Table D-12: Changes (Δ) in effort in the 2005–06 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	6 860			1 636	-9	-0.5
		East Coast South Island	1 745			54		
		Subantarctic	1 365			0		
		Stewart Snares Shelf	1 030			967		
	Small vessels	Northland and Hauraki	10 552	34	0.3	116		
		Bay of Plenty	3 817	-37	-1.0	41		
		East Coast North Island	3 079	-8	-0.3	0		
		Chatham Rise	2 682	3	0.1	0		
		West Coast South Island	1 037	-10	-1.0	0		
PS	All vessels	Bay of Plenty	499			16		
		Northland and Hauraki	330			20		
		West Coast North Island	206	-4	-1.9	70	-4	-5.4
Surface longline	Large vessels	Fiordland	524			524		
	Small vessels	East Coast North Island	1 516			68		
		Northland and Hauraki	705			5		
		Bay of Plenty	502			4		
		West Coast North Island	154			1		
Set net	All vessels	Northland and Hauraki	7 033	-11	-0.2	0		
		West Coast North Island	6 614	186	2.9	0		
		East Coast South Island	4 044	-2	-0.0	14	2	16.7
		Taranaki	2 066	-217	-9.5	80	13	19.4
		Bay of Plenty	1 432	2	0.1	0		
Trawl	Large vessels	Stewart Snares Shelf	7 356			1 128	2	0.2
		Chatham Rise	6 714			844	2	0.2
		East Coast South Island	5 225			729	2	0.3
		West Coast South Island	4 941			1 230		
		Auckland Islands	2 928			556	3	0.5
		East Coast North Island	2 249			9		
		Taranaki	2 102			573	3	0.5
		Subantarctic	1 990			461	4	0.9
		West Coast North Island	1 909			256	12	4.9
		Cook Strait	1 527			13		
	Small vessels	East Coast South Island	15 024	-106	-0.7	0		
		East Coast North Island	10 934	-2	-0.0	14		
		West Coast South Island	8 550	13	0.2	13		
		Stewart Snares Shelf	8 308	54	0.7	0		
		Taranaki	7 204	17	0.2	5		
		Northland and Hauraki	6 441	20	0.3	5		
		Bay of Plenty	5 590	-20	-0.4	109		
		Cook Strait	3 369	59	1.8	52		
		Chatham Rise	2 121	4	0.2	97		
		West Coast North Island	2 058	-42	-2.0	23		

Table D-13: Changes (Δ) in effort in the 2006–07 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	5 032			0		
		Stewart Snares Shelf	1 448			155		
		East Coast South Island	1 395			179		
		Subantarctic	1 266			0		
		Cook Strait	1 126			552		
	Small vessels	Northland and Hauraki	9 884	-14	-0.1	108	5	4.9
		East Coast North Island	4 254	-17	-0.4	134	2	1.5
		Chatham Rise	3 819			189		
		Bay of Plenty	3 230	17	0.5	50	-3	-5.7
		East Coast South Island	2 117	-2	-0.1	0		
		West Coast South Island	1 254	-41	-3.2	0		
PS	All vessels	Northland and Hauraki	585			73		
		Bay of Plenty	338			20		
Surface longline	Large vessels	Fiordland	1 017			595		
		East Coast North Island	265			189		
	Small vessels	East Coast North Island	1 151			78		
		Northland and Hauraki	551			35		
		Bay of Plenty	311			33		
		West Coast North Island	194			18		
		Kermadec Islands	142			36		
Set net	All vessels	Northland and Hauraki	7 038	-8	-0.1	0		
		West Coast North Island	6 330	138	2.2	0		
		East Coast South Island	4 081	4	0.1	65		
		Taranaki	2 193	-162	-6.9	83	32	62.7
		Bay of Plenty	1 298	2	0.2	0		
		Stewart Snares Shelf	1 207	7	0.6	109	44	67.7
Trawl	Large vessels	Chatham Rise	6 356			1 224	9	0.7
		Stewart Snares Shelf	6 206			1 353	3	0.2
		East Coast South Island	4 690			497	4	0.8
		West Coast South Island	3 830			881	4	0.5
		East Coast North Island	2 987			26		
		Subantarctic	2 413			1 185	15	1.3
		Taranaki	2 120			591	14	2.4
		Auckland Islands	1 982			603	6	1.0
		West Coast North Island	1 734			409	17	4.3
		Cook Strait	1 610			175		
	Small vessels	East Coast South Island	12 625	7	0.1	41	15	57.7
		East Coast North Island	10 087	9	0.1	29		
		West Coast South Island	9 265	-20	-0.2	71	10	16.4
		Stewart Snares Shelf	8 818			0		
		Taranaki	8 337	21	0.3	3		
		Northland and Hauraki	6 152	-10	-0.2	98		
		Bay of Plenty	4 210	6	0.1	133		
		Cook Strait	2 939	-27	-0.9	53		
		Chatham Rise	2 594			152		
		West Coast North Island	2 212	13	0.6	66		

Table D-14: Changes (Δ) in effort in the 2007–08 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	4 197	-4	-0.1	1 006	-31	-3.0
		Subantarctic	3 595			1 382		
		East Coast South Island	1 416			350		
		Stewart Snares Shelf	1 204			108		
	Small vessels	Northland and Hauraki	8 913	7	0.1	107		
		East Coast North Island	5 835	-3	-0.1	18		
		Chatham Rise	4 671	-8	-0.2	387	6	1.6
		Bay of Plenty	3 247	-9	-0.3	20		
		East Coast South Island	1 832	-3	-0.2	64	3	4.9
		West Coast South Island	1 549			0		
		West Coast North Island	1 063			0		
PS	All vessels	Bay of Plenty	614	3	0.5	82		
		Northland and Hauraki	411	-3	-0.7	45		
		West Coast North Island	120	-2	-1.6	15	-2	-11.8
Surface longline	Large vessels	Fiordland	568			285		
	Small vessels	East Coast North Island	608			50		
		Northland and Hauraki	531			50		
		Bay of Plenty	285			16		
		West Coast North Island	141			12		
Set net	All vessels	West Coast North Island	5 733	170	3.1	11	3	37.5
		Northland and Hauraki	4 880	-12	-0.2	0		
		East Coast South Island	3 411			118	3	2.6
		Taranaki	2 586	-203	-7.3	102	52	104.0
		Stewart Snares Shelf	1 531	-2	-0.1	109		
		Bay of Plenty	1 058			0		
Trawl	Large vessels	Chatham Rise	6 429			1 655	6	0.4
		Stewart Snares Shelf	4 928			1 542	6	0.4
		East Coast South Island	4 408	-3	-0.1	705		
		West Coast South Island	3 143			916		
		Subantarctic	2 634			1 319	3	0.2
		East Coast North Island	2 234			112		
		West Coast North Island	2 222			320		
		Taranaki	2 220			583		
		Auckland Islands	1 891			657	2	0.3
		Cook Strait	1 304			107		
	Small vessels	East Coast North Island	9 608			101		
		East Coast South Island	9 055	-6	-0.1	16		
		West Coast South Island	7 587			42	5	13.5
		Stewart Snares Shelf	7 563	5	0.1	0		
		Taranaki	6 697	3	0.0	12		
		Northland and Hauraki	4 586			23		
		Bay of Plenty	4 302			162		
		Cook Strait	2 377	-3	-0.1	106	3	2.9
		West Coast North Island	2 098			17	2	13.3
		Chatham Rise	1 940			181	3	1.7

Table D-15: Changes (△) in effort in the 2008–09 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (△) and percentage change (△ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	5 113			1 826	5	0.3
		Subantarctic	2 963	-8	-0.3	1 371		
		Stewart Snares Shelf	1 323			0		
		East Coast South Island	1 275			0		
	Small vessels	Northland and Hauraki	9 032	-2	-0.0	300	20	7.1
		East Coast North Island	5 274			0		
		Chatham Rise	2 742	4	0.1	304		
		Bay of Plenty	2 456	3	0.1	43	6	16.2
		East Coast South Island	1 992			222	-5	-2.2
		West Coast South Island	1 488			0		
		West Coast North Island	1 054			18	5	38.5
PS	All vessels	Bay of Plenty	445			60		
		Northland and Hauraki	312			43		
Surface longline	Large vessels	Fiordland	722			699		
	Small vessels	East Coast North Island	783			24		
		Northland and Hauraki	672			41		
		Bay of Plenty	372			39		
		West Coast North Island	293			41		
		West Coast South Island	159			6		
Set net	All vessels	West Coast North Island	5 925	132	2.3	24	-3	-11.1
		Northland and Hauraki	4 851	-6	-0.1	0		
		East Coast South Island	2 777			236	-29	-10.9
		Taranaki	2 739	-156	-5.4	26		
		Stewart Snares Shelf	1 132			115	-18	-13.5
		Bay of Plenty	1 063	-2	-0.2	0		
		Cook Strait	1 014	31	3.2	14		
Trawl	Large vessels	Chatham Rise	4 957			1 362	2	0.1
		East Coast South Island	4 237	3	0.1	759		
		Stewart Snares Shelf	4 201	-2	-0.0	1 281		
		Subantarctic	2 893			925	4	0.4
		West Coast South Island	2 658			866	4	0.5
		East Coast North Island	2 557			66		
		Auckland Islands	2 450			884	2	0.2
		West Coast North Island	2 013			316	2	0.6
		Taranaki	1 808			586		
		Cook Strait	1 441			141	5	3.7
	Small vessels	East Coast South Island	10 396	-9	-0.1	655	-80	-10.9
		East Coast North Island	9 129			39		
		West Coast South Island	7 378	-3	-0.0	401	-25	-5.9
		Taranaki	7 211			162	-4	-2.4
		Stewart Snares Shelf	6 864	11	0.2	405	-28	-6.5
		Northland and Hauraki	5 010			218	-81	-27.1
		Bay of Plenty	4 587			124	-13	-9.5
		Cook Strait	2 806	-2	-0.1	37		
		West Coast North Island	1 796			112	-6	-5.1
		Chatham Rise	1 201			204		
		Auckland Islands	1 053			0		

Table D-16: Changes (△) in effort in the 2009–10 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (△) and percentage change (△ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	5 712	5	0.1	0		
		Subantarctic	2 576			836		
		East Coast South Island	2 176			0		
	Small vessels	Northland and Hauraki	10 227	5	0.0	610	-185	-23.3
		East Coast North Island	5 686			0	-19	-100.0
		Bay of Plenty	3 399			91	-41	-31.1
		Chatham Rise	3 269			0		
		East Coast South Island	1 493			0		
		West Coast South Island	1 466			0		
		West Coast North Island	1 084			23	6	35.3
PS	All vessels	Bay of Plenty	618	2	0.3	117		
		Northland and Hauraki	358	3	0.8	60		
Surface longline	Large vessels	Fiordland	479			479		
	Small vessels	East Coast North Island	1 105			64	-11	-14.7
		Northland and Hauraki	595			51		
		Bay of Plenty	398			29		
		West Coast South Island	206			20		
		West Coast North Island	174			20		
Set net	All vessels	Northland and Hauraki	5 926	-15	-0.3	5		
		West Coast North Island	5 531	97	1.8	0		
		East Coast South Island	3 476			311	-68	-17.9
		Taranaki	2 624	-110	-4.0	0		
		Bay of Plenty	1 366	4	0.3	0		
		Stewart Snares Shelf	1 172			108	-176	-62.0
Trawl	Large vessels	Chatham Rise	5 030			1 358	3	0.2
		Stewart Snares Shelf	4 726			1 763	7	0.4
		East Coast South Island	4 372			748	3	0.4
		East Coast North Island	3 021			148		
		Subantarctic	2 845			983	2	0.2
		West Coast South Island	2 701			943	5	0.5
		Taranaki	1 983			581	3	0.5
		Auckland Islands	1 636			447		
		West Coast North Island	1 276			224		
		Cook Strait	1 208			280		
	Small vessels	East Coast South Island	11 546	13	0.1	415	-251	-37.7
		East Coast North Island	10 076			27		
		Taranaki	8 179	2	0.0	4		
		West Coast South Island	8 112			282	-245	-46.5
		Stewart Snares Shelf	7 707	-12	-0.2	212	-4	-1.9
		Bay of Plenty	5 020			148	2	1.4
		Northland and Hauraki	4 919			58		
		Cook Strait	3 592	-2	-0.1	87	-3	-3.3
		West Coast North Island	2 304			0		
		Chatham Rise	1 115			106		

Table D-17: Changes (△) in effort in the 2010–11 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (△) and percentage change (△ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	4 496	-4	-0.1	533		
		East Coast South Island	2 984			194	4	2.1
		Subantarctic	2 161			581		
	Small vessels	Northland and Hauraki	10 653	-4	-0.0	0		
		East Coast North Island	5 239			202	68	50.7
		Chatham Rise	3 660	4	0.1	0		
		Bay of Plenty	3 544			33	3	10.0
		West Coast South Island	1 499			8		
		East Coast South Island	1 488			44		
		West Coast North Island	1 359	-3	-0.2	0		
PS	All vessels	Bay of Plenty	667			75		
		Northland and Hauraki	458			87		
		Taranaki	152	-8	-5.0	17	-3	-15.0
		West Coast North Island	152	11	7.8	21	3	16.7
Surface longline	Large vessels	Fiordland	497			497		
	Small vessels	Northland and Hauraki	1 003			51		
		East Coast North Island	925			60		
		Bay of Plenty	355			30		
		West Coast North Island	200			25		
		West Coast South Island	169			5		
Set net	All vessels	Northland and Hauraki	5 684	-6	-0.1	0		
		West Coast North Island	5 515	64	1.2	0		
		East Coast South Island	4 145			166	-22	-11.7
		Taranaki	2 523	-112	-4.3	0		
		Stewart Snares Shelf	1 219	-4	-0.3	0		
Trawl	Large vessels	East Coast South Island	4 507			843		
		Stewart Snares Shelf	4 315			1 328	4	0.3
		Chatham Rise	3 734	-2	-0.1	602		
		West Coast South Island	3 546			810	7	0.9
		Subantarctic	2 357	-2	-0.1	868	3	0.3
		East Coast North Island	2 338			311	3	1.0
		Auckland Islands	2 257			691	6	0.9
		Taranaki	1 254			352		
		West Coast North Island	1 128			179	2	1.1
		Cook Strait	1 090			34		
	Small vessels	East Coast South Island	10 543	-4	-0.0	0		
		East Coast North Island	10 240			432	-91	-17.4
		Taranaki	6 764	-5	-0.1	244	-4	-1.6
		West Coast South Island	6 726			4		
		Stewart Snares Shelf	6 437	2	0.0	7		
		Bay of Plenty	4 789			271	-38	-12.3
		Northland and Hauraki	4 669			6		
		Cook Strait	3 657	5	0.1	58		
		West Coast North Island	2 527			0		
		Chatham Rise	1 122			100		

Table D-18: Changes (Δ) in effort in the 2011–12 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	4 088	-5	-0.1	0		
		Subantarctic	3 558			1 407		
		Stewart Snares Shelf	1 418			18		
	Small vessels	Northland and Hauraki	9 743	-3	-0.0	0		
		Chatham Rise	4 270	-11	-0.3	0		
		East Coast North Island	3 848			0		
		Bay of Plenty	3 329	-3	-0.1	0		
		East Coast South Island	1 933			0		
		West Coast South Island	1 498			39		
		West Coast North Island	1 021			0		
PS	All vessels	Bay of Plenty	475			34		
		Northland and Hauraki	333			29		
		West Coast North Island	197	-12	-5.7	12		
Surface longline	Large vessels	Fiordland	527			530		
	Small vessels	Northland and Hauraki	657			47		
		West Coast South Island	566			52		
		East Coast North Island	556			47		
		Bay of Plenty	473			9		
		West Coast North Island	267			12		
Set net	All vessels	Northland and Hauraki	5 020	-7	-0.1	0		
		West Coast North Island	4 905	141	3.0	2		
		East Coast South Island	3 539			0		
		Taranaki	2 354	-182	-7.2	65	-11	-14.5
		Stewart Snares Shelf	1 156			0		
		Cook Strait	1 031	46	4.7	0		
Trawl	Large vessels	Chatham Rise	4 466	2	0.0	1 053	2	0.2
		Stewart Snares Shelf	4 440			1 653		
		West Coast South Island	3 702			1 477	-6	-0.4
		East Coast South Island	3 493	-2	-0.1	704		
		Auckland Islands	1 807			651	2	0.3
		Subantarctic	1 622	2	0.1	891	2	0.2
		Taranaki	1 504			1 118	2	0.2
		Cook Strait	1 332			121		
		West Coast North Island	1 168			375		
		East Coast North Island	1 094			93		
	Small vessels	East Coast South Island	10 429	-12	-0.1	102	8	8.5
		East Coast North Island	9 292			178		
		Stewart Snares Shelf	7 408	12	0.2	244	26	11.9
		West Coast South Island	7 192			101		
		Taranaki	6 584	3	0.0	0		
		Bay of Plenty	4 456			78		
		Northland and Hauraki	4 123			47		
		Cook Strait	3 781	-4	-0.1	74		
		West Coast North Island	2 881			0		
		Chatham Rise	1 659			100		

Table D-19: Changes (Δ) in effort in the 2012–13 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	3 387	10	0.3	225	-2	-0.9
		Stewart Snares Shelf	1 249			0		
	Small vessels	Northland and Hauraki	9 364	-2	-0.0	113	-42	-27.1
		Chatham Rise	5 479	-6	-0.1	0		
		Bay of Plenty	2 994	6	0.2	266	8	3.1
		East Coast North Island	2 656			0		
		East Coast South Island	2 265	-3	-0.1	0		
		West Coast South Island	1 348			0	-6	-100.0
PS	All vessels	Bay of Plenty	554			12		
		Northland and Hauraki	346	2	0.6	29		
		West Coast North Island	126	-2	-1.6	44		
Surface longline	Large vessels	Fiordland	450			450		
	Small vessels	East Coast North Island	652			6		
		Northland and Hauraki	599			26		
		West Coast South Island	481			2		
		Bay of Plenty	446			28		
		West Coast North Island	188			11		
Set net	All vessels	Northland and Hauraki	5 936	-4	-0.1	0		
		West Coast North Island	5 471	109	2.0	10	-3	-23.1
		East Coast South Island	3 699	2	0.1	117	-7	-5.6
		Taranaki	2 222	-157	-6.6	598	-34	-5.4
		Stewart Snares Shelf	1 316			0		
		Cook Strait	1 107	50	4.7	0		
Trawl	Large vessels	Stewart Snares Shelf	4 362			3 044		
		Chatham Rise	3 815			966		
		East Coast South Island	3 777			1 461	6	0.4
		West Coast South Island	3 749	10	0.3	2 547	12	0.5
		Cook Strait	1 653			153		
		Taranaki	1 495			1 225	4	0.3
		West Coast North Island	1 328	2	0.2	321	7	2.2
		Auckland Islands	1 156			911		
		Subantarctic	1 056			920		
	Small vessels	East Coast South Island	11 627			188	-4	-2.1
		East Coast North Island	9 088			16		
		Stewart Snares Shelf	7 267	-2	-0.0	0		
		West Coast South Island	6 818			58		
		Taranaki	6 246	-4	-0.1	4		
		Cook Strait	4 461	4	0.1	48		
		Northland and Hauraki	4 268			6		
		Bay of Plenty	4 000			7		
		West Coast North Island	3 115			0		
		Chatham Rise	1 699			118		
		Auckland Islands	1 024			136		

Table D-20: Changes (△) in effort in the 2013–14 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (△) and percentage change (△ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	5 282	-16	-0.3	304	-6	-1.9
		Subantarctic	4 574			1 040		
		Stewart Snares Shelf	1 082			22		
	Small vessels	Northland and Hauraki	9 811			532	-17	-3.1
		Chatham Rise	6 921	13	0.2	321	5	1.6
		Bay of Plenty	3 479	-2	-0.1	266	-104	-28.1
		East Coast North Island	2 567			0		
		East Coast South Island	1 984			293	7	2.4
		West Coast South Island	1 944			0		
PS	All vessels	Bay of Plenty	667			56		
		Northland and Hauraki	344			34		
		West Coast South Island	219			13		
		Taranaki	126			4		
Surface longline	Large vessels	Fiordland	653			653		
	Small vessels	East Coast North Island	541			20		
		West Coast South Island	454			44		
		Northland and Hauraki	440			32		
		Bay of Plenty	309			27		
		West Coast North Island	135			6		
Set net	All vessels	West Coast North Island	5 611	115	2.1	4	-2	-33.3
		Northland and Hauraki	5 038			0	-3	-100.0
		East Coast South Island	3 240			80	-2	-2.4
		Taranaki	2 348	-148	-5.9	247	-52	-17.4
		Stewart Snares Shelf	1 580	-2	-0.1	0		
		Bay of Plenty	1 227			0		
		Cook Strait	1 050	36	3.6	0		
Trawl	Large vessels	West Coast South Island	4 424	-3	-0.1	2 434	3	0.1
		Stewart Snares Shelf	4 082	2	0.0	2 476	14	0.6
		Chatham Rise	4 058	-4	-0.1	1 032	-4	-0.4
		East Coast South Island	4 011	2	0.0	1 401	5	0.4
		Cook Strait	1 897			231		
		Taranaki	1 778			1 433	3	0.2
		East Coast North Island	1 240			0		
		West Coast North Island	1 196			376	5	1.3
		Subantarctic	1 123			974	8	0.8
	Small vessels	East Coast South Island	11 687	-2	-0.0	48	-22	-31.4
		East Coast North Island	9 890			149		
		West Coast South Island	7 237			112	-4	-3.4
		Stewart Snares Shelf	7 217	3	0.0	0		
		Taranaki	5 490			22	2	10.0
		Northland and Hauraki	4 206			605	3	0.5
		Bay of Plenty	4 101			621		
		Cook Strait	3 404			0		
		West Coast North Island	2 688			256		
		Chatham Rise	2 356			92		

Table D-21: Changes (△) in effort in the 2014–15 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (△) and percentage change (△ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	△	△ (%)	Effort	△	△ (%)
Bottom longline	Large vessels	Chatham Rise	4 844	13	0.3	351	-6	-1.7
		Subantarctic	3 570			0		
		Stewart Snares Shelf	1 087			0		
	Small vessels	Northland and Hauraki	9 764			8		
		Chatham Rise	5 924	16	0.3	205	76	58.9
		Bay of Plenty	3 775			19		
		East Coast North Island	3 070			8		
		West Coast South Island	1 923	2	0.1	89	-4	-4.3
		East Coast South Island	1 343	4	0.3	0		
		West Coast North Island	1 099	-3	-0.3	17		
PS	All vessels	Bay of Plenty	623			29		
		Northland and Hauraki	462			47		
		West Coast North Island	103			25		
Surface longline	Large vessels	Fiordland	429			429		
		West Coast South Island	193			189		
	Small vessels	West Coast South Island	497			22		
		Bay of Plenty	484			26		
		East Coast North Island	410			36		
		Northland and Hauraki	225			18		
		West Coast North Island	162			3		
Set net	All vessels	West Coast North Island	4 966	77	1.6	9		
		Northland and Hauraki	4 339	-6	-0.1	0		
		East Coast South Island	3 458			20	-77	-79.4
		Taranaki	2 340	-121	-4.9	233	-10	-4.1
		Stewart Snares Shelf	1 446	6	0.4	254	-10	-3.8
Trawl	Large vessels	West Coast South Island	5 562	28	0.5	2 958	3	0.1
		Chatham Rise	4 506			1 036	39	3.9
		Stewart Snares Shelf	4 053			2 412	4	0.2
		East Coast South Island	3 854			872		
		Cook Strait	1 651			401		
		Taranaki	1 363			1 134	-21	-1.8
		West Coast North Island	1 267			647	-135	-17.3
		East Coast North Island	1 074			262		
	Small vessels	East Coast South Island	9 367			5		
		East Coast North Island	8 747			101		
		West Coast South Island	6 971	2	0.0	0		
		Stewart Snares Shelf	5 954	-2	-0.0	0		
		Taranaki	5 162	7	0.1	1		
		Northland and Hauraki	4 157			638	-10	-1.5
		Bay of Plenty	3 512			678	-30	-4.2
		Cook Strait	3 091	-6	-0.2	4		
		West Coast North Island	2 945	-11	-0.4	537	-87	-13.9
		Chatham Rise	2 386			337		

Table D-22: Changes (Δ) in effort in the 2015–16 fishing year between the previous and current version of the Protected Species Capture (PSC) database, showing the fisher-reported and observed effort (1000 hooks for longline methods; km net for set net; number of tows for trawl; number of sets for purse seine) in the current version, and changes resulting from updates, presented as number (Δ) and percentage change (Δ %). Changes of are only shown if they were more than 1 effort unit. Data are only shown for method, vessel size, and area groups with an annual average of more than 100 sets (purse seine), 100 000 hooks (surface longline), 1000 km (set net), 1 000 000 hooks (bottom longline) or 1000 tows (trawl). Cut-off lengths for small and large vessels were 28 m for trawl, 34 m for bottom longline, and 45 m for surface longline.

Method	Vessel size	Area	Fisher reported effort			Observed effort		
			Effort	Δ	Δ (%)	Effort	Δ	Δ (%)
Bottom longline	Large vessels	Chatham Rise	8 186	-2	-0.0	1 949	6	0.3
		Subantarctic	4 295			0		
		East Coast South Island	1 106			67		
	Small vessels	Northland and Hauraki	9 194	-7	-0.1	209	-375	-64.2
		Chatham Rise	6 205			0		
		Bay of Plenty	3 363	-3	-0.1	142	-111	-43.9
		East Coast North Island	2 932	12	0.4	44		
		West Coast South Island	1 911			54		
		East Coast South Island	1 512	-4	-0.3	0	-4	-100.0
		Taranaki	1 212			121	-13	-9.7
		West Coast North Island	1 203	2	0.2	21	-5	-19.2
PS	All vessels	Bay of Plenty	439			33		
		Northland and Hauraki	259			12		
		West Coast North Island	207			36		
Surface longline	Small vessels	West Coast South Island	701	-2	-0.3	127		
		East Coast North Island	582			104		
		Bay of Plenty	542			42		
		Northland and Hauraki	311			34		
		West Coast North Island	200			5		
Set net	All vessels	East Coast South Island	4 076	-3	-0.1	115	-2	-1.7
		West Coast North Island	4 016	42	1.1	2	-7	-77.8
		Northland and Hauraki	3 947			0		
		Taranaki	2 216	-99	-4.3	155	-2	-1.3
		Stewart Snares Shelf	1 247	4	0.3	175	-40	-18.6
Trawl	Large vessels	West Coast South Island	5 163			2 479	9	0.4
		Chatham Rise	4 945			1 608	-45	-2.7
		East Coast South Island	3 832			993	-2	-0.2
		Stewart Snares Shelf	3 088			2 014	8	0.4
		Auckland Islands	1 559			1 297		
		West Coast North Island	1 419			631	-501	-44.3
		Cook Strait	1 327			51		
		East Coast North Island	1 068			91	-59	-39.3
		Taranaki	1 051			845	-79	-8.5
	Small vessels	East Coast South Island	9 078	-2	-0.0	107	-99	-48.1
		East Coast North Island	8 202	-2	-0.0	27		
		West Coast South Island	7 455			77	7	10.0
		Stewart Snares Shelf	6 504	-5	-0.1	15		
		Taranaki	5 191	-3	-0.1	4		
		Northland and Hauraki	4 212			475	17	3.7
		Cook Strait	3 331	3	0.1	108	2	1.9
		Bay of Plenty	3 160	3	0.1	394	65	19.8
		West Coast North Island	2 559			953	-257	-21.2
		Chatham Rise	1 805			0		
		Auckland Islands	1 362			66		