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Fish bycatch in New Zealand tuna longline fisheries 2018–19 to 2020–21

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PLAIN LANGUAGE SUMMARY

This report summarises the catch in the New Zealand tuna surface longline (SLL) fishery during the 2018–19 to 2020−21 fishing years, and focuses on the main non-target fish and sharks species caught. Nonfish bycatch such as seabirds and mammals were not included in this study.

Between 2018–19 and 2020–21, there were 34 396 fish and invertebrates from at least 60 species in the observed captures. Many species were rarely recorded by observers. Only 38 species (or species groups) exceeded 100 observations between 1988–89 and 2020–21. The highest number of fish observed were blue shark, making up 45% of observed specimens. The next two most abundant species were southern bluefin tuna and lancetfish. Other important non-target species were Ray's bream, porbeagle shark, pelagic stingray, sunfish, moonfish, and mako shark, followed by oilfish, yellowfin tuna, escolar, striped marlin, butterfly tuna, Pacific bluefin tuna, and thresher shark.

Most of the tuna species and swordfish were retained. All striped marlin were returned to the sea (as required). Two other quota species, moonfish and Ray's bream were mostly kept, while retaining or discarding of non quota species was more variable. A shark finning ban was introduced in 2014–15; since then, most sharks have not been landed.

EXECUTIVE SUMMARY

Griggs, L.H.[1]; Datta, S.; Finucci, B. (2024). Fish bycatch in New Zealand tuna longline fisheries 2018–19 to 2020–21.

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Observer Programme data were used to assess the species composition of the New Zealand tuna longline fisheries and to estimate the catch per unit effort (CPUE) and the number of fish caught by observed vessels during the 2018–19 to 2020−21 fishing years. During the 2018–19 to 2020−21 fishing years the New Zealand Domestic fleet was the only fleet fishing by surface longline (SLL) in New Zealand waters, but Foreign and Charter fleets are included in the historical time series. For the main non-target species, observer data were used to estimate the proportions of fish that were alive and dead at recovery, and the proportions that were retained and discarded.

Hooks set by the Domestic vessels declined between 2018–19 and 2020−21, following the trend observed since 2011–12, and reached a historical low of 1.6 million hooks in 2020−21. Observer coverage on Domestic vessels ranged between 9.1% and 11.2% of hooks. Observer coverage represented the spatial and temporal distribution of the fishery well during 2018–19 to 2020–21. Fishing effort and observed catches were stratified by region (North and South) to estimate CPUE and numbers caught, and these were added to the time series, which starts in the 1988–89 fishing year. For most species there were large differences in CPUE between fleets and between regions. Although observer coverage of Domestic vessels was higher than many previous years, coverage between 2018–19 and 2020–21 was insufficient to reliably determine recent trends in CPUE.

Between 2018–19 and 2020–21, 34 396 fish and invertebrates from at least 60 species were observed captured. Most species were rarely observed, with only 38 species (or species groups) exceeding 100 observations between 1988–89 and 2020–21. Between 2018–19 and 2020–21 blue shark was the most abundant species in the observed catches, making up 45% of observed specimens. The next two most abundant species were southern bluefin tuna and lancetfish, although this varied from year to year, with albacore in the top three in 2020–21. Other important non-target species were Ray's bream, porbeagle shark, pelagic stingray, sunfish, moonfish, and mako shark, followed by oilfish, yellowfin tuna, escolar, striped marlin, butterfly tuna, Pacific bluefin tuna, and thresher shark. The first longline capture of a manta ray, a protected species in New Zealand, was recorded in 2020–21. Catches of deepwater dogfish, dealfish, bigscale pomfret, and school shark were much lower between 1988–89 and 2020–21 than previously observed.

Reported catches between 2018–19 and 2020–21 remained high for blue sharks, whereas mako and porbeagle catches decreased. Over the same period, southern bluefin tuna catches have been steady, yellowfin tuna catches increased after being very low for about a decade and have remained steady, albacore, and Ray's bream, bigscale pomfret, school shark, and deepwater dogfish catches remained low.

A shark finning ban was introduced in 2014–15; since then, most sharks have not been landed. Most blue and mako sharks, and all porbeagle sharks were released/discarded during 2018–19 to 2020–21. Some school sharks were retained for their flesh, and the few deepwater dogfish caught were discarded. Between 2018–19 and 2020–21, most sharks were alive when landed or brought to the vessel, with the highest percentage alive for blue sharks and lowest for porbeagle sharks.

Most albacore, southern bluefin tuna, bigeye tuna, yellowfin tuna, and swordfish were retained. Numbers of butterfly tuna were lower than seen previously and of those nearly two thirds were

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discarded. All 97 striped marlin that were observed were returned to the sea. Most moonfish and Ray's bream were retained. Trends in retaining or discarding the non-quota fish bycatch species were variable. Between 2018–19 to 2020–21, over half of landed escolar and oilfish were retained. Lancetfish, sunfish, and dealfish were discarded. Most of the albacore, swordfish, butterfly tuna, and lancetfish were landed dead, but most southern bluefin tuna, bigeye tuna, yellowfin tuna, striped marlin, Ray's bream, moonfish, escolar, oilfish, rudderfish, and almost all sunfish were brought to the vessel alive.

1. INTRODUCTION

The New Zealand tuna longline fishery comprises about 40 New Zealand flagged vessels targeting bigeye tuna (*Thunnus obesus*), southern bluefin tuna (*Thunnus maccoyii*), and swordfish (*Xiphias gladius*), and, until 2015–16, a small Foreign Charter fleet (4 vessels) targeting southern bluefin tuna. Fisheries New Zealand (a business unit with the Ministry for Primary Industries, MPI) is responsible for managing all New Zealand fisheries, including target and non-target fish species. To fulfil this responsibility, it is necessary to obtain regular estimates of the catch and catch rates of non-target fish species taken as bycatch during normal fishing operations. Estimates of target and non-target discard quantities are also required. These quantities provide an estimate of the level of removals from the population.

Many of the fish bycatch species taken in longline fisheries are highly migratory species which are managed under Regional Fisheries Management Organisations (RFMOs). New Zealand has an obligation to provide estimates of the numbers of non-target fish species taken in the tuna longline fishery as part of its contribution to the Ecologically Related Species (ERS) Working Group under the Convention for the Conservation of Southern Bluefin Tuna (CCSBT), and to the Western and Central Pacific Fisheries Commission (WCPFC).

New Zealand developed a National Plan of Action (NPOA) on sharks, as part of the Food and Agriculture Organisation of the United Nations (FAO) initiated International Plan of Action for the Conservation and Management of Sharks (IPOA–Sharks), to improve the assessment and management of shark fisheries worldwide. New Zealand's NPOA-Sharks was approved in 2008 (Anon. 2008), reviewed and revised in 2013 (Ministry for Primary Industries 2013). A revised NPOA was drafted in 2022 (Fisheries New Zealand & Department of Conservation 2022). Information on the shark bycatch from New Zealand tuna longline fisheries provides crucial, ongoing input into management measures, including risk assessments and bycatch monitoring.

Tuna longline fishing is often considered a highly specific, environmentally sound fishing technique compared with other methods (e.g., trawling and pelagic driftnet fishing). However, for some target species, regions, and seasons, bycatch levels can be high (Griggs et al. 2021). In the New Zealand Exclusive Economic Zone (EEZ) and adjacent waters more than 100 non-target fish species have been recorded by scientific observers in the target bigeye tuna, southern bluefin tuna, and swordfish fisheries. Many species were rarely observed, with only 37 species (or species groups) exceeding 100 observations between 1988–89 and 2017–18 (Griggs et al. 2021). The most commonly observed species from 1988–89 to 2017–18 were blue shark (*Prionace glauca*), Ray's bream (*Brama* spp.), and albacore tuna (*Thunnus alalunga*), with these three species making up nearly 70% of the catch by numbers. Most of these fish bycatch species are highly migratory and many of those commonly caught in New Zealand waters are also reported in Australian catches (Stobutzki et al. 2006), in the Western and Central Pacific Ocean (WCPO), and beyond (Bailey et al. 1996, Clarke et al. 2014, SPC-OFP 2010). Catch data for these species are often limited due to a number of factors including low observer coverage, difficulties of species identification, low commercial value, under-reporting, and frequent discarding. In many years, less than 10% of the annual Domestic tuna longline fishing effort in the New Zealand fishery was observed, and this is the only independent source of information on the scale of bycatch and discarding in the fishery.

Billfish species are commonly caught in longline fisheries targeting tunas. The species caught in tuna longline fisheries vary with region and fishery. Swordfish are the most commonly reported billfish species in the western tropical Pacific tuna longline fishery (Peatman & Nicol 2020). In New Zealand, swordfish are targeted, striped marlin (*Kajikia audax*) are occasionally taken as bycatch, and other marlins are rarely caught (Griggs et al. 2021). Swordfish are the only billfish that can be retained, and this species is managed under the Quota Management System (QMS). Within the EEZ, commercial fishers are obliged by regulation to release all other billfish whether the fish is alive or dead upon capture. This regulation includes a provision that live billfish should be tagged if possible, and tagged

marlin recaptured by commercial fishers can be landed and brought to port for scientific study (Holdsworth & Saul 2017).

Pelagic bycatch taken by tuna longlines in in New Zealand waters has been the focus of several previous reports that reported to Fisheries New Zealand and its predecessors (Francis et al. 1999, 2000, 2001, 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018, Griggs et al. 2021). The collection by observers of information on longline catches, and species-, size- and sex-composition of the catches has enabled the calculation of a series of stock status indicators for blue, porbeagle (*Lamna nasus*), and mako sharks (*Isurus oxyrinchus*) (Clarke et al. 2013, Francis et al. 2014, Francis & Large 2017, Francis & Finucci 2019), providing insight into their response to fishing pressure. However, the collection of some of these data appears to have been reduced since the implementation of management actions (e.g., shark finning ban in 2014). This encouraged sharks to be released at sea, rather than hauled on-board, making it difficult to record biological measurements (Francis & Finucci 2019).

The present study updates previous analyses for three more years which extends the time series to 33 years. This report addresses the following objective of Fisheries New Zealand project HMS2019-01: To estimate the catches, catch rates, and discards of non-target fish in tuna longline fisheries data from the Observer Programme and commercial fishing returns for the 2018–19, 2019–20, and 2020–21 fishing years, and to describe bycatch trends in tuna longline fisheries using data from this project and the results of previous similar projects.

2. METHODS

2.1 Data sources and data treatment

New Zealand tuna longline fishery data for the 2018–19 to 2020–21 fishing years were obtained from two sources: commercial fishing records and observer data. Observer data were extracted from the centralised observer database (*cod*). Groomed commercial surface longline data were extracted from the database *tuna* in 2018–19 and 2019–20, and from an extract provided by Fisheries New Zealand for the 2020–21 year.

Tuna longline vessels submitted information on their fish catch to Fisheries New Zealand on Tuna Longlining Catch Effort Returns forms (TLCERs). The version introduced in 2003 includes a section for reporting discards. Historically some catch had been reported on Catch Effort Landing Returns (CELRs), but this has not occurred since 2015–16. CELR returns underestimated bycatch because much of it was discarded at sea and not recorded (Francis et al. 2000, Griggs & Baird 2013). Electronic reporting (ERS) of catch and effort information by vessels began during 2019. This did not change any of the data attributes used for this project.

More reliable data on the amount of bycatch from each longline set are available from the Fisheries New Zealand Observer Programme, in which observers on board commercial vessels identify and count all the bycatch during the time they are observing. Observers also record whether fish are alive or dead at recovery, their subsequent fate, and lengths, weights, and sex of individual fish. Observer data can therefore provide a good independent source of information on the scale of bycatch and discarding in the fishery. Observer data were used to determine which non-target fish species are caught, and to estimate unstandardised catch per unit effort (CPUE), the total number of fish caught, the proportion of the catch alive and dead at recovery, and the proportion of fish processed and discarded.

Commercial and observer data prior to 2018–19 were obtained from the studies by Francis et al. (1999, 2000, 2004), Ayers et al. (2004), Griggs et al. (2007, 2008), Griggs & Baird (2013), and Griggs et al. (2018, 2021).
Data were stratified by fishing year, fleet, and region for analysis. Three fleets have routinely fished in New Zealand waters: Foreign licensed vessels (mainly Japanese but also some Korean); Foreign vessels

chartered by New Zealand companies; and New Zealand Domestic owner-operated vessels. Foreign licensed vessels have not fished in New Zealand waters since 1995. Foreign licensed and Chartered vessels have been grouped together for analysis because they fished similar regions with similar gear (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018). This grouping is used to present a time series of trends in fishing effort. One large New Zealand Domestic vessel fished with this fleet in the same region and with the same methods up until 2004 and was included in this group. Philippine-flagged Charter vessels fished in New Zealand in 2002–03, and Australian Charter vessels fished in New Zealand during 2005–06 and 2006–07 and these two fleets were both treated as separate fleets due to differences in their fishing methods and regions fished. From 2010–11 to 2014–15, only two surface longline fleets fished in New Zealand waters: the Japanese Charter fleet and the New Zealand Domestic fleet. The names "Charter" (referring to the Japanese Charter fleet) and "Domestic" are retained due to historical use for description of these fleets and for continuity.

During the 2018–19 to 2020–21 fishing years, the only fleet fishing in New Zealand waters comprised New Zealand Domestic vessels.

Two geographic strata are used: "North" and "South" (Appendix 1). The North region is defined as sets that began north of latitude 39.5° S off the west coast and north of 43.75° S off the east coast, these being the same boundaries as used previously by Ayers et al. (2004). The South region has previously been subdivided into south-west and south-east regions (Ayers et al. 2004), but no sets have been made in the south-east region since 2003–04, so this separation was not made.

Non-fish bycatch (seabirds, marine mammals, and turtles) were excluded from this analysis as this was outside the scope of the project objectives. As with previous analyses (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018, 2021), some species were grouped together. "Deepwater dogfish" included Owston's dogfish (*Centroscymnus owstonii*), Portuguese dogfish (*Centroscymnus coelolepis*), seal shark (*Dalatias licha*), lantern shark (*Etmopterus* spp.), and cookie-cutter shark (*Isistius brasiliensis*). Shortnose and longnose lancetfish (*Alepisaurus ferox* and *A. brevirostris*) were combined. Deepwater dogfish and lancetfish were usually cut off the lines and observers often did not have the opportunity to identify them to the species level. Hāpuku and bass (*Polyprion oxygeneios* and *P. americanus*) were combined because they were often not separated to the species level for reporting. Additionally, two species of *Brama* occur in New Zealand waters, Ray's bream (*Brama brama*), and southern Ray's bream (*Brama australis*), but it is not known if observers distinguish between the two species. Here, reference to 'Ray's bream' means *Brama* spp. rather than only *Brama brama*.

2.2 Estimation of catch per unit effort and total numbers

CPUE was expressed as the number of fish observed caught per 1000 hooks set. The basic unit of sampling was an individual set; a set i has information on the number of fish caught (C_i) and the amount of effort expended (U_i the number of hooks). All hooks on a set may not be observed. In the calculation of CPUE the estimated number of observed hooks was used; this estimate was derived from the proportion of the haul observed (based on the haul duration and the time recorded as unobserved in the observer events logs) multiplied by the number of hooks set.

For the main catch species, CPUE values ($\hat{y}$) were calculated for each stratum (fishing year, fleet, and region) in 2010–11 to 2014–15 by use of a ratio of means estimator (see Bradford 2002, Ayers et al. 2004):

$$\hat{y} = \frac{\sum_{i=1}^{n} c_i / n}{\sum_{i=1}^{n} u_i / n} = \frac{\sum_{i=1}^{n} c_i}{\sum_{i=1}^{n} u_i}$$

where n is the number of observed sets.

Ayers et al. (2004) compared the use of two analytical and one bootstrap variance estimators and found the difference was negligible. These authors reported estimates of variance based on the sample means, which have better statistical properties (Thompson 1992):

$$\hat{\text{var}}(\hat{y}) = \frac{1}{\mu_u^2}\left(\frac{N-n}{N}\right)\frac{s_{\hat{y}}^2}{n}$$

$$\text{where} \quad s_{\hat{y}}^2 = \frac{1}{n-1}\sum_{i=1}^{n}(c_i - \hat{y}u_i)^2$$

and μ_u is the population mean of the effort variable. There has been some indication that the estimator $\hat{\text{var}}(\hat{y})$ is correlated with the mean of the effort variable ($\overline{u}$). An adjusted estimator,

$$\tilde{\text{var}}(\hat{y}) = \left(\frac{\mu_u}{\overline{u}}\right)^2 \hat{\text{var}}(\hat{y})$$

has been suggested to alleviate this problem (Thompson 1992). This was used in the present study to provide analytical estimates of confidence intervals.

The total number of each species caught in each stratum was estimated by scaling up the CPUE to the total number of hooks set (N), thus, $\hat{T} = N\hat{y}$. These numbers were then summed across strata to give total annual catch estimates. The estimated variance of these totals was given by $\hat{\text{var}}(\hat{T}) = N^2\ \tilde{\text{var}}(\hat{y})$

CPUE values are provided for all year/area strata having more than 10 sets and more than 2% observer coverage. These filters were applied to avoid presenting estimated catches that were based on grossly inadequate observer coverage. Estimated catches are also provided if the strata that passed the above CPUE filters accounted for more than 85% of the hooks set in that year. The years that were excluded were as follows: 1988–89, 1990–91, 1993–94, 1994–95, 1998–99, 1999–2000, 2001–02, 2002–03, and 2012–13.

CPUE values and catch estimates are provided for 2018–19 to 2020–21 and update the time series for 1988–89 to 2017–18 (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018, Griggs et al. 2021). Catch numbers estimated from observer data were compared with catch numbers reported by commercial fishers on their TLCER forms.

2.3 Status of fish on recovery and subsequent treatment

The status of the fish at time of recovery (i.e., retrieval to the side of the vessel) and the subsequent treatment (i.e., whether processed or discarded) were analysed from observer data for 2018–19 to 2020–21 for each of the main non-target species plus swordfish.

Prior to 2014–15, fish status was recorded as alive, dead, killed by crew, or unobserved. Fish recorded as killed by crew were treated as alive on recovery. Fish treatment was recorded as retained, finned, discarded, lost, or unobserved. Retained and finned fish were grouped as fish that were processed in some way, whereas the discarded and lost fish were categorised as not processed.

From 2014–15 onwards, observers recorded a more detailed 'life status on landing' and a 'fate' code for its subsequent status after a specimen is landed or brought alongside the vessel. Life status on landing is recorded as alive, dead, or unobserved, but with additional information, where possible, on whether a live specimen was uninjured or injured and, if injured, whether it can be expected to survive or not. The fate code is a processed state for fish that are retained, or a life status on release for non-retained specimens using the same criteria as for life status on landing. Retaining shark fins as a primary processed state is now illegal and there are codes to capture this process if it occurs. Fins can only be

retained if the whole shark is retained. Life status codes and fate codes used by observers are shown in Appendix 2.

Observers recorded life status on release, where this could be determined. They recorded if a released specimen was released alive uninjured, alive with injuries that the observer considered survivable, near death and unlikely to survive, or dead (Appendix 2).

2.4 Length frequency analysis

Observer length frequency data were extracted for blue, mako, and porbeagle sharks, Ray's bream, and striped marlin, and length frequency distributions were summarised by sex and region, if the data were adequate to do so.

3. RESULTS

3.1 Fishing effort and observer coverage

The New Zealand tuna longline fishery was dominated by the Foreign licensed fleet during the 1980s (Francis et al. 2004). Most effort came from Japanese vessels, but Korean vessels were also involved. The total number of hooks set declined from a maximum of 27 million in 1980–81 to less than 4 million in the mid-1990s when the Foreign licensed vessels ceased fishing in New Zealand (Figure 1).

Chartered Japanese vessels fished in New Zealand waters mainly from 1986 onwards until 2015, and their effort (including effort by one large New Zealand vessel) peaked at 2.2 million hooks during 1990–91 and averaged 0.9 million hooks per year. The Philippine fleet fished under charter arrangements in 2002–03 only, setting almost 1 million hooks. Australian vessels fished in New Zealand waters under charter arrangements, contributing 16 550 hooks in 2005–06 (0.45% of the total set in that year) and 72 160 hooks in the 2006–07 fishing year (1.9% of the total set).

The Domestic fleet has increased its effort since 1991–92 and has been dominant since 1993–94 (Table 1, Figure 1). Domestic effort peaked at almost 10 million hooks in 2001–02, producing a second fishery peak of almost 11 million total hooks. Domestic and total effort have dropped substantially since then. The introduction of several pelagic species into the QMS in October 2004 resulted in a change in fishing practices and a reduction in the number of Domestic boats in the fishery, but Domestic effort had been declining since 2002–03. In 2007–08, total effort dropped to a (then) all-time low of 2.2 million hooks, of which 1.7 million hooks were set by the Domestic fleet. Effort then increased to around 3 million in 2008–09 and then gradually declined to 2.4 million in 2014–15, with nearly 1.8 million hooks set by the Domestic fleet. In 2015–16, there was an increase to 2.4 million hooks set by the Domestic fleet followed by 2.1 million in 2016–17, and 2.2 million in 2017–18.

Between 2018–19 and 2020–21, only Domestic vessels fished by surface longline in New Zealand waters. The fleet set a total of 2.0 million hooks in 2018–19 and 2019–20, and 1.6 million in 2020–21. This represents a gradual decline in hooks set by the Domestic fleet from 2017–18 onwards. The 1.6 million set in 2020–21 was the lowest number of hooks ever set in the fishery, less than the previous low in 2007–08 (Figure 1, Table 1).

The overall number of observed trips and sets, the observed hooks and reported hooks by fleet, and the percentage of set hooks reported on CELR, TLCER, and ERS forms are shown in Table 1. Use of CELR forms for reporting longline fishing ceased in 2005–06.

Observed hooks as a percentage of those set by the fishery are shown in Table 2, and by fleet and region in Figure 2, for all years. Observer coverage on Domestic vessels peaked at 16.5% in 2016–17. Between 2018–19 and 2020–21, there was a drop to 9.1% in 2018–19, followed by 9.7% in 2019–20, and 11.2% in 2020–21.

The percentages of hooks observed per set between 2018–19 and 2020–21 are shown in Table 3. Most Domestic sets that were observed were fully observed.

The numbers of sets and hooks (in thousands) reported on TLCER forms or with ERS, and the percentages observed, are shown for North and South regions by fleet and fishing year in Table 4. This shows the number of sets and hooks available for estimating CPUE and numbers of fish caught, by fishing year, fleet, and region. The criteria used to omit years where observer coverage was insufficient to use for reliable estimates was less than 10 sets observed or less than 2% of hooks observed. The years that were excluded were as follows: 1988–89, 1990–91, 1993–94, 1994–95, 1998–99, 1999–2000, 2001–02, 2002–03, and 2012–13 (shaded on Table 4).

Fishing positions of sets reported and observed sets in 2018–19 to 2020–21 are shown in Figure 3. In earlier years, the Domestic fleet fished mainly in the North and the Foreign and Charter vessels fished predominantly in the South (Ayers et al. 2004, Francis et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018).

During 2018–19 to 2020–21, Domestic vessels fished both North and South (Figure 3), continuing the trend seen in the previous three years (Griggs et al. 2021). In 2018–19, 31% of sets were in the South region, in 2019–20, 36% of sets were in the South, and in 2020–21, Southern sets made up 27% of the total. There was some effort off the east coast of the South Island in all three years, as seen in 2017–18 (Griggs et al. 2013), but prior to 2017–18 this had not occurred since 2003–04. Most of the sets in the North were concentrated off the east coast and mainly targeted bigeye tuna, southern bluefin tuna, swordfish, and Pacific bluefin tuna (*Thunnus orientalis*), whereas most of the sets in the South were off the west coast South Island where they mainly targeted southern bluefin tuna with some sets for swordfish. Southern bluefin tuna was the predominant target species, with 65% of sets targeting southern bluefin tuna over the three years, 21% targeting bigeye tuna, and 12% of sets targeting swordfish. Domestic vessels fished all year round, but with most effort between March and August corresponding to the southern bluefin tuna season (Figure 4).

A comparison of the spatial distributions of commercial and observed sets for the past 21 years is shown in Figures 5 and 6. Observer coverage represented the spatial distribution of the fishery well during 2018–19 to 2020–21 (Figures 3, 5, and 6) with improved observer coverage. Observer coverage also represented the temporal distribution of the fishery well in most months (Figures 4 and 7).

3.2 Species composition

Between 2018–19 and 2020–21, 34 376 fish and invertebrates from at least 60 species were observed (Table 5, Appendix 3). The most commonly observed species since 1988–89 have been blue shark, Ray's bream, and albacore tuna, together constituting 66% of the catch by numbers (Appendix 3). Most species were rarely observed, with only 38 species (or species groups) exceeding 100 recorded fish since 1988–89. The first observed longline capture of a manta ray, a protected species in New Zealand, was recorded in 2020–21.

Observed catches by year and region between 2018–19 and 2020–21 are shown in Table 5, for each year and the three years combined. These data provide a useful within-stratum comparison of relative species abundance but should not be compared among strata because of the different numbers of observed hooks in each stratum. These three years are different from earlier years prior to 2015–16 due to lack of Charter vessels from any other countries, and therefore are based on only the Domestic fleet.

In the three-year period spanning 2018–19 to 2020–21, blue shark was the most abundant species in the observed catches, making up 45% of observed specimens. This was followed by southern bluefin tuna, then lancetfish. The top three species made up 74% of the observed catch.

While blue shark was the most abundant species each year, the next two most abundant species varied. Blue shark were followed by lancetfish and southern bluefin tuna in 2018–19, southern bluefin tuna then lancetfish in 2019–20, and southern bluefin tuna then albacore in 2020–21 (Table 5).

Southern bluefin tuna was in the top three most abundant observed species in the seven years prior, 2011–12 to 2017–18 (Griggs et al. 2018, 2021), and this was a different trend compared with earlier years, when numbers of Ray's bream and albacore were higher than southern bluefin tuna in observed catches. Ray's bream was one of the most abundant species in previous years (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018), but was only the sixth most abundant species in observed catches during 2018–19 to 2020–21 (Table 5).

The next most abundant species in the observed catch varied from year to year, but over the three-year period combined these were, in descending order: albacore, swordfish, Ray's bream, porbeagle shark, pelagic stingray (*Pteroplatytrygon violacea*), bigeye tuna, sunfish (*Mola* spp.), moonfish (*Lampris guttatus*), and mako shark. Observed catches of oilfish (*Ruvettus pretiosus*), yellowfin tuna (*Thunnus albacares*), escolar (*Lepidocybium flavobrunneum*), striped marlin, butterfly tuna (*Gasterochisma melampus*), Pacific bluefin tuna, and thresher shark (*Alopias vulpinus*) were next highest (Table 5). These trends were similar to those of the previous three years 2015–16 to 2017–18 (Griggs et al. 2021).

Some species that were more abundant in previous years (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018), in particular deepwater dogfish, dealfish (*Trachipterus trachypterus*), bigscale pomfret (*Taratichthys longipinnis*), school shark (*Galeorhinus galeus*), oilfish, escolar, and rudderfish (*Centrolophus niger*), were seen in very low numbers in 2015–16 to 2020–21. This is largely due to the lack of other fleets in the fishery. A manta ray (*Manta birostris*), a protected species, was caught in 2020–21, this being the first recorded capture in the New Zealand tuna longline fishery.

There were 184 unidentified fish observed between 2018–19 and 2020–21. Most of these were cut off the line at the side of the vessel or lost and not seen by the observer. Some could be identified to the level of 'shark', 'ray', or 'tuna' (Table 5).

Catch composition varied with region. Blue sharks and porbeagle sharks were observed caught in the North and South, with more observed caught in the South. Southern bluefin tuna and butterfly tuna were also caught in both regions.
Lancetfish, sunfish, bigeye tuna, yellowfin tuna, oilfish, escolar, pelagic rays, swordfish, and striped marlin were observed caught in the North. More albacore, moonfish, mako sharks, and rudderfish were caught in the North. Ray's bream, and the few dealfish and deepwater dogfish, were mostly caught in the South. The few bigscale pomfret, previously observed caught in the South, were observed in the North between 2018–19 and 2020–21 (Table 5).

Most of the observed effort was in the North, with 66.9% of observed hooks in 2018–19, 61.4% in 2019–20, and 68.4% in 2020–21, and this accounts for some of the relative abundance in the observed catches in the North and South regions.

3.3 Catch per unit effort

The number of hooks and sets used in the CPUE calculations are shown in Table 4. CPUE estimates for 2018–19 to 2020–21 were added to the time series for 1988–89 to 2017–18 and these are shown in Figure 8.

CPUE estimates for the Charter fleet are included in the time series and can be considered reliable from 1992–93 onwards (Griggs et al. 2007), particularly in the Southern region. Charter vessels fished few sets in the North region in their last five fishing years (Griggs et al. 2018).
The CPUE results from the Domestic fleet should be interpreted with caution due to the low level of observer coverage of this fleet, and the spatial and temporal variation of their fishing effort.

Over the full time series the following trends were apparent:

- CPUE of blue sharks peaked in 1994–95 for Charter North, and subsequently declined to low levels during the late 1990s/early 2000s; in 2004–05, trends increased for Domestic North to 2012–13 and have been steadily declining since to low levels observed in the late 1990s; CPUEs for Domestic South have been variable without trend over time and have been higher than Domestic North since 2016–17.
- CPUE of mako shark was higher in the North than the South, but from 2010–11, the North CPUE has steadily declined to levels similar to the South.
- CPUE of porbeagle shark was variable without long-term trend in the Domestic North and South fleets; the Domestic North fleet has shown some declines since 2015–16 to levels observed in the 1990s/early 2000s.
- CPUE of school shark appeared higher in the South than the North in the late 1990s/early 2000s and has remained low in both regions since, especially in recent years (2018–19 to 2020–21).
- CPUE of deepwater dogfish was higher for the Charter fleet in the South (to 2014–15), but consistently very low for Domestic vessels.
- CPUE has remained high for southern bluefin tuna in the South and appears to have increased in the North and remained high between 2018–19 and 2020–21.
- Catch rates of albacore, bigeye, butterfly, and yellowfin tunas, striped marlin, swordfish, and lancetfish were greatest in the North and for the Domestic fleet.
- Yellowfin tuna CPUE had been very low but showed some increase in recent years particularly in 2019–20 and 2020–21.
- Butterfly tuna CPUE has decreased in the South and increased in the North over recent years.
- CPUE of Ray's bream, bigscale pomfret, and dealfish were highest in the South and for the Charter fleet and have been lower in recent years.
- Moonfish, oilfish, and escolar had higher catch rates in the North.
- Catch rates of moonfish appear to be consistent, especially in the North.
- Escolar, oilfish, and rudderfish catch rates have declined in recent years.

3.4 Total numbers of fish caught

The fisher-reported and estimated numbers of fish caught between 2018–19 and 2020–21 were added to the time series generated previously for 1988–89 to 2017–18 (Griggs et al. 2021) and these are shown in Figure 9.

CELR data from the earlier years were not included because either fish number or fish weight could be reported on these forms, so the data for fish numbers are incomplete. This will cause a negative bias, especially in the mid-1990s when a significant proportion of the catch was reported on CELR forms (see Table 1). CELR forms have not been used since 2005–06, so the recent numbers will not be affected by this.

Trends in numbers of fish caught by species during are given below:

- Reported catches of blue, mako, and porbeagle sharks have declined since the Charter fleet ceased fishing in New Zealand waters; catches of blue shark have continued at a relatively high level but are more consistent with levels observed in the 1990s.
- Catches of mako and porbeagle sharks declined during 2018–19 to 2020–21 and are amongst the lowest levels in the time series.
- Catches of deepwater dogfish and school shark have declined to low numbers and are amongst the lowest levels in the time series.
- Southern bluefin tuna catches have increased steadily and peaked in 2017–18, and they have been fairly constant since then.
- Albacore catches were low over the last sixteen years.

- Yellowfin tuna catches declined consistently during the 2000s to extremely low levels, with the first re-appearance in 2014–15 and levels have been fairly low but steady since then.
- Catches of butterfly tuna were fairly low over the last six analysis years, from 2015–16 to 2020–21, whereas in the previous eleven years reported catches were below estimated catches, suggesting the species may have been under-reported.
- Catches of striped marlin were low in 2018–19 and 2019–20, with a large increase in 2020–21.
- Swordfish catches decreased in 2018–19 and increased in 2019–20 and 2020–21.
- Catches of moonfish were a little lower than the previous three years.
- Catches of Ray's bream dropped significantly to a low level in 2017–18 and have stayed low since then.
- After a peak in 2006–07, bigscale pomfret catches have fallen and remained very low, especially from 2015–16 to 2020–21.
- Reported dealfish catches were very low from 2015–16 onwards.
- Escolar catches decreased from a 2010–11 peak, with low catches over the last eight analysis years.
- Reported catches of lancetfish were below estimated catches suggesting they were under-reported, but reported catches increased in 2020–21.
- Catches of oilfish and rudderfish have been relatively low over the last fifteen years.

Reported numbers of each species caught in 2018–19 to 2020–21 are shown in Appendix 4.

3.5 Length frequency distributions

Since the ban on shark finning was introduced (starting in 2014–15), most sharks were not landed, and hence few were measured. Those that were measured appeared to be the smaller sharks that were easier to handle, and large sharks were not landed and not measured. Length frequency data for blue shark were considered inadequate to represent the population. Few mako and porbeagle shark lengths were recorded. Striped marlin data are not presented because only two were measured in the three-year time period.

Length frequency distributions of measured Ray's bream are shown by year and region for both sexes combined in Figure 10. It is possible that the length data for Ray's bream includes southern Ray's bream (*Brama australis*) because it is not known how well observers distinguish the two species. Ray's bream that were retained were usually kept whole and not sexed (97.4% during 2018–19 to 2020–21). Differences in the North/South distributions have been shown previously, with southern fish being larger, although the distributions for males and females were similar (Griggs & Baird 2013). Female Ray's bream mature at about 43 cm (Francis et al. 2004). It appears that most females were probably immature during 2018–19 to 2020–21, with only 43.3% larger than the length at maturity. This differs from previous years where most females were probably mature: 59.4% during 2015–16 to 2017–18 (Griggs et al. 2021), and 77.2% in the previous five-year period (Griggs et al. 2018). This may reflect the lower catches of Ray's bream in 2018–19 to 2020–21.

3.6 Status of fish on recovery and discards

The percentages of the main non-target species recorded alive or dead, by species, year, and region are given in Table 6. The top 15 most abundant species in 2018–19 to 2020–21 (combined) were included in this table, along with school shark, deepwater dogfish, bigscale pomfret, dealfish, rudderfish, and striped marlin, which have been included in previous bycatch reports (Ayers et al. 2004, Francis et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018, Griggs et al. 2021).

During 2018–19 to 2020–21, most sharks were alive when landed or brought to the vessel, with the highest percentage alive for blue sharks (88% overall) and lowest for porbeagle sharks (36%). The percentage alive for porbeagle sharks is lower than the 52% alive seen in the previous three years (Griggs et al. 2021). Few deepwater dogfish and school shark were caught, mostly alive. Percentage alive was previously shown to vary with region and to be lower in the North than in the South, but that trend was not obvious in 2018–19 to 2020–21.

Most of the albacore, swordfish, and butterfly tuna were landed dead, and most southern bluefin tuna, bigeye tuna, yellowfin tuna, and striped marlin were landed alive (Table 6).

Most Ray's bream, moonfish, escolar, oilfish, rudderfish, and almost all sunfish were alive when recovered, as previously observed (Ayers et al. 2004, Francis et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018, Griggs et al. 2021). Most lancetfish were recovered dead. Too few bigscale pomfret and dealfish were caught to indicate a reliable trend (Table 6).

The numbers of fish retained (i.e., processed in some way), and discarded (including those released alive), and lost or unknown, for each year (2018–19 to 2020–21), in order of decreasing abundance in observed catches are shown in Figure 11. For each year, the upper graph shows the main bycatch species, and the three most abundant species are excluded from the lower graph.

The proportions of each species retained and discarded, by fishing year, are given in Table 7. Shark discard practices that commenced in 2014–15 continued due to the ban on finning. Most blue and mako sharks, and all porbeagle sharks, were discarded during 2018–19 to 2020–21. Some of the few school sharks were retained for their flesh, and the few deepwater dogfish caught were discarded.

Most albacore, southern bluefin tuna, bigeye tuna, yellowfin tuna, and swordfish were retained. Numbers of butterfly tuna were lower than seen previously and of those nearly two thirds were discarded. All 97 striped marlin that were caught were returned to the sea. Most moonfish and Ray's bream were retained.

Trends in retaining or discarding the non-quota fish bycatch species were more variable. Escolar and oilfish varied from year to year. Most escolar were retained in 2018–19, and just over half were kept in 2019–20 and 2020–21, while most oilfish were retained in 2018–19 and 2019–20 and most were discarded in 2020–21. Lancetfish, sunfish, and dealfish were discarded (Table 7).

Life status of discarded fish in 2018–19 to 2020–21 is shown in Table 8. Most discarded sharks were alive when recovered and could be Schedule 6 releases. Blue, mako, and porbeagle sharks are listed under Schedule 6 of the Fisheries Act 1996 as QMS species that can be returned to the sea, either alive and expected to survive (reported but not counted under Annual Catch Entitlement, ACE), or dead or unlikely to survive (reported and counted against ACE). Most of the discarded blue sharks were alive (over 85%), but, for mako shark this was lower, averaging 63% over the three-year period. Over the three years, two thirds of discarded porbeagle shark were dead, though this varied by year (57% in 2019–20 to 72% in 2020–21).

Most of the discarded albacore and butterfly tuna were dead on recovery. Most southern bluefin tuna and all yellowfin discards were recovered alive. Of the few bigeye tuna that were discarded, most were alive. Most of the swordfish discards were recovered alive, and 77% of striped marlin were alive on capture. Ray's bream discards, along with the few moonfish discards, were mostly alive, which differed from previous years when most of the Ray's bream and moonfish discards were dead (Griggs et al. 2021).

Discarding of some QMS species can be explained by damage, which applies to 7.1% of discarded blue shark, 2.9% of mako shark, 15.1% of porbeagle shark, 16.7% of moonfish, 14.4% of Ray's bream, 8.0% of southern bluefin tuna, and 13.0% of swordfish. There were observer authorised discards of five southern bluefin tuna in 2018–19, one southern bluefin tuna and two swordfish in 2019–20, and 21 fish in 2020–21: eleven swordfish, six southern bluefin tuna, one yellowfin tuna, one albacore and two Ray's bream. Of the non-QMS fish species, most of the lancetfish and dealfish discards were recovered dead, and most oilfish, escolar, rudderfish, and sunfish were alive (Table 8).

Insufficient information about life status on release was recorded by observers for most species, except blue shark. Over the three-year time period, 2018–19 and 2020–21, 7936 individual blue shark were recovered alive with life status recorded by observers when they were returned to the sea. Of these

68.8% were recorded as released uninjured, 28.8% were considered by the observer to have injures that would not be expected to be fatal, and 2.4% were returned to the sea dead or dying from their injures.

There was insufficient information on the fate of fish bycatch species to draw reliable conclusions. Some, particularly lancetfish, don't usually survive the hook retrieval process (Zane Duncan, Matt Saunders, Fisheries New Zealand Observer Programme, pers. comm.).

4. SUMMARY AND DISCUSSION

From 2015–16 onwards, the New Zealand Domestic fleet was the only fleet fishing in New Zealand waters by surface longline. Effort by the Domestic fleet has declined since its peak in 2001–02. Over the previous 10 years (2008–09 to 2017–18) effort was fairly consistent with an average of 2.2 million hooks set each year, but this dropped during this reporting period to an all-time low of 1.6 million hooks set in 2020–21.

In 2017–18, there was some fishing effort off the east coast of the South Island, an area not fished since 2003–04, and this has continued between 2018–19 and 2020–21.

The species most commonly observed on tuna longlines in previous years were blue shark, Ray's bream, and albacore tuna (Francis et al. 1999, 2000, 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013). From 2015–16 onwards, southern bluefin tuna were in the top three most abundant observed species (Griggs et al. 2018), and this trend continued during 2018–19 to 2020–21.

Over the three years combined, blue shark was still the most abundant in observed catches (45%), followed by southern bluefin tuna and then lancetfish. Catch composition varied with region fished, and with greater observer coverage in the North region than in the South. There was a greater proportion of northern species including lancetfish, sunfish, swordfish, and yellowfin tuna, and lower proportion of southern species such as Ray's bream, bigscale pomfret, dealfish, and deepwater dogfish in the observed catches, reflecting spatial patterns in observer coverage and fleet differences. There was a further increase of yellowfin tuna, a species almost absent in catches for about eight years prior to 2015–16.

Trends in reported catches between 2018–19 and 2020–21 include: blue shark captures continued to be relatively high but are more consistent with levels observed in the 1990s, whereas mako and porbeagle shark catches decreased and are amongst the lowest observed levels in the time series. Southern bluefin tuna catches have been steady; yellowfin tuna catches increased after being very low for about a decade and have remained steady; albacore, Ray's bream, bigscale pomfret, school shark, and deepwater dogfish catches remained very low.

Observer coverage on Domestic vessels had improved in recent years, although it was lower between 2018–19 and 2020–21. It appeared to be more spatially representative of the fishing effort, but not high enough to reliably describe CPUE and adequately quantify changes in catch made by the Domestic fleet. QMS fish species (swordfish, moonfish, and Ray's bream) were mostly retained. Trends of retaining or discarding the non-quota fish bycatch species were more variable.

Discard practices are likely to vary from vessel to vessel and may also vary with the presence of an observer on board. When observers are on board, practices may change, and observers can provide 'Authority to Discard' forms which are signed by vessel personnel and the observer and allow discarding of QMS species in certain circumstances. Some fishers also admit that they do not report discards of non-quota species, a practice claimed to be widespread (Observer Programme observers, pers. comm.), so many of the fish bycatch species may be under-reported. Fishing practices have also changed over time, particularly since the introduction of the shark finning ban beginning in 2014–15. No sharks have been observed finned as a primary state since the introduction of this ban. In addition, the use of monofilament gear increases the number of bite-offs (which can be high), and this may also lead to an underestimation of the actual number of sharks caught in longline fisheries (Scott et al. 2022).

Pelagic sharks are an important bycatch of commercial longline fisheries throughout the Pacific Ocean. As they are long-lived, slow growing, late maturing, and have few young, these species have life histories that make them vulnerable to overexploitation from fishing (Cortés 2008, Dulvy et al. 2008, Cortés et al. 2010). Globally, pelagic sharks have undergone about a 70% decline in abundance since 1970 (Pacoureau et al. 2021). Over the period 2005–2015, standardised CPUE indicators for both commercial and observer datasets, and distribution indicators which quantify the spatial distribution of areas of high CPUE, were consistent for all three species in showing either increasing trends, or an increasing trend followed by stabilisation at a constant level (Francis et al. 2014, Francis & Large 2017). An update of this analysis to 2018 found most of the abundance indicators showed declining trends in recent years, particularly in North region during 2017–18 (Francis & Finucci 2019). At the time, these indicators were unlikely to accurately index shark abundance in recent years for several reasons: (i) steep declines in North region CPUEs were too large to represent changes in population biomass; (ii) these declines were observed in all three species and it seems unlikely the abundance of all three species would decline so steeply at the same time; (iii) contrasting trends between the commercial fishery and observer standardised CPUE analyses; and (iv) declining effort of surface longlining within the EEZ (Francis & Finucci 2019). However, these trends reported by Francis & Finucci (2019) continue to be observed here in the Domestic fleets and should be closely monitored and reviewed further.

Most blue, mako, and porbeagle sharks were discarded during 2018–19 to 2020–21, and most were alive when brought to the vessel with the highest survival rate for blue sharks and the lowest for porbeagles. Records of life status on release suggest that these sharks were released uninjured or with injuries that would not be expected to be fatal. However, the recording of life status at release is subject to observer assessment and may vary from observer to observer, and at-vessel condition at release has been shown to not accurately reflect long-term survival (Raoult et al. 2019). Blue sharks represent the highest proportion of shark bycatch worldwide (and in New Zealand), and though initial at-vessel mortality appears to be low (Gilman et al. 2022), longer term post-release survival appears to be low (Hutchinson et al. 2022). Post-release mortality rates of discarded sharks are poorly understood. Recent work on mako sharks tagged off New Zealand and the Pacific Islands estimated post-release survival rates were relatively high after 60 days (88%). However, when factoring in a complete fishing interaction (haulback, handling, and release), survival estimates were markedly reduced to 49% (Francis et al. 2023). Studies on blue shark carried out in Pacific Islands longline fisheries report that blue sharks are highly susceptible to post-release mortality, and this species had the lowest post-release survival rate (62%) of sharks investigated in this study, including mako. In longer projections only 18% of blue sharks survived (Hutchinson et al. 2022).

There have been various studies investigating post-release mortality of sharks captured on longline fisheries, and survival can be influenced by a number of factors, including species, gear type, fisher behaviour and handling techniques, and environmental variables (Gilman et al. 2022, Hutchinson et al. 2022). Condition of the shark on release (good versus injured) and the amount trailing gear left on the animals were the two factors that had the largest effect on post-release fate. Sharks released in good condition without trailing gear had the highest rates of survival (Hutchinson & Bigelow 2019). Sharks and other species released with trailing gear may be burdened for a long period of time, and it is likely to reduce survival by restricting swimming, increasing predation, and increasing the risk of infection (Scott et al. 2022). The effects of trailing gear are worsened when several metres of line are attached, or when weights are included (for seabird mitigation). Currently, there are no data to determine if, and how much, gear remains on discarded catch. To reduce injury and increase survival rates, best practice guides encourage that sharks are brought as close to the vessel as possible, kept in the water, and released with minimal amounts of trailing fishing gear (AFMA 2016, Australian Fisheries Management Authority shark and ray handling practices[2], Hutchinson et al. 2022,). The use of alternative gear types, such as biodegradable monofilament, should also be investigated.

Pelagic sharks have increasingly been released alive or discarded dead by fishers following the ban on shark finning, to the extent that few sharks are now hauled aboard or processed by tuna longliners

[2] https://www.afma.gov.au/protected-species/sharks/shark-and-ray-handling-practices

(Francis 2015, 2016, Francis & Ó Maolagáin 2016). This compromises the utility of observer data for monitoring trends in size composition and sex ratio. In this study, most sharks were not landed, and hence few were measured, and those that were measured appeared to be the smaller sharks that were easier to handle; so length frequency data were considered inadequate to represent the population. Alternative means of collecting biological data should be investigated.

It is difficult to assess the impacts of the tuna longline fishery on stocks of non-target bony fish. There is considerable variation between vessels in fishing gear and fishing methods, and variation in reporting and discard practices, especially in the wider range of the stock and other fisheries in the WCPO and beyond, and in Areas Beyond Natural Jurisdiction (ABNJ) (Clarke et al. 2014, Clarke 2015). Some of the most commonly encountered species are important as local food supplies and should be safeguarded for that reason (Clarke et al. 2014, Clarke 2015). For many of these species there is little knowledge of handling or post-release mortality. All the information on non-target bony fish species available to WCPFC is from observer data from member countries. In some areas there was little or no observer coverage particularly in Pacific nations. With more focus on tuna, billfish, sharks, and non-fish bycatch, there is little focus on other non-target bony fish species. Limited quantity and quality of data lead to high uncertainty about protection of bycatch from depletion. There are also issues of identification, fish of low or no market value being considered unimportant, frequent discarding and non/under-reporting, and little is known about handling and post-release mortality. Efforts are being made to address standardisation of reporting of bycatch by different countries, and to explore possible mitigation options (Chapman 2001, Clarke at al. 2014, Clarke 2015).

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7. TABLES

Table 1: Number of tuna longline trips, sets and hooks observed, and number of hooks reported on TLCER and CELR forms by tuna longline vessels fishing in New Zealand. Set hooks were mostly recorded on TLCER forms, except for those specified as CELR. "% on CELR" refers to percentage of total hooks recorded on CELR forms; the majority were recorded on TLCER. "Foreign and Charter" vessels are predominantly Japanese, with some Korean effort in the 1980s, Philippine effort in 2002–03, Australian effort in 2005–06 and 2006–07, and the effort of one large Domestic vessel that fished with the Japanese Charter fleet.

	Observed		Observed hooks			Set hooks			
Fishing year	Trips	Sets	Domestic	Foreign+ Charter	Total	Domestic	Foreign+ Charter	Total	% on CELR
1988–89	5	86	0	234 826	234 826	11 800	9 953 745	9 965 545	0.1
1989–90	6	154	0	447 239	447 239	117 562	8 553 288	8 670 850	1.3
1990–91	3	150	0	421 808	421 808	350 897	15 316 845	15 667 742	2.0
1991–92	8	192	19 525	508 629	528 154	544 658	10 362 346	10 907 004	1.9
1992–93	17	373	0	1 057 985	1 057 985	996 293	5 970 648	6 966 941	1.8
1993–94	9	246	2 418	693 262	695 680	1 798 970	1 763 343	3 562 313	11.2
1994–95	12	339	65 694	815 807	881 501	3 003 260	1 641 585	4 644 845	15.7
1995–96	5	147	162 922	0	162 922	3 048 663	258 203	3 306 866	21.2
1996–97	15	424	79 991	882 763	962 754	2 336 462	1 455 906	3 792 368	6.9
1997–98	15	438	70 835	989 566	1 060 401	2 943 762	1 277 666	4 221 428	4.6
1998–99	9	402	35 264	1 052 721	1 087 985	5 394 338	1 504 271	6 898 609	3.6
1999–00	13	274	38 458	659 923	698 381	7 143 042	1 150 085	8 293 127	2.9
2000–01	23	474	240 979	818 744	1 059 723	8 907 172	943 018	9 850 190	1.3
2001–02	17	398	144 716	773 443	918 159	9 973 801	984 695	10 958 496	0.3
2002–03	9	610	0	1 887 816	1 887 816	8 650 712	2 216 292	10 867 004	0.2
2003–04	16	549	128 399	1 336 066	1 464 465	5 924 227	1 471 454	7 395 681	0.1
2004–05	14	343	150 574	562 825	713 399	3 091 477	642 074	3 733 551	0.6
2005–06	16	265	89 983	548 653	638 036	3 095 479	625 160	3 720 639	<0.1
2006–07	21	446	169 592	786 327	955 919	2 292 222	1 453 370	3 745 592	0.0
2007–08	18	226	141 489	254 208	395 697	1 664 974	568 285	2 233 259	0.0
2008–09	17	384	147 196	657 535	804 731	2 309 003	809 230	3 118 233	0.0
2009–10	21	325	179 700	387 285	571 994	2 507 977	478 558	2 986 535	0.0
2010–11	18	324	172 502	370 072	542 574	2 701 559	503 370	3 204 929	0.0
2012–12	16	337	173 078	463 493	636 571	2 552 937	554 940	3 107 877	0.0
2012–13	13	233	71 053	380 335	451 388	2 393 152	487 520	2 880 672	0.0
2013–14	17	343	129 289	545 265	674 554	1 877 847	653 330	2 531 177	0.0
2014–15	17	304	107 508	502 755	610 263	1 785 086	622 300	2 407 386	0.0
2015–16	24	342	322 370	–	322 370	2 356 191	–	2 356 191	0.0
2016–17	22	378	344 001	–	344 001	2 080 686	–	2 080 686	0.0
2017–18	20	325	295 278	–	295 278	2 242 391	–	2 242 391	0.0
2018–19	20	221	184 879	–	184 879	2 037 307	–	2 037 307	0.0
2019–20	13	214	193 329	–	193 329	1 999 748	–	1 999 748	0.0
2020–21	14	191	179 169	–	179 169	1 600 759	–	1 600 759	–

Table 2: Percentage of hooks observed.

Fishing year	Domestic	Foreign+ Charter	Total
1988–89	0.0	2.4	2.4
1989–90	0.0	5.2	5.2
1990–91	0.0	2.8	2.7
1991–92	3.6	4.9	4.8
1992–93	0.0	17.7	15.2
1993–94	0.1	39.3	19.5
1994–95	2.2	49.7	19.0
1995–96	5.3	0.0	4.9
1996–97	3.4	60.6	25.4
1997–98	2.4	77.5	25.1
1998–99	0.7	70.0	15.8
1999–00	0.5	57.4	8.4
2000–01	2.7	86.8	10.8
2001–02	1.5	78.5	8.4
2002–03	0.0	85.2	17.4
2003–04	2.2	90.8	19.8
2004–05	4.9	87.7	19.1
2005–06	2.9	87.8	17.1
2006–07	7.4	54.1	25.5
2007–08	8.5	44.7	17.7
2008–09	6.4	81.3	25.8
2009–10	7.2	80.9	19.2
2010–11	6.4	73.5	16.9
2012–12	6.8	83.5	20.5
2012–13	3.0	78.0	15.7
2013–14	6.9	83.5	26.6
2014–15	6.0	80.8	25.3
2015–16	13.7	–	13.7
2016–17	16.5	–	16.5
2017–18	13.2	–	13.2
2018–19	9.1	–	9.1
2019–20	9.7	–	9.7
2020–21	11.2	–	11.2
Total	**4.6**	**25.0**	**13.8**

Table 3: Percentage of the hooks that were observed on observed sets on Domestic vessels between 2018–19 and 2020–21. Values are the numbers of sets in each category.

Fishing year	% hooks observed	Number of sets
2018–19	0–9	1
	20–29	2
	50–59	1
	80–89	2
	90–99	2
	100	213
	Total	**221**
2019–20	80–89	1
	100	213
	Total	**214**
2020–21	0–9	1
	40–49	1
	60–69	1
	100	188
	Total	**191**

Table 4: Number of sets and hooks available for estimating catch-per-unit-effort (CPUE) and numbers of fish caught, by fishing year, fleet, and region. Hook numbers (from TLCER or ERS) are in thousands. The criteria used to omit years where observer coverage was insufficient to use for reliable estimates was less than 10 sets observed or less than 2% of hooks observed. The years that were excluded were as follows: 1988–89, 1990–91, 1993–94, 1994–95, 1998–99, 1999–2000, 2001–02, 2002–03, and 2012–13 (shaded). North region. (Continued next page)

		Foreign and Charter fleet				Domestic fleet			
Fishing year	Area	Reported sets	% sets observed	Reported hooks	% hooks observed	Reported sets	% sets observed	Reported hooks	% hooks observed
1988–89	N	1 284	4	3 701	3	12	0	12	0
1989–90	N	1 294	6	3 752	6	265	0	117	0
1990–91	N	2 052	6	6 032	6	447	0	319	0
1991–92	N	1 550	5	4 500	5	691	0	540	0
1992–93	N	445	29	1 207	28	1 117	0	944	0
1993–94	N	49	65	137	63	1 978	0	1 649	0
1994–95	N	23	57	61	45	2 705	2	2 210	3
1995–96	N	0	–	0	–	3 154	2	2 775	2
1996–97	N	48	92	136	87	2 792	4	2 328	3
1997–98	N	123	76	328	74	3 267	2	2 930	2
1998–99	N	53	55	167	50	5 383	1	5 376	1
1999–00	N	46	54	134	51	6 547	0	7 087	0
2000–01	N	31	100	83	94	7 731	3	8 842	3
2001–02	N	4	100	12	98	8 196	2	9 683	2
2002–03	N	27	100	80	86	7 120	0	8 539	0
2003–04	N	16	100	52	80	4 722	2	5 487	2
2004–05	N	42	100	138	85	2 754	5	3 017	5
2005–06	N	18	100	50	82	2 769	2	2 992	3
2006–07	N	82	68	274	61	2 275	7	2 289	7
2007–08	N	0	–	0	–	1 675	9	1 572	9
2008–09	N	23	100	73	81	2 233	7	2 150	7
2009–10	N	0	–	0	–	2 454	7	2 307	7
2010–11	N	2	100	7	71	2 582	7	2 538	7
2012–12	N	2	100	7	72	2 080	6	1 997	7
2012–13	N	11	100	37	84	2 006	4	1 904	4
2013–14	N	0	–	0	–	1 641	7	1 425	6
2014–15	N	0	–	0	–	1 565	6	1 291	7
2015–16	N	–		–		2 078	10	1 722	11
2016–17	N	–		–		1 863	13	1 523	14
2017–18	N	–		–		2 134	11	1 812	12
2018–19	N	–		–		1 549	8	1 363	7
2019–20	N	–		–		1 430	10	1 227	10
2020–21	N	–		–		1 316	9	1 095	9

Table 4 *(continued)*: Number of sets and hooks available for estimating CPUE and numbers of fish caught, by fishing year, fleet, and region. Hook numbers are in thousands. South region.

		Foreign and Charter fleet				Domestic fleet			
Fishing year	Area	Reported sets	% sets observed	Reported hooks	% hooks observed	Reported sets	% sets observed	Reported hooks	% hooks observed
1988–89	S	2 137	2	6 253	2	0	–	0	–
1989–90	S	1 628	5	4 801	5	2	0	<1	0
1990–91	S	3 127	1	9 285	1	23	0	31	0
1991–92	S	1 995	5	5 862	5	7	0	5	0
1992–93	S	1 563	16	4 763	15	29	0	53	0
1993–94	S	560	38	1 626	37	129	0	150	0
1994–95	S	540	51	1 580	50	798	0	793	0
1995–96	S	96	0	258	0	323	25	274	36
1996–97	S	457	61	1 320	58	14	0	9	0
1997–98	S	318	83	950	79	16	0	14	0
1998–99	S	436	77	1 338	73	34	0	19	0
1999–00	S	334	64	1 016	58	60	0	56	0
2000–01	S	277	87	860	86	79	0	65	0
2001–02	S	320	85	973	78	283	0	291	0
2002–03	S	348	100	1 134	93	150	0	137	0
2003–04	S	431	100	1 420	91	410	1	448	1
2004–05	S	157	100	504	88	107	8	97	8
2005–06	S	164	100	556	90	109	11	104	11
2006–07	S	321	60	1 107	53	3	0	3	0
2007–08	S	167	50	568	45	101	0	93	0
2008–09	S	216	97	736	81	160	3	159	4
2009–10	S	144	100	479	81	238	7	204	10
2010–11	S	149	100	497	74	172	0	164	0
2012–12	S	162	100	548	84	542	7	556	8
2012–13	S	137	100	450	78	490	1	489	0
2013–14	S	186	100	653	84	473	10	453	10
2014–15	S	181	100	622	81	484	5	494	5
2015–16	S	–		–		624	21	634	20
2016–17	S	–		–		558	24	558	23
2017–18	S	–		–		432	19	430	18
2018–19	S	–		–		708	13	674	12
2019–20	S	–		–		819	8	773	9
2020–21	S	–		–		499	14	506	15

Table 4 *(continued)*: Philippine and Australian fleets.

		Philippine fleet			
Fishing year	Area	Reported sets	% sets observed	Reported hooks	% hooks observed
2002–03	N	241	96.7	1002	76.6

		Australian fleet			
Fishing year	Area	Reported sets	% sets observed	Reported hooks	% hooks observed
2005–06	N	15	53.3	17	52.4
2006–07	N	79	45.6	72	42.9

Table 5: Numbers of the most common species observed during 2018–19 by fleet and region. Species are given in descending order of total abundance. Also given is the percentage of these species that were retained, and the percentage of the discarded fish that were dead on landing (n/a, none discarded). (Continued next pages)

	Domestic		Total	% of	%	discards
Species	North	South	number	catch	retained	% dead
Blue shark	2 570	4 908	7 478	56.2	0.1	13.9
Lancetfish	1 783	25	1 808	13.6	0.0	81.7
Southern bluefin tuna	546	1 209	1 755	13.2	96.8	16.0
Albacore tuna	531	205	736	5.5	85.9	59.0
Porbeagle shark	70	222	292	2.2	0.0	61.0
Rays bream	63	142	205	1.5	52.9	20.8
Moonfish	127	41	168	1.3	96.9	25.0
Swordfish	123	43	166	1.2	97.0	50.0
Sunfish	137	10	147	1.1	0.7	0.7
Mako shark	65	35	100	0.8	5.0	32.6
Bigeye tuna	72	0	72	0.5	98.6	0.0
Pelagic stingray	49	1	50	0.4	0.0	14.3
Escolar	46	1	47	0.4	82.2	42.9
Shark, unidentified	0	37	37	0.3	0.0	0.0
Oilfish	33	0	33	0.2	77.4	14.3
Butterfly tuna	10	18	28	0.2	25.0	88.9
Striped marlin	14	0	14	0.1	0.0	14.3
Thresher shark	13	1	14	0.1	0.0	28.6
Ray, unidentified	8	5	13	0.1	0.0	16.7
Rudderfish	10	2	12	0.1	10.0	12.5
Cubehead	9	1	10	0.1	0.0	60.0
Deepwater dogfish	2	8	10	0.1	0.0	20.0
Salp	10	0	10	0.1	0.0	0.0
Pacific bluefin tuna	8	0	8	0.1	100.0	n/a
School shark	3	4	7	0.1	42.9	75.0
Yellowfin tuna	6	0	6	<0.1	100.0	n/a
Dolphinfish	4	0	4	<0.1	100.0	n/a
Shortbill spearfish	4	0	4	<0.1	0.0	25.0
Bronze whaler shark	3	0	3	<0.1	0.0	0.0
Dealfish	0	3	3	<0.1	0.0	50.0
Hake	0	3	3	<0.1	100.0	n/a
Kingfish	3	0	3	<0.1	66.7	0.0
Snake mackerel	3	0	3	<0.1	0.0	100.0
Gemfish	2	0	2	<0.1	0.0	0.0
Barracouta	0	1	1	<0.1	0.0	100.0
Flathead pomfret	1	0	1	<0.1	100.0	n/a
Hapuku and bass	0	1	1	<0.1	100.0	n/a
Pelagic stargazer	1	0	1	<0.1	0.0	0.0
Sea cucumber	1	0	1	<0.1	0.0	0.0
Sixgill shark	0	1	1	<0.1	0.0	0.0
Skipjack tuna	0	1	1	<0.1	100.0	n/a
Slender tuna	0	1	1	<0.1	0.0	0.0
Spine-tailed devil ray	1	0	1	<0.1	0.0	0.0
Unidentified fish	40	1	41			
Total	**6 371**	**6 930**	**13 301**			

Table 5: (*continued*). 2019–20.

Species	Domestic North	Domestic South	Total number	% of catch	% retained	discards % dead
Blue shark	1 973	1 698	3 671	35.2	0.1	13.0
Southern bluefin tuna	1 250	1 161	2 411	23.1	88.3	12.6
Lancetfish	1 003	109	1 112	10.7	0.0	74.0
Albacore tuna	834	170	1 004	9.6	87.6	69.7
Swordfish	397	4	401	3.8	96.0	42.9
Rays bream	151	166	317	3.0	97.2	11.1
Bigeye tuna	204	0	204	2.0	93.6	33.3
Moonfish	151	31	182	1.7	97.2	25.0
Pelagic stingray	175	0	175	1.7	0.0	0.6
Sunfish	156	3	159	1.5	0.0	0.0
Porbeagle shark	65	66	131	1.3	0.0	56.7
Oilfish	111	0	111	1.1	65.8	41.7
Mako shark	81	4	85	0.8	0.0	31.6
Escolar	74	0	74	0.7	53.4	9.1
Yellowfin tuna	62	0	62	0.6	96.8	0.0
Dolphinfish	31	0	31	0.3	87.1	25.0
Pacific bluefin tuna	26	4	30	0.3	100.0	n/a
Striped marlin	27	0	27	0.3	0.0	29.6
Thresher shark	24	0	24	0.2	0.0	33.3
Rudderfish	13	3	16	0.2	20.0	25.0
Skipjack tuna	13	0	13	0.1	53.8	83.3
Butterfly tuna	4	8	12	0.1	72.7	100.0
Salp	10	0	10	0.1	0.0	16.7
Bronze whaler shark	7	0	7	0.1	0.0	28.6
Dealfish	0	7	7	0.1	0.0	85.7
Kingfish	6	0	6	0.1	83.3	0.0
Big scale pomfret	5	0	5	<0.1	80.0	100.0
Deepwater dogfish	0	3	3	<0.1	0.0	100.0
Gemfish	3	0	3	<0.1	100.0	n/a
Hake	0	3	3	<0.1	100.0	n/a
Large headed slickhead	3	0	3	<0.1	0.0	0.0
School shark	0	3	3	<0.1	100.0	n/a
Shortbill spearfish	3	0	3	<0.1	0.0	0.0
Black barracouta	2	0	2	<0.1	0.0	50.0
Blue marlin	2	0	2	<0.1	0.0	50.0
Hāpuku and bass	2	0	2	<0.1	100.0	n/a
Pelagic stargazer	2	0	2	<0.1	0.0	0.0
Flathead pomfret	0	1	1	<0.1	0.0	0.0
Marlin, unspecified	1	0	1	<0.1	0.0	0.0
Unidentified fish	115	0	115			
Total	**6 986**	**3 444**	**10 430**			

Table 5: (*continued*). 2020–21.

Species	Domestic North	Domestic South	Total number	% of catch	% retained	discards % dead
Blue shark	1 586	2 550	4 136	38.9	0.0	13.1
Southern bluefin tuna	599	1 888	2 487	23.4	88.3	2.1
Albacore tuna	608	128	736	6.9	96.2	70.8
Swordfish	590	39	629	5.9	96.0	8.3
Lancetfish	491	25	516	4.8	0.0	87.5
Pelagic stingray	397	1	398	3.7	0.0	3.9
Rays bream	17	339	356	3.3	96.3	18.2
Porbeagle shark	26	269	295	2.8	0.0	71.7
Bigeye tuna	219	0	219	2.1	98.6	33.3
Sunfish	169	4	173	1.6	0.0	0.6
Yellowfin tuna	114	0	114	1.1	91.2	0.0
Mako shark	91	8	99	0.9	1.0	46.9
Moonfish	81	11	92	0.9	97.6	0.0
Striped marlin	58	0	58	0.5	0.0	22.2
Oilfish	48	0	48	0.5	21.3	30.6
Escolar	46	0	46	0.4	52.2	31.8
Butterfly tuna	12	27	39	0.4	39.5	77.3
Pacific bluefin tuna	14	11	25	0.2	100.0	n/a
Rudderfish	15	3	18	0.2	17.6	50.0
Slender tuna	0	16	16	0.2	18.8	53.8
Thresher shark	15	1	16	0.2	0.0	26.7
Dolphinfish	15	0	15	0.1	100.0	n/a
Kingfish	13	1	14	0.1	7.1	0.0
Bronze whaler shark	13	0	13	0.1	0.0	15.4
Skipjack tuna	12	0	12	0.1	100.0	n/a
Hāpuku and bass	5	2	7	0.1	100.0	n/a
Deepwater dogfish	0	6	6	0.1	0.0	33.3
Salp	6	0	6	0.1	0.0	0.0
School shark	3	2	5	<0.1	20.0	75.0
Hammerhead shark	4	0	4	<0.1	0.0	25.0
Dealfish	0	3	3	<0.1	0.0	33.3
Shortbill spearfish	3	0	3	<0.1	0.0	66.7
Blue marlin	2	0	2	<0.1	0.0	100.0
Short-tailed black ray	1	1	2	<0.1	0.0	0.0
Big scale pomfret	1	0	1	<0.1	0.0	0.0
Bluenose	0	1	1	<0.1	0.0	0.0
Cubehead	1	0	1	<0.1	0.0	100.0
Gemfish	1	0	1	<0.1	100.0	n/a
Longtailed stingray	1	0	1	<0.1	0.0	0.0
Manta ray	1	0	1	<0.1	0.0	100.0
Pilotfish	1	0	1	<0.1	100.0	n/a
Porcupine Fish	1	0	1	<0.1	0.0	0.0
Ribbonfish	0	1	1	<0.1	0.0	100.0
Unidentified fish	26	2	28			
Total	**5 306**	**5 339**	**10 645**			

Table 5: (*continued*). 2018–19 to 2020–21 combined.

Species	Domestic North	Domestic South	Total number	% of catch	% retained	discards % dead
Blue shark	6129	9156	15285	44.5	0.1	13.5
Southern bluefin tuna	2395	4258	6653	19.4	90.5	8.0
Lancetfish	3277	159	3436	10.0	0.0	80.1
Albacore tuna	1973	503	2476	7.2	89.7	65.4
Swordfish	1110	86	1196	3.5	96.1	30.0
Rays bream	231	647	878	2.6	86.5	19.8
Porbeagle shark	161	557	718	2.1	0.0	64.6
Pelagic stingray	621	2	623	1.8	0.0	3.8
Bigeye tuna	495	0	495	1.4	96.5	33.3
Sunfish	462	17	479	1.4	0.2	0.4
Moonfish	359	83	442	1.3	97.2	20.0
Mako shark	237	47	284	0.8	2.1	37.5
Oilfish	192	0	192	0.6	56.6	34.2
Yellowfin tuna	182	0	182	0.5	93.4	0.0
Escolar	166	1	167	0.5	61.0	21.0
Striped marlin	99	0	99	0.3	0.0	23.2
Butterfly tuna	26	53	79	0.2	39.0	83.7
Pacific bluefin tuna	48	15	63	0.2	100.0	n/a
Thresher shark	52	2	54	0.2	0.0	30.2
Dolphinfish	50	0	50	0.1	91.8	25.0
Rudderfish	38	8	46	0.1	16.7	31.3
Shark, unidentified	0	37	37	0.1	0.0	n/a
Salp	26	0	26	0.1	0.0	7.7
Skipjack tuna	25	1	26	0.1	76.9	83.3
Bronze whaler shark	23	0	23	0.1	0.0	17.4
Kingfish	22	1	23	0.1	34.8	0.0
Deepwater dogfish	2	17	19	0.1	0.0	36.8
Slender tuna	0	17	17	<0.1	17.6	50.0
School shark	6	9	15	<0.1	46.7	75.0
Dealfish	0	13	13	<0.1	0.0	66.7
Ray, unidentified	8	5	13	<0.1	0.0	16.7
Cubehead	10	1	11	<0.1	0.0	63.6
Hāpuku and bass	7	3	10	<0.1	100.0	n/a
Shortbill spearfish	10	0	10	<0.1	0.0	30.0
Big scale pomfret	6	0	6	<0.1	66.7	100.0
Gemfish	6	0	6	<0.1	66.7	0.0
Hake	0	6	6	<0.1	100.0	n/a
Blue marlin	4	0	4	<0.1	0.0	75.0
Hammerhead shark	4	0	4	<0.1	0.0	25.0
Large Headed Slickhead	3	0	3	<0.1	0.0	0.0
Pelagic stargazer	3	0	3	<0.1	0.0	0.0
Snake mackeral	3	0	3	<0.1	0.0	100.0
Black barracouta	2	0	2	<0.1	0.0	50.0
Flathead pomfret	1	1	2	<0.1	50.0	0.0
Short-Tailed Black Ray	1	1	2	<0.1	0.0	0.0

Table 5: (*continued*). 2018–19 to 2020–21 combined (*continued*).

	Domestic		Total	% of	%	discards
Species	North	South	number	catch	retained	% dead
Barracouta	0	1	1	<0.1	0.0	100.0
Bluenose	0	1	1	<0.1	0.0	0.0
Longtailed stingray	1	0	1	<0.1	0.0	0.0
Manta ray	1	0	1	<0.1	0.0	100.0
Marlin, unspecified	1	0	1	<0.1	0.0	0.0
Pilotfish	1	0	1	<0.1	100.0	n/a
Porcupine fish	1	0	1	<0.1	0.0	0.0
Ribbonfish	0	1	1	<0.1	0.0	100.0
Sea cucumber	1	0	1	<0.1	0.0	0.0
Sixgill shark	0	1	1	<0.1	0.0	0.0
Spine-tailed devil ray	1	0	1	<0.1	0.0	0.0
Unidentified fish	181	3	184			
Total	**18 663**	**15 713**	**34 376**			

Table 6: Percentage of main non-target species (including discards) that were alive or dead when observed between 2018–19 and 2020–21, by fishing year and region. Small sample sizes (number observed < 20) omitted, –, small sample or none caught.

1. Sharks and rays (Continued next pages)

Species	Year	Region	% Alive	% Dead	Number
Blue shark	**2018–19**	North	83.8	16.2	2 553
		South	87.7	12.3	4 901
		Total	**86.4**	**13.6**	**7 454**
	2019–20	North	88.3	11.7	1 937
		South	86.6	13.4	1 602
		Total	**87.5**	**12.5**	**3 539**
	2020–21	North	89.7	10.3	1 544
		South	91.3	8.7	2 517
		Total	**90.7**	**9.3**	**4 061**
	Total all strata		**87.8**	**12.2**	**15 054**
Mako shark	**2018–19**	North	78.5	21.5	65
		South	55.9	44.1	34
		Total	**70.7**	**29.3**	**99**
	2019–20	North	71.1	28.9	76
		Total	**70.0**	**30.0**	**80**
	2020–21	North	62.6	37.4	91
		Total	**63.6**	**36.4**	**99**
	Total all strata		**68.0**	**32.0**	**278**
Porbeagle shark	**2018–19**	North	38.6	61.4	70
		South	40.1	59.9	222
		Total	**39.7**	**60.3**	**292**
	2019–20	North	52.3	47.7	65
		South	33.3	66.7	63
		Total	**43.0**	**57.0**	**128**
	2020–21	North	50.0	50.0	26
		South	28.0	72.0	268
		Total	**29.9**	**70.1**	**294**
	Total all strata		**36.3**	**63.7**	**714**
School shark	**2018–19**	**Total**	–	–	**7**
	2019–20	**Total**	–	–	**3**
	2020–21	**Total**	–	–	**5**
	Total all strata		**60.0**	**40.0**	**15**

Table 6 (*continued*). Sharks and rays (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Deepwater dogfish	**2018–19**	**Total**	–	–	**10**
	2019–20	**Total**	–	–	**3**
	2020–21	**Total**	–	–	**6**
	Total all strata		**63.2**	**36.8**	**19**
Pelagic ray	**2018–19**	North	95.9	4.1	49
		Total	**96.0**	**4.0**	**50**
	2019–20	North	98.3	1.7	175
		Total	**98.3**	**1.7**	**175**
	2020–21	North	98.7	1.3	391
		Total	**98.7**	**1.3**	**392**
	Total all strata		**98.4**	**1.6**	**617**

Table 6 (*continued*). 2. Tuna and billfish

Species	Year	Region	% Alive	% Dead	Number
Albacore	**2018–19**	North	44.3	55.7	531
		South	33.7	66.3	202
		Total	**41.3**	**58.7**	**733**
	2019–20	North	29.9	70.1	834
		South	33.5	66.5	170
		Total	**30.5**	**69.5**	**1 004**
	2020–21	North	28.9	71.1	598
		South	35.4	64.6	127
		Total	**30.1**	**69.9**	**725**
	Total all strata		**33.6**	**66.4**	**2 462**
Bigeye tuna	2018–19	North	81.9	18.1	72
		Total	**81.9**	**18.1**	**72**
	2019–20	North	77.9	22.1	204
		Total	**77.9**	**22.1**	**204**
	2020–21	North	67.6	32.4	219
		Total	**67.6**	**32.4**	**219**
	Total all strata		**73.9**	**26.1**	**495**
Butterfly tuna	**2018–19**	**Total**	**17.9**	**82.1**	**28**
	2019–20	**Total**	–	–	**12**
	2020–21	South	25.9	74.1	27
		Total	**23.1**	**76.9**	**39**
	Total all strata		**20.3**	**79.7**	**79**
Southern bluefin tuna	**2018–19**	North	75.6	24.4	546
		South	79.6	20.4	1208
		Total	**78.4**	**21.6**	**1 754**
	2019–20	North	70.6	29.4	1250
		South	78.9	21.1	1149
		Total	**74.6**	**25.4**	**2 399**
	2020–21	North	75.0	25.0	591
		South	76.0	24.0	1888
		Total	**75.7**	**24.3**	**2 479**
	Total all strata		**76.0**	**24.0**	**6632**
Yellowfin tuna	**2018–19**	**Total**	–	–	**6**
	2019–20	North	82.3	17.7	62
		Total	**82.3**	**17.7**	**62**
	2020–21	North	75.4	24.6	114
		Total	**75.4**	**24.6**	**114**
	Total all strata		**78.0**	**22.0**	**182**

Table 6 (*continued*). Tuna and billfish (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Striped marlin	**2018–19**	**Total**	–	–	**14**
	2019–20	North	70.4	29.6	27
		Total	**70.4**	**29.6**	**27**
	2020–21	North	78.2	21.8	55
		Total	**78.2**	**21.8**	**55**
	Total all strata		**77.1**	**22.9**	**96**
Swordfish	**2018–19**	North	33.3	66.7	123
		South	46.5	53.5	43
		Total	**36.7**	**63.3**	**166**
	2019–20	North	23.2	76.8	397
		Total	**23.4**	**76.6**	**401**
	2020–21	North	22.4	77.6	589
		South	71.8	28.2	39
		Total	**25.5**	**74.5**	**628**
	Total all strata		**26.4**	**73.6**	**1 195**

Table 6: (*continued*). 3. Teleosts

Species	Year	Region	% Alive	% Dead	Number
Bigscale pomfret	**2018–19**	**Total**	–	–	**0**
	2019–20	**Total**	–	–	**5**
	2020–21	**Total**	–	–	**1**
	Total all strata		**66.7**	**33.3**	**6**
Dealfish	**2018–19**	**Total**	–	–	**3**
	2019–20	**Total**	–	–	**7**
	2020–21	**Total**	–	–	**3**
	Total all strata		**30.8**	**69.2**	**13**
Lancetfish	**2018–19**	North	37.5	62.5	1757
		South	52.0	48.0	25
		Total	**37.7**	**62.3**	**1 782**
	2019–20	North	41.2	58.8	969
		South	14.7	85.3	102
		Total	**38.7**	**61.3**	**1 071**
	2020–21	North	16.1	83.9	483
		South	24.0	76.0	25
		Total	**16.5**	**83.5**	**508**
	Total all strata		**34.8**	**65.2**	**3 361**
Escolar	**2018–19**	North	76.1	23.9	46
		Total	**74.5**	**25.5**	**47**
	2019–20	North	87.7	12.3	73
		Total	**87.7**	**12.3**	**73**
	2020–21	North	76.1	23.9	46
		Total	**76.1**	**23.9**	**46**
	Total all strata		**80.7**	**19.3**	**166**
Moonfish	**2018–19**	North	68.5	31.5	127
		South	89.7	10.3	39
		Total	**73.5**	**26.5**	**166**
	2019–20	North	70.0	30.0	150
		South	90.3	9.7	31
		Total	**73.5**	**26.5**	**181**
	2020–21	North	75.3	24.7	81
		Total	**77.2**	**22.8**	**92**
	Total all strata		**74.3**	**25.7**	**439**

Table 6 (*continued*). Teleosts (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Oilfish	**2018–19**	North	100.0	0.0	33
		Total	**100.0**	**0.0**	**33**
	2019–20	North	86.4	13.6	110
		Total	**86.4**	**13.6**	**110**
	2020–21	North	77.1	22.9	48
		Total	**77.1**	**22.9**	**48**
	Total all strata		**86.4**	**13.6**	**191**
Rays bream	**2018–19**	North	88.9	11.1	63
		South	83.8	16.2	142
		Total	**85.4**	**14.6**	**205**
	2019–20	North	88.1	11.9	151
		South	89.8	10.2	166
		Total	**89.0**	**11.0**	**317**
	2020–21	South	86.0	14.0	336
		Total	**84.4**	**15.6**	**353**
	Total all strata		**86.3**	**13.7**	**875**
Rudderfish	**2018–19**	**Total**	−	−	**12**
	2019–20	**Total**	−	−	**16**
	2020–21	**Total**	−	−	**18**
	Total all strata		**71.7**	**28.3**	**46**
Sunfish	**2018–19**	North	100.0	0.0	137
		Total	**100.0**	**0.0**	**147**
	2019–20	North	100.0	0.0	156
		Total	**100.0**	**0.0**	**158**
	2020–21	North	99.4	0.6	168
		Total	**99.4**	**0.6**	**172**
	Total all strata		**99.8**	**0.2**	**477**

Table 7: Percentage of main non-target species that were retained, or discarded or lost, when observed between 2018–19 and 2020–21, by fishing year and fleet. Small sample sizes (number observed < 20) omitted, –, small sample or none caught.

1. Sharks (Continued next pages)

Species	Year	Region	% Retained	% Discarded or lost	Number
Blue shark	**2018–19**	North	0.2	99.8	2 569
		South	0.0	100.0	4 907
		Total	**0.1**	**99.9**	**7 476**
	2019–20	North	0.0	100.0	1 965
		South	0.1	99.9	1 666
		Total	**0.1**	**99.9**	**3 631**
	2020–21	North	0.0	100.0	1 548
		South	0.0	100.0	2 539
		Total	**0.0**	**100.0**	**4 087**
	Total all strata		**0.1**	**99.9**	**15 194**
Mako shark	**2018–19**	North	7.7	92.3	65
		South	0.0	100.0	35
		Total	**5.0**	**95.0**	**100**
	2019–20	North	0.0	100.0	80
		Total	**0.0**	**100.0**	**84**
	2020–21	North	1.1	98.9	91
		Total	**1.0**	**99.0**	**99**
	Total all strata		**2.1**	**97.9**	**283**
Porbeagle shark	**2018–19**	North	0.0	100.0	70
		South	0.0	100.0	222
		Total	**0.0**	**100.0**	**292**
	2019–20	North	0.0	100.0	65
		South	0.0	100.0	64
		Total	**0.0**	**100.0**	**129**
	2020–21	North	0.0	100.0	26
		South	0.0	100.0	269
		Total	**0.0**	**100.0**	**295**
	Total all strata		**0.0**	**100.0**	**716**
School shark	**2018–19**	**Total**	–	–	**7**
	2019–20	**Total**	–	–	**3**
	2020–21	**Total**	–	–	**5**
	Total all strata		**46.7**	**53.3**	**15**

Table 7 (*continued*). Sharks (*continued*)

Species	Year	Region	% Retained	% Discarded or lost	Number
Deepwater dogfish	**2018–19**	**Total**	–	–	**10**
	2019–20	**Total**	–	–	**3**
	2020–21	**Total**	–	–	**6**
	Total all strata		**0.0**	**100.0**	**19**
Pelagic ray	**2018–19**	North	0.0	100.0	49
		Total	**0.0**	**100.0**	**50**
	2019–20	North	0.0	100.0	175
		Total	**0.0**	**100.0**	**175**
	2020–21	North	0.0	100.0	392
		Total	**0.0**	**100.0**	**393**
	Total all strata		**0.0**	**100.0**	**618**

Table 7: (*continued*). 2. Tuna and billfish

Species	Year	Region	% Retained	% Discarded or lost	Number
Albacore	**2018–19**	North	80.8	19.2	531
		South	94.6	5.4	205
		Total	**84.6**	**15.4**	**736**
	2019–20	North	84.9	15.1	834
		South	98.8	1.2	170
		Total	**87.3**	**12.7**	**1 004**
	2020–21	North	94.7	5.3	608
		South	99.2	0.8	128
		Total	**95.5**	**4.5**	**736**
	Total all strata		**88.9**	**11.1**	**2 476**
Bigeye tuna	2018–19	North	95.8	4.2	72
		Total	**95.8**	**4.2**	**72**
	2019–20	North	93.6	6.4	204
		Total	**93.6**	**6.4**	**204**
	2020–21	North	98.2	1.8	219
		Total	**98.2**	**1.8**	**219**
	Total all strata		**96.0**	**4.0**	**495**
Butterfly tuna	**2018–19**	**Total**	**25.0**	**75.0**	**28**
	2019–20	**Total**	−	−	**12**
	2020–21	South	51.9	48.1	27
		Total	**39.5**	**60.5**	**38**
	Total all strata		**38.5**	**61.5**	**78**
Southern bluefin tuna	**2018–19**	North	97.6	2.4	546
		South	95.0	5.0	1 209
		Total	**95.8**	**4.2**	**1 755**
	2019–20	North	84.8	15.2	1250
		South	91.0	9.0	1161
		Total	**87.8**	**12.2**	**2 411**
	2020–21	North	92.0	8.0	597
		South	86.3	13.7	1887
		Total	**87.7**	**12.3**	**2 484**
	Total all strata		**89.9**	**10.1**	**6 650**

Table 7 (*continued*). Tuna and billfish (*continued*)

Species	Year	Region	% Retained	% Discarded or lost	Number
Yellowfin tuna	**2018–19**	**Total**	–	–	**6**
	2019–20	North	96.8	3.2	62
		Total	**96.8**	**3.2**	**62**
	2020–21	North	90.4	9.6	114
		Total	**90.4**	**9.6**	**114**
	Total all strata		**92.9**	**7.1**	**182**
Striped marlin	**2018–19**	**Total**	–	–	**14**
	2019–20	North	0.0	100.0	27
		Total	**0.0**	**100.0**	**27**
	2020–21	North	0.0	100.0	56
		Total	**0.0**	**100.0**	**56**
	Total all strata		**0.0**	**100.0**	**97**
Swordfish	**2018–19**	North	95.1	4.9	123
		South	100.0	0.0	43
		Total	**96.4**	**3.6**	**166**
	2019–20	North	95.2	4.8	396
		Total	**95.3**	**4.8**	**400**
	2020–21	North	94.2	5.8	589
		South	100.0	0.0	39
		Total	**94.6**	**5.4**	**628**
	Total all strata		**95.1**	**4.9**	**1 194**

Table 7: (*continued*). 3. Teleosts

Species	Year	Region	% Retained	% Discarded or lost	Number
Bigscale pomfret	**2018–19**	**Total**	–	–	**0**
	2019–20	**Total**	–	–	**5**
	2020–21	**Total**	–	–	**1**
	Total all strata		**66.7**	**33.3**	**6**
Dealfish	**2018–19**	**Total**	–	–	**3**
	2019–20	**Total**	–	–	**7**
	2020–21	**Total**	–	–	**3**
	Total all strata		**0.0**	**100.0**	**13**
Lancetfish	**2018–19**	North	0.0	100.0	1 783
		South	0.0	100.0	25
		Total	**0.0**	**100.0**	**1 808**
	2019–20	North	0.0	100.0	1001
		South	0.0	100.0	108
		Total	**0.0**	**100.0**	**1 109**
	2020–21	North	0.0	100.0	484
		South	0.0	100.0	25
		Total	**0.0**	**100.0**	**509**
	Total all strata		**0.0**	**100.0**	**3 426**
Escolar	**2018–19**	North	80.4	19.6	46
		Total	**78.7**	**21.3**	**47**
	2019–20	North	52.7	47.3	74
		Total	**52.7**	**47.3**	**74**
	2020–21	North	52.2	47.8	46
		Total	**52.2**	**47.8**	**46**
	Total all strata		**59.9**	**40.1**	**167**
Moonfish	**2018–19**	North	94.5	5.5	127
		South	92.7	7.3	41
		Total	**94.0**	**6.0**	**168**
	2019–20	North	97.4	2.6	151
		South	90.3	9.7	31
		Total	**96.2**	**3.8**	**182**
	2020–21	North	88.9	11.1	81
		Total	**89.1**	**10.9**	**92**
	Total all strata		**93.9**	**6.1**	**442**

Table 7 (*continued*). Teleosts (*continued*)

Species	Year	Region	% Retained	% Discarded or lost	Number
Oilfish	**2018–19**	North	72.7	27.3	33
		Total	**72.7**	**27.3**	**33**
	2019–20	North	65.8	34.2	111
		Total	**65.8**	**34.2**	**111**
	2020–21	North	20.8	79.2	48
		Total	**20.8**	**79.2**	**48**
	Total all strata		**55.7**	**44.3**	**192**
Rays bream	**2018–19**	North	98.4	1.6	63
		South	32.4	67.6	142
		Total	**52.7**	**47.3**	**205**
	2019–20	North	99.3	0.7	151
		South	95.2	4.8	166
		Total	**97.2**	**2.8**	**317**
	2020–21	South	95.9	4.1	338
		Total	**95.8**	**4.2**	**355**
	Total all strata		**86.2**	**13.8**	**877**
Rudderfish	**2018–19**	**Total**	−	−	**12**
	2019–20	**Total**	−	−	**16**
	2020–21	**Total**	−	−	**18**
	Total all strata		**15.2**	**84.8**	**46**
Sunfish	**2018–19**	North	0.7	99.3	137
		Total	**0.7**	**99.3**	**147**
	2019–20	North	0.0	100.0	156
		Total	**0.0**	**100.0**	**159**
	2020–21	North	0.0	100.0	168
		Total	**0.0**	**100.0**	**172**
	Total all strata		**0.2**	**99.8**	**478**

Table 8: Percentage of discarded main non–target species that were alive or dead when recovered on observed sets between 2018–19 and 2020–21, by fishing year and fleet. Small sample sizes (number observed < 20) omitted, –, small sample or none discarded.

1. Sharks (Continued next pages)

Species	Year	Region	% Alive	% Dead	Number
Blue shark	**2018–19**	North	82.0	18.0	2 506
		South	88.2	11.8	4 814
		Total	**86.1**	**13.9**	**7 320**
	2019–20	North	87.7	12.3	1 924
		South	86.1	13.9	1 591
		Total	**87.0**	**13.0**	**3 515**
	2020–21	North	79.3	20.7	1 461
		South	91.4	8.6	2 449
		Total	**86.9**	**13.1**	**3 910**
	Total all strata		**86.5**	**13.5**	**14 745**
Mako shark	**2018–19**	North	73.3	26.7	60
		South	56.3	43.8	32
		Total	**67.4**	**32.6**	**92**
	2019–20	North	69.3	30.7	75
		Total	**68.4**	**31.6**	**79**
	2020–21	North	51.1	48.9	88
		Total	**53.1**	**46.9**	**96**
	Total all strata		**62.5**	**37.5**	**267**
Porbeagle shark	**2018–19**	North	38.6	61.4	70
		South	39.1	60.9	220
		Total	**39.0**	**61.0**	**290**
	2019–20	North	53.8	46.2	65
		South	32.3	67.7	62
		Total	**43.3**	**56.7**	**127**
	2020–21	North	33.3	66.7	24
		South	27.8	72.2	266
		Total	**28.3**	**71.7**	**290**
	Total all strata		**35.4**	**64.6**	**707**
School shark	**2018–19**	**Total**	–	–	**4**
	2019–20	**Total**	–	–	**0**
	2020–21	**Total**	–	–	**4**
	Total all strata		**25.0**	**75.0**	**8**

Table 8 (*continued*). Sharks (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Deepwater dogfish	**2018–19**	**Total**	**–**	**–**	**10**
	2019–20	**Total**	**–**	**–**	**3**
	2020–21	**Total**	**–**	**–**	**6**
	Total all strata		**63.2**	**36.8**	**19**
Pelagic ray	**2018–19**	North	85.4	14.6	48
		Total	**85.7**	**14.3**	**49**
	2019–20	North	99.4	0.6	173
		Total	**99.4**	**0.6**	**173**
	2020–21	North	96.1	3.9	386
		Total	**96.1**	**3.9**	**387**
	Total all strata		**96.2**	**3.8**	**609**

Table 8 (*continued*) 2. Tuna and billfish

Species	Year	Region	% Alive	% Dead	Number
Albacore	**2018–19**	North	40.4	59.6	94
		Total	**41.0**	**59.0**	**100**
	2019–20	North	30.3	69.7	122
		Total	**30.3**	**69.7**	**122**
	2020–21	North	26.1	73.9	23
		Total	**29.2**	**70.8**	**24**
	Total all strata		**34.6**	**65.4**	**246**
Bigeye tuna	**2018–19**	**Total**	–	–	**0**
	2019–20	**Total**	–	–	**12**
	2020–21	**Total**	–	–	**3**
	Total all strata		**66.7**	**33.3**	**15**
Butterfly tuna	**2018–19**	**Total**	**11.1**	**88.9**	**18**
	2019–20	**Total**	**0.0**	**100.0**	**3**
	2020–21	**Total**	**22.7**	**77.3**	**22**
	Total all strata		**16.3**	**83.7**	**43**
Southern bluefin tuna	**2018–19**	North	–	–	10
		South	87.5	12.5	40
		Total	**84.0**	**16.0**	**50**
	2019–20	North	88.8	11.2	179
		South	84.8	15.2	99
		Total	**87.4**	**12.6**	**278**
	2020–21	North	91.4	8.6	35
		South	98.8	1.2	246
		Total	**97.9**	**2.1**	**281**
	Total all strata		**92.0**	**8.0**	**609**
Yellowfin tuna	**2018–19**	**Total**	–	–	**0**
	2019–20	**Total**	–	–	**2**
	2020–21	**Total**	–	–	**9**
	Total all strata		**100.0**	**0.0**	**11**

Table 8 (*continued*) 2. Tuna and billfish (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Striped marlin	**2018–19**	**Total**	**–**	**–**	**14**
	2019–20	North	70.4	29.6	27
		Total	**70.4**	**29.6**	**27**
	2020–21	North	77.8	22.2	54
		Total	**77.8**	**22.2**	**54**
	Total all strata		**76.8**	**23.2**	**95**
Swordfish	**2018–19**	**Total**	**–**	**–**	**4**
	2019–20	**Total**	**–**	**–**	**14**
	2020–21	**Total**	**–**	**–**	**12**
	Total all strata		**70.0**	**30.0**	**30**

Table 8 (*continued*) 3. Teleosts

Species	Year	Region	% Alive	% Dead	Number
Bigscale pomfret	**2018–19**	**Total**	**–**	**–**	**0**
	2019–20	**Total**	**–**	**–**	**1**
	2020–21	**Total**	**–**	**–**	**0**
	Total all strata		**0.0**	**100.0**	**1**
Dealfish	**2018–19**	**Total**	**–**	**–**	**2**
	2019–20	**Total**	**–**	**–**	**7**
	2020–21	**Total**	**–**	**–**	**3**
	Total all strata		**33.3**	**66.7**	**12**
Lancetfish	**2018–19**	North	17.9	82.1	1 768
		South	47.6	52.4	21
		Total	**18.3**	**81.7**	**1 789**
	2019–20	North	27.3	72.7	987
		South	13.6	86.4	103
		Total	**26.0**	**74.0**	**1 090**
	2020–21	North	12.3	87.7	479
		South	16.0	84.0	25
		Total	**12.5**	**87.5**	**504**
	Total all strata		**19.9**	**80.1**	**3 383**
Escolar	**2018–19**	**Total**	**–**	**–**	**7**
	2019–20	North	90.9	9.1	33
		Total	**90.9**	**9.1**	**33**
	2020–21	North	68.2	31.8	22
		Total	**68.2**	**31.8**	**22**
	Total all strata		**79.0**	**21.0**	**62**
Moonfish	**2018–19**	**Total**	**–**	**–**	**4**
	2019–20	**Total**	**–**	**–**	**4**
	2020–21	**Total**	**–**	**–**	**2**
	Total all strata		**80.0**	**20.0**	**10**

Table 8 (*continued*). Teleosts (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Oilfish	**2018–19**	**Total**	**–**	**–**	**7**
	2019–20	North	58.3	41.7	36
		Total	**58.3**	**41.7**	**36**
	2020–21	North	69.4	30.6	36
		Total	**69.4**	**30.6**	**36**
	Total all strata		**65.8**	**34.2**	**79**
Rays bream	**2018–19**	South	80.0	20.0	95
		Total	**79.2**	**20.8**	**96**
	2019–20	**Total**	**–**	**–**	**9**
	2020–21	**Total**	**–**	**–**	**11**
	Total all strata		**80.2**	**19.8**	**116**
Rudderfish	**2018–19**	**Total**	**–**	**–**	**8**
	2019–20	**Total**	**–**	**–**	**12**
	2020–21	**Total**	**–**	**–**	**12**
	Total all strata		**68.8**	**31.3**	**32**
Sunfish	**2018–19**	North	99.3	0.7	136
		Total	**99.3**	**0.7**	**144**
	2019–20	North	100.0	0.0	156
		Total	**100.0**	**0.0**	**158**
	2020–21	North	99.4	0.6	160
		Total	**99.4**	**0.6**	**164**
	Total all strata		**99.6**	**0.4**	**466**

8. FIGURES

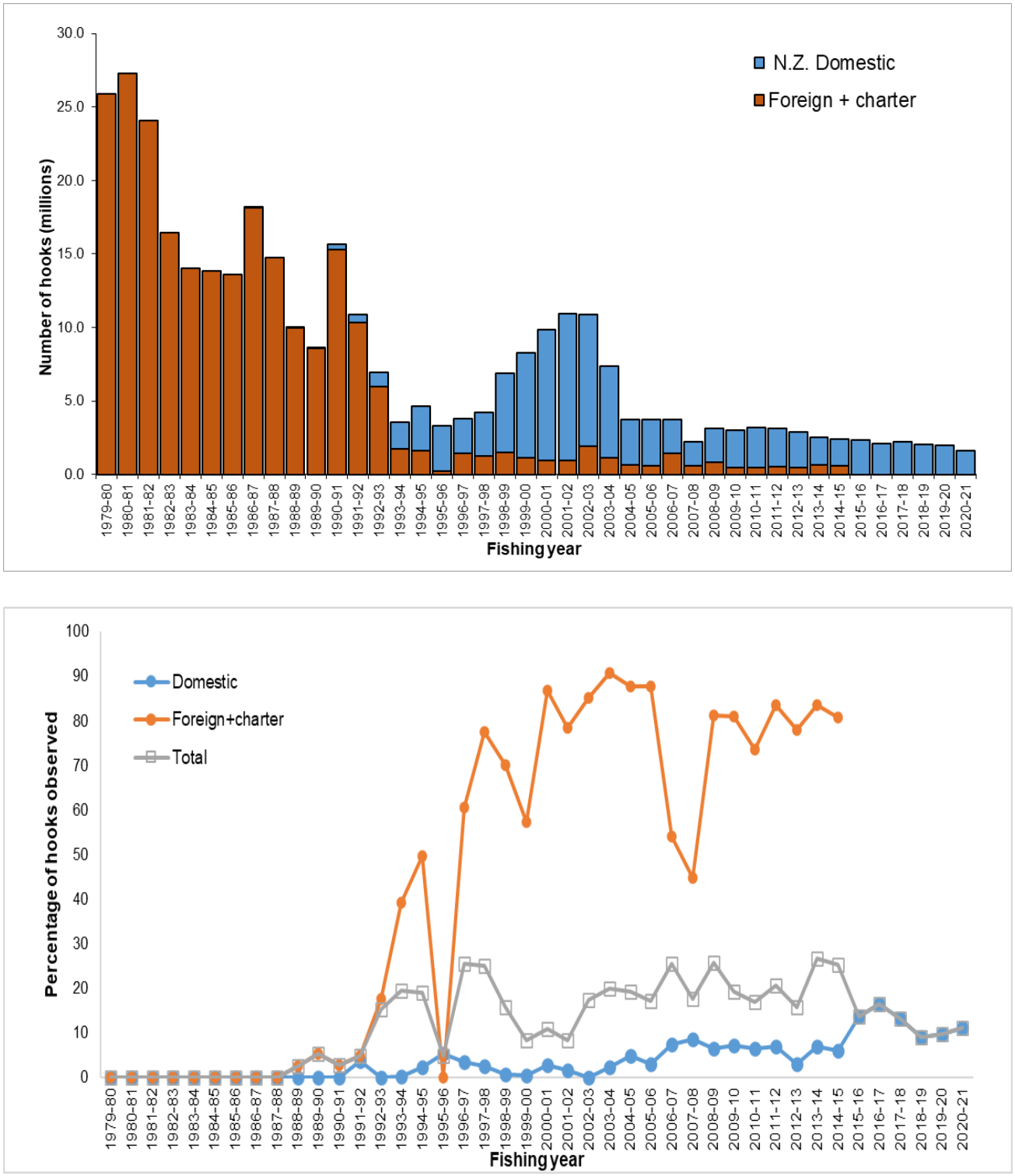


Figure 1: **Number of reported hooks set by fishing year and fleet from 1979–80 to 2020–21 (above) and percentage of hooks observed (below). "Foreign + Charter" includes Japanese Foreign licensed and Charter vessels, Korean Foreign licensed vessels, Philippine Charter vessels, Australian Charter vessels, and one large New Zealand Domestic vessel which fished with the Charter fleet.**

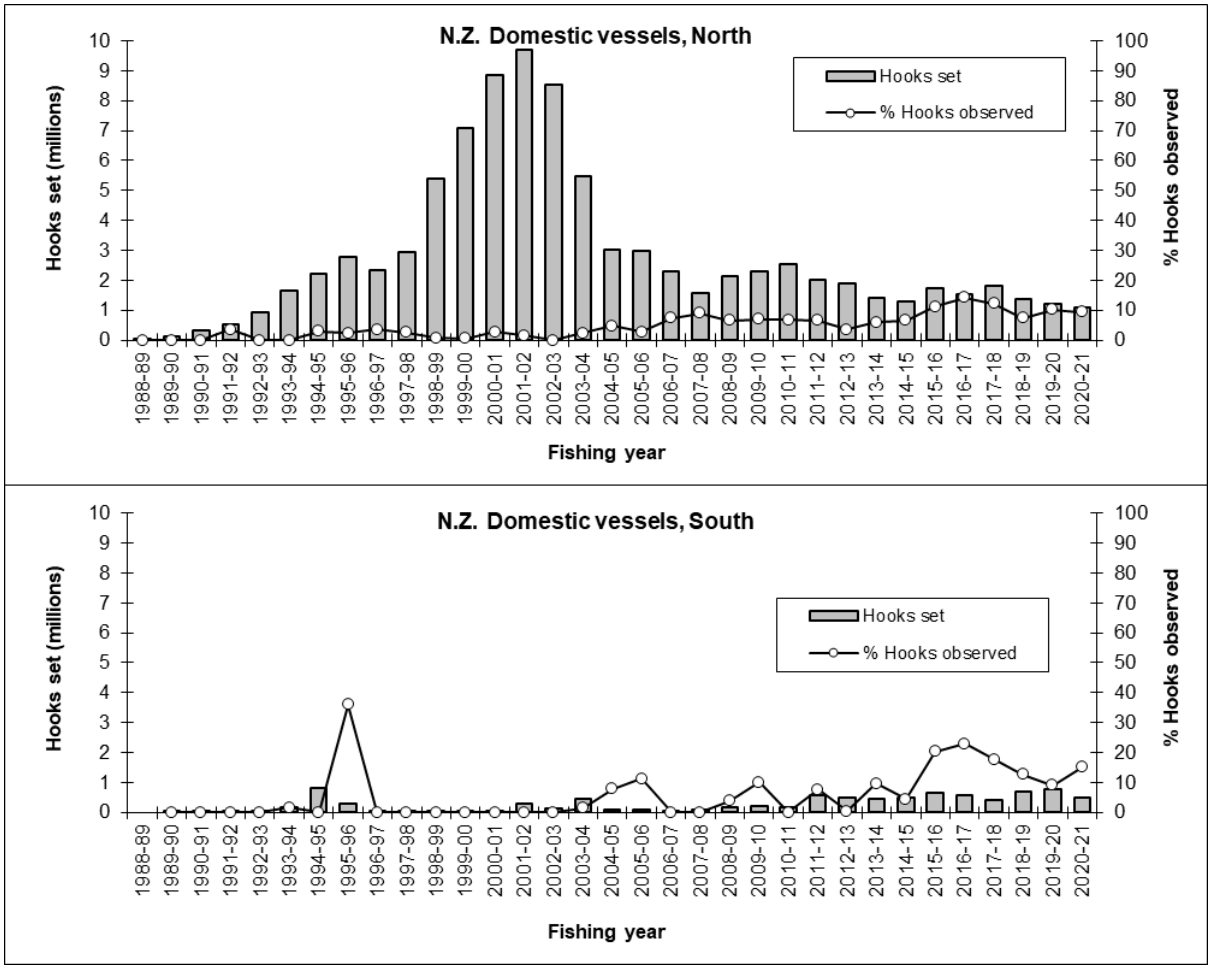


Figure 2: Numbers of hooks set, and percentage of hooks observed, by the Domestic fleet, by region and fishing year.

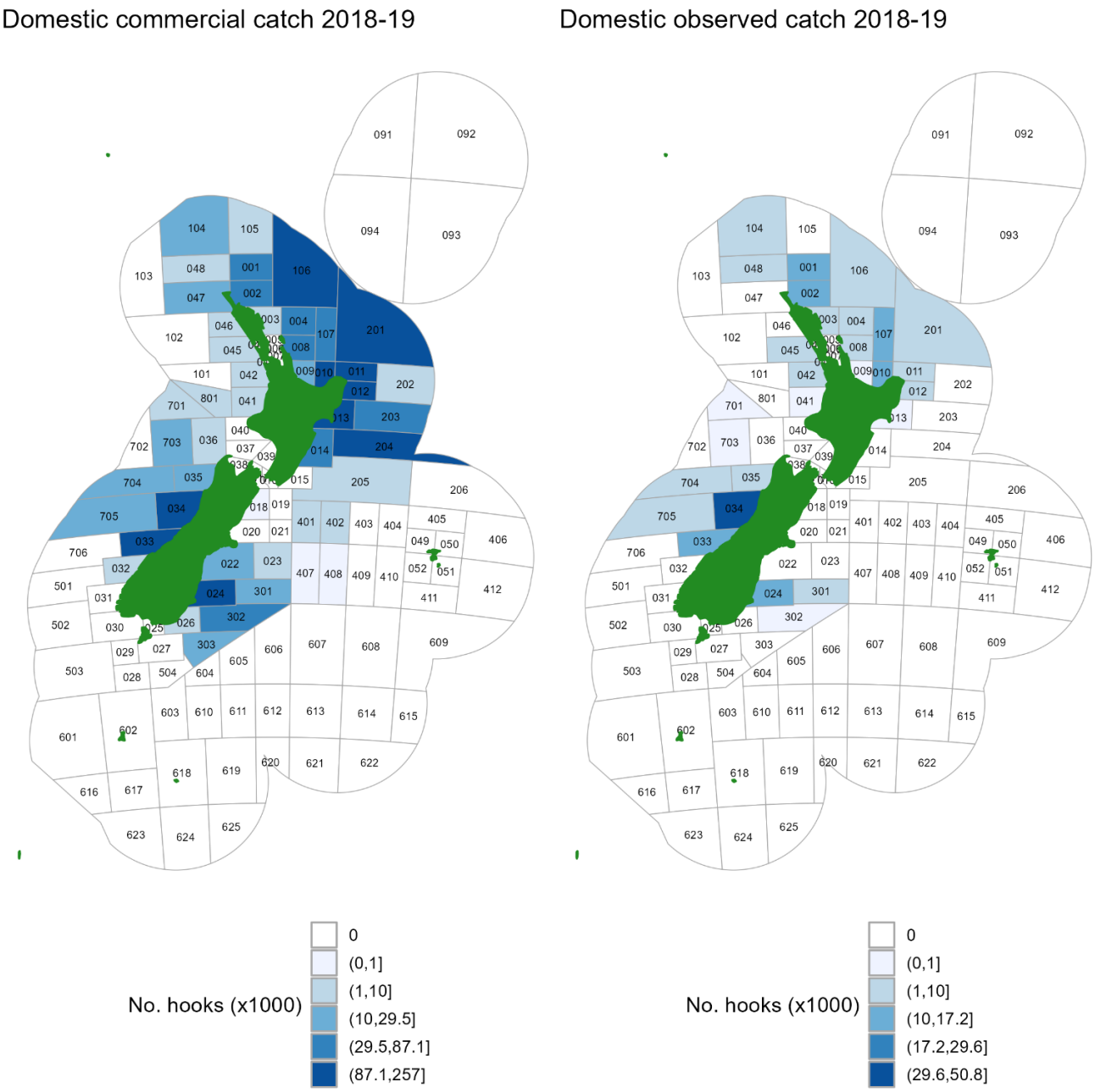


Figure 3: Numbers of hooks set (thousands) based on commercial returns (left) and observed (right) for longlines set by Domestic vessels shown as Statistical Area density plots. Colour legend shows number of hooks (differs among maps). Numerals are statistical area codes. 2018–19. (Continued next pages)

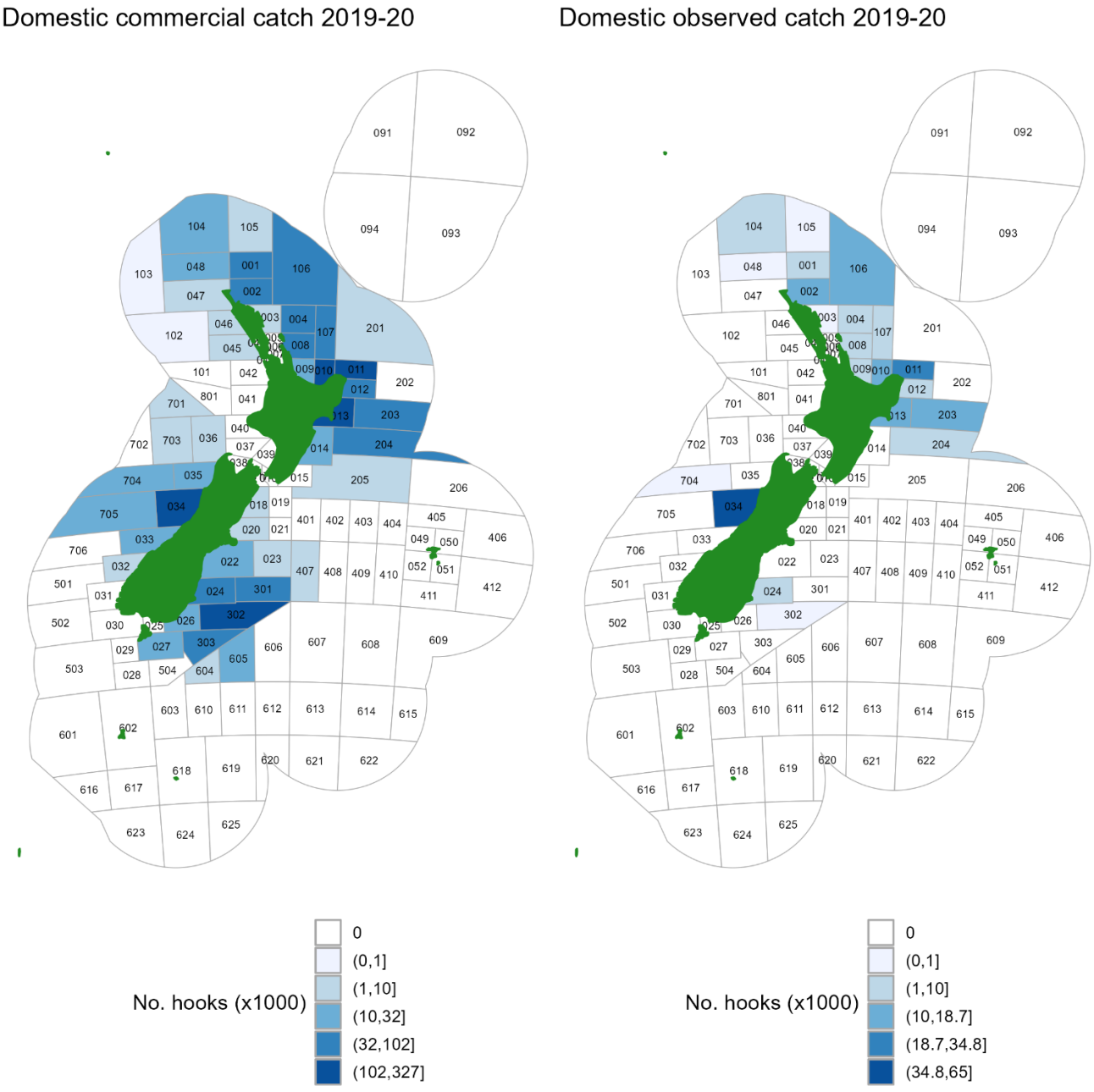


Figure 3: (*continued*). 2019–20.

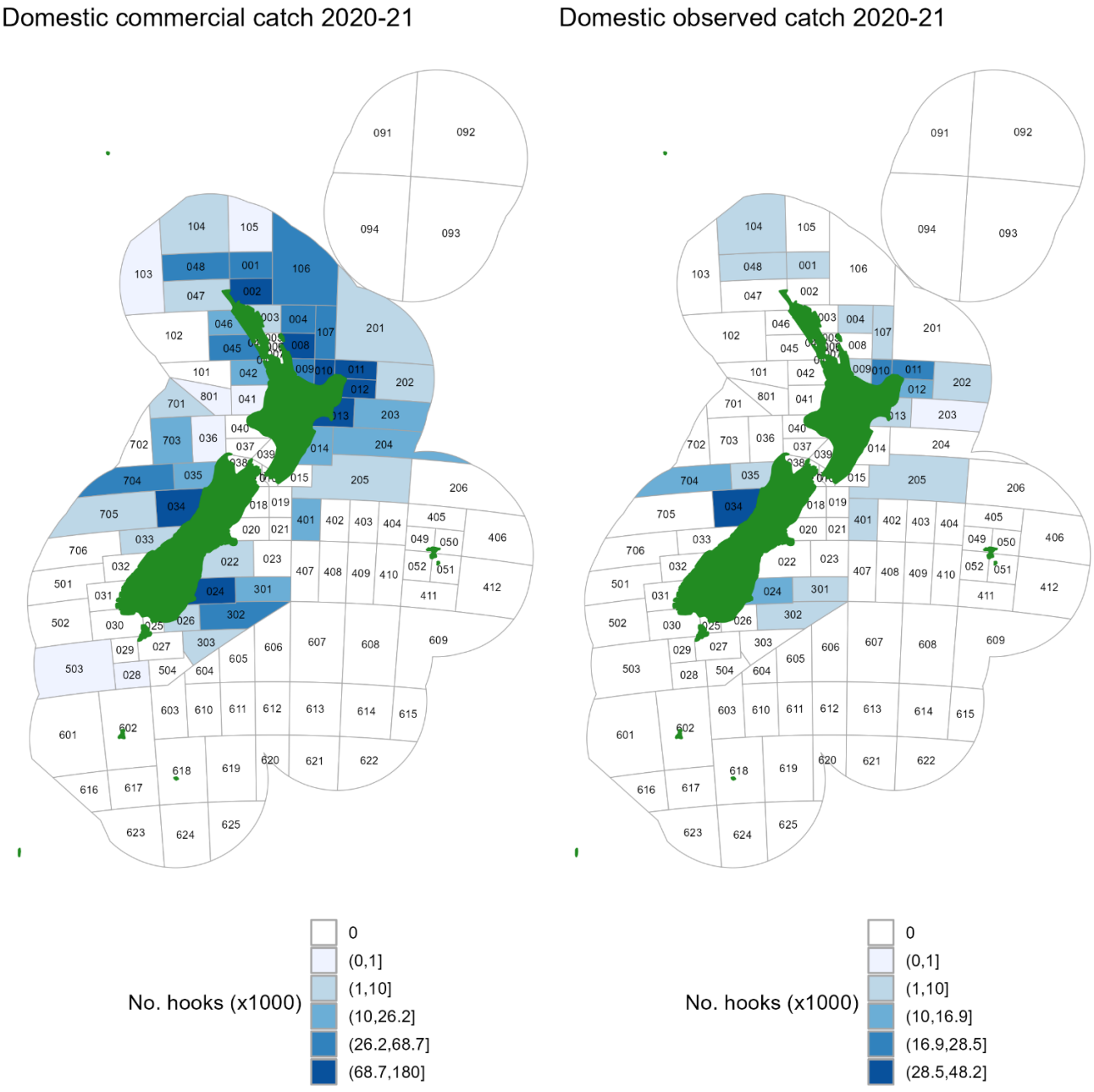


Figure 3: (*continued*). 2020–21.

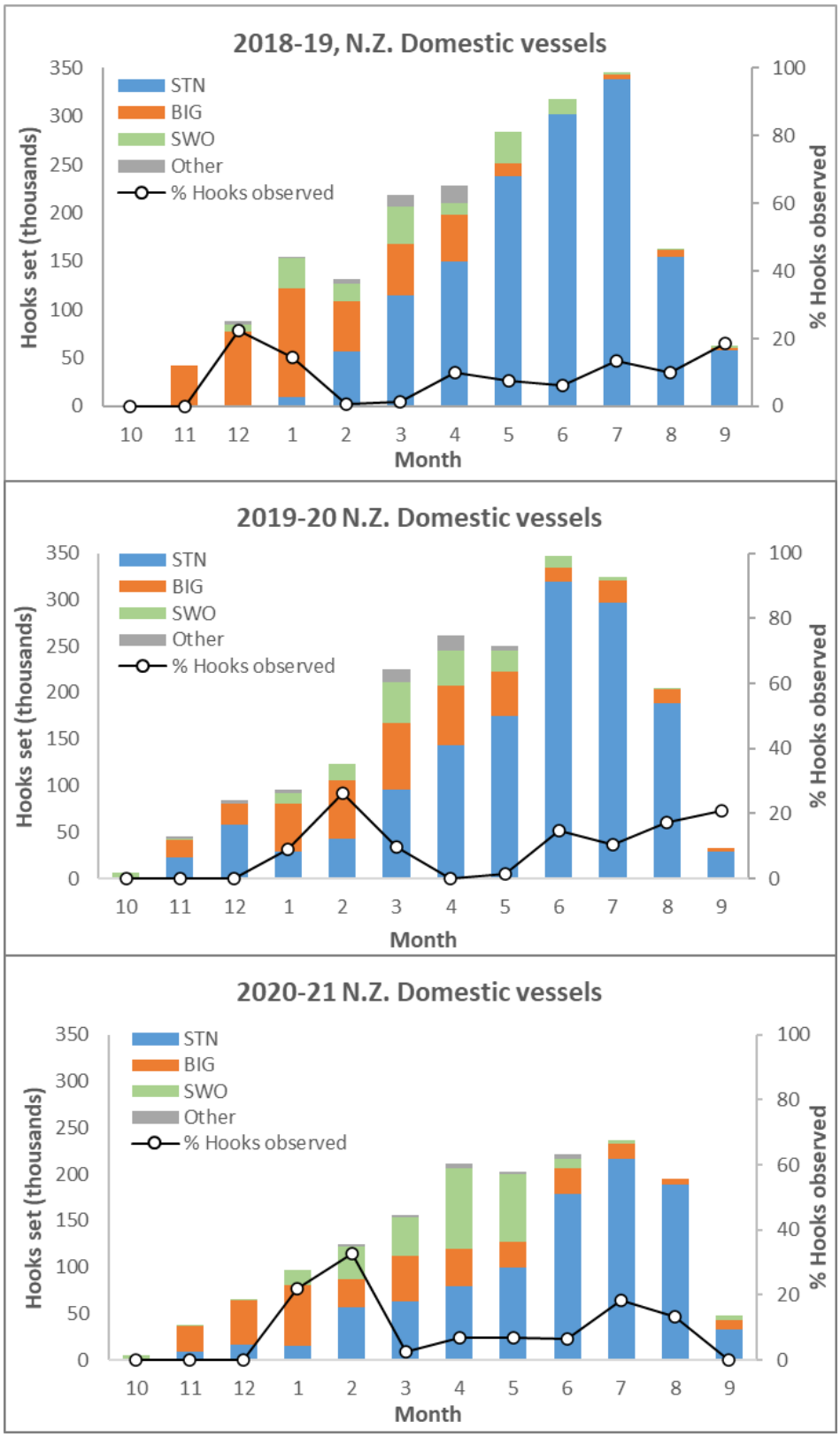


Figure 4: Monthly distribution of reported hooks and the percentage observed in 2019–20 to 2020–21 by Domestic vessels by month and target species. Colours show number of hooks set by each target species. The percentage of hooks observed is shown on the right-hand axes (white circles). STN = southern bluefin tuna, BIG = bigeye tuna, SWO = swordfish.

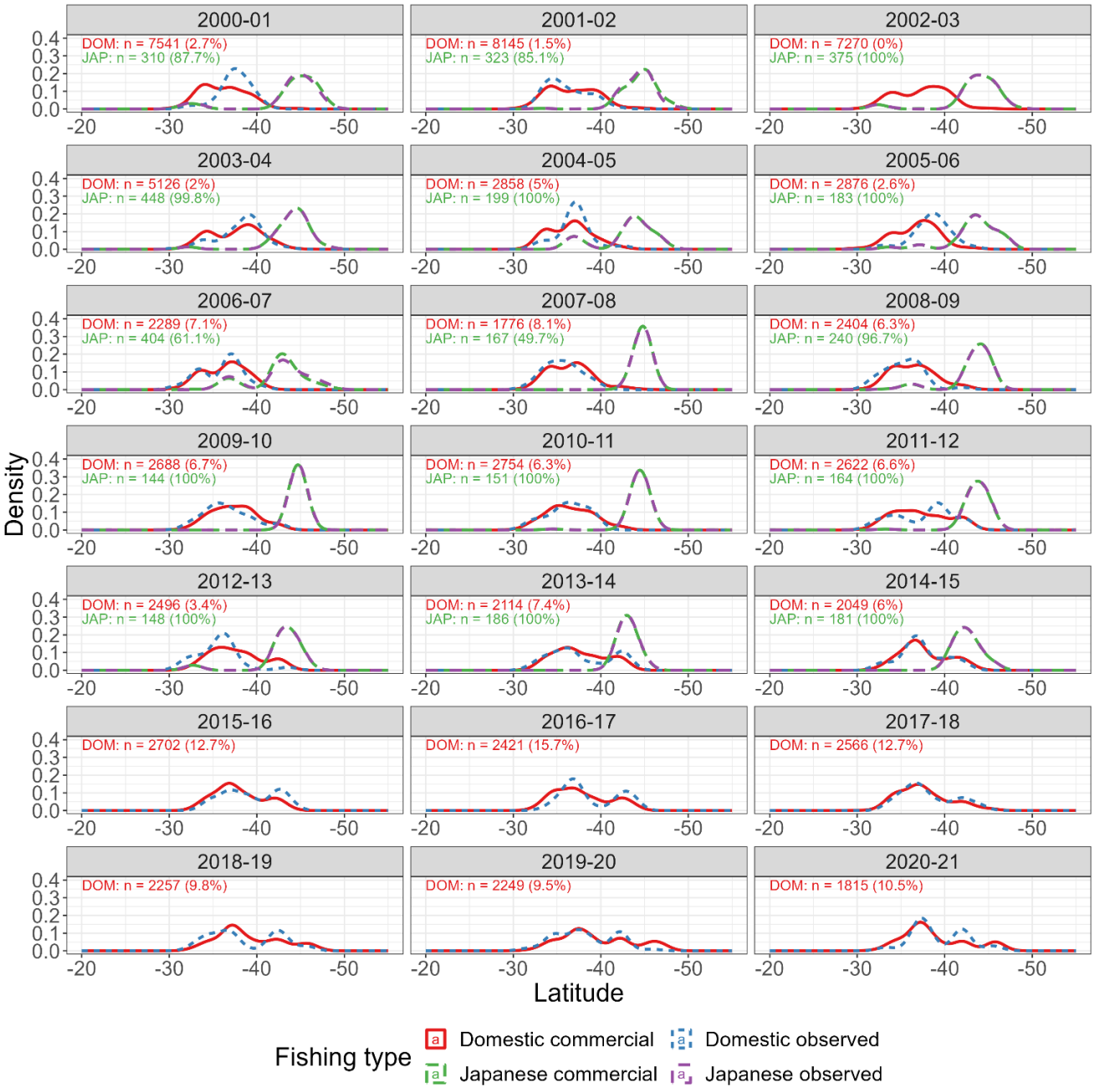


Figure 5: Distribution of start latitude positions for commercial and observed numbers of sets, for Domestic vessels (black lines) and Chartered Japanese vessels (grey lines), 2000–01 to 2020–21. Solid lines represent commercial data and dashed lines represent observed data. The total number of sets by each fleet and the percentage observed is given for each fishing year. Note: there was no observed Domestic effort in 2002–03. One large Domestic vessel was included in the Japanese effort during 2000–01 to 2003–04.

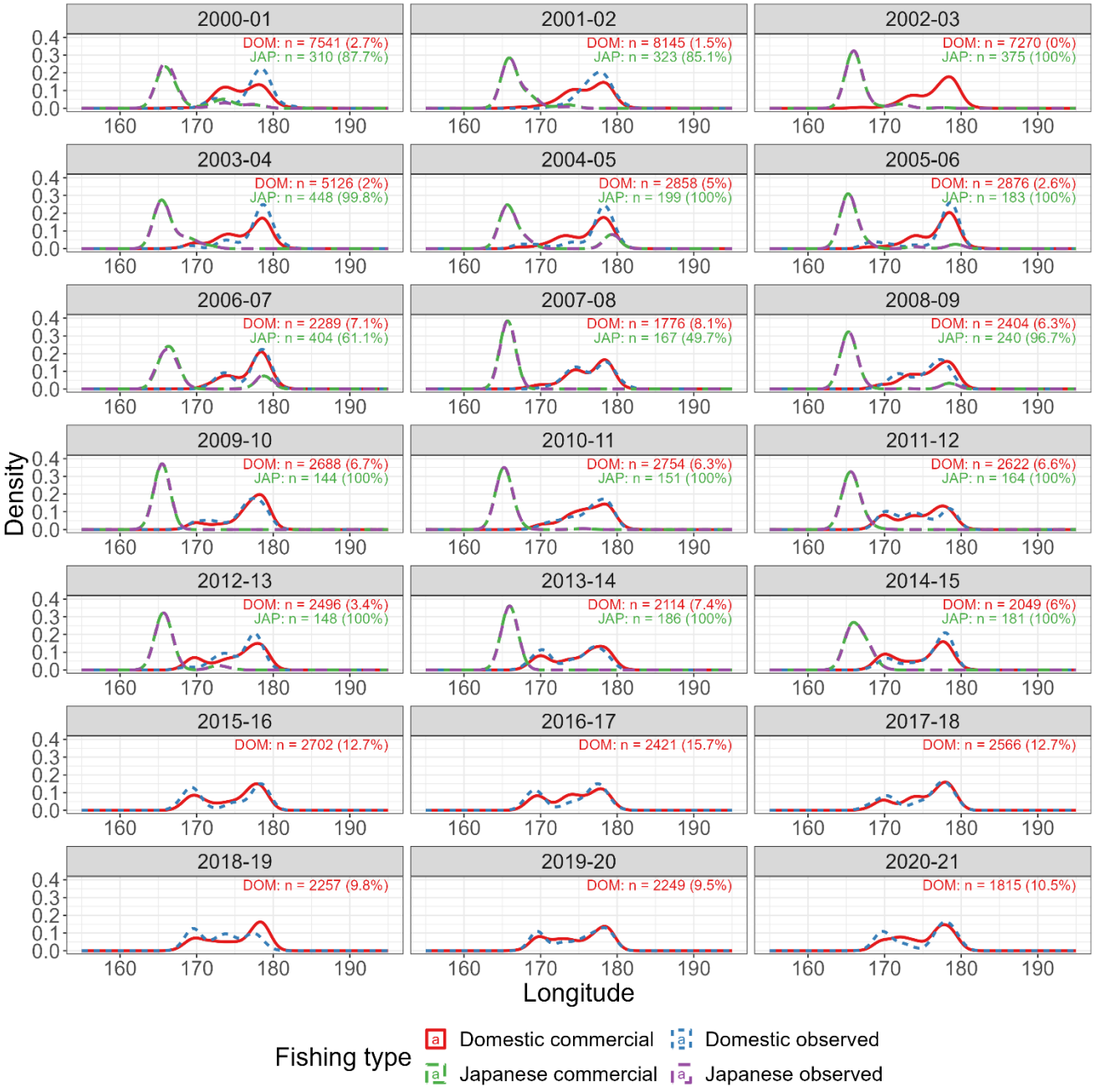


Figure 6: **Distribution of start longitude positions for commercial and observed numbers of sets, for Domestic vessels (black lines) and Chartered Japanese vessels (grey lines), 2000–01 to 2020-21. Solid lines represent commercial data and dashed lines represent observed data. The total number of sets by each fleet and the percentage observed is given for each fishing year. Note: there was no observed Domestic effort in 2002–03. One large Domestic vessel was included in the Japanese effort during 2000–01 to 2003–04.**

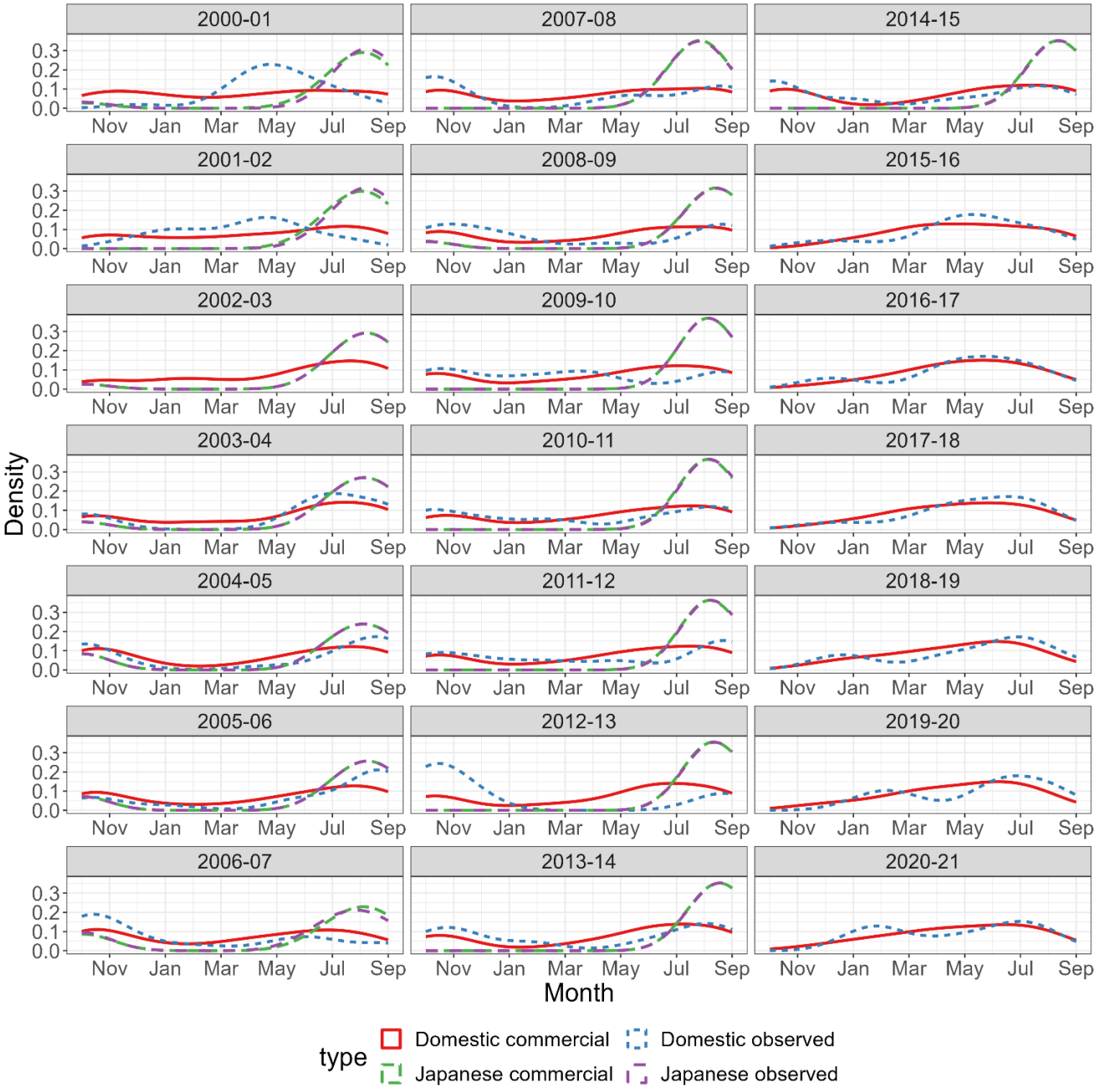


Figure 7: Distribution of month of fishing year (October to September) for commercial and observed numbers of sets, for Domestic vessels (black lines) and Chartered Japanese vessels (grey lines), 2000–01 to 2020-21. Solid lines represent commercial data and dashed lines represent observed data. Note: there was no observed Domestic effort in 2002–03. One large Domestic vessel was included in the Japanese effort during 2000–01 to 2003–04.

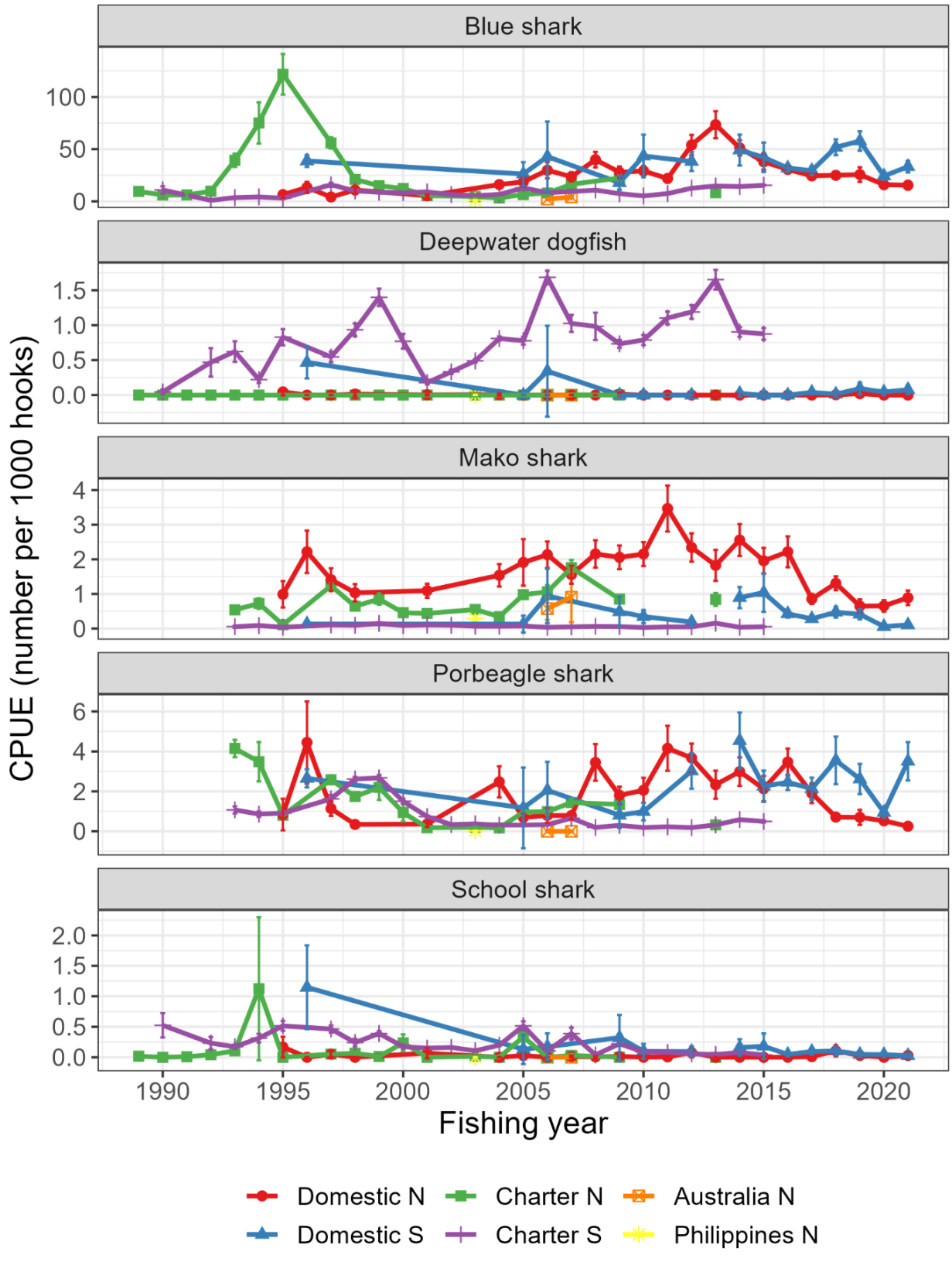


Figure 8: Annual variation in CPUE by fleet and region. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989. 1. Sharks. (Continued next pages)

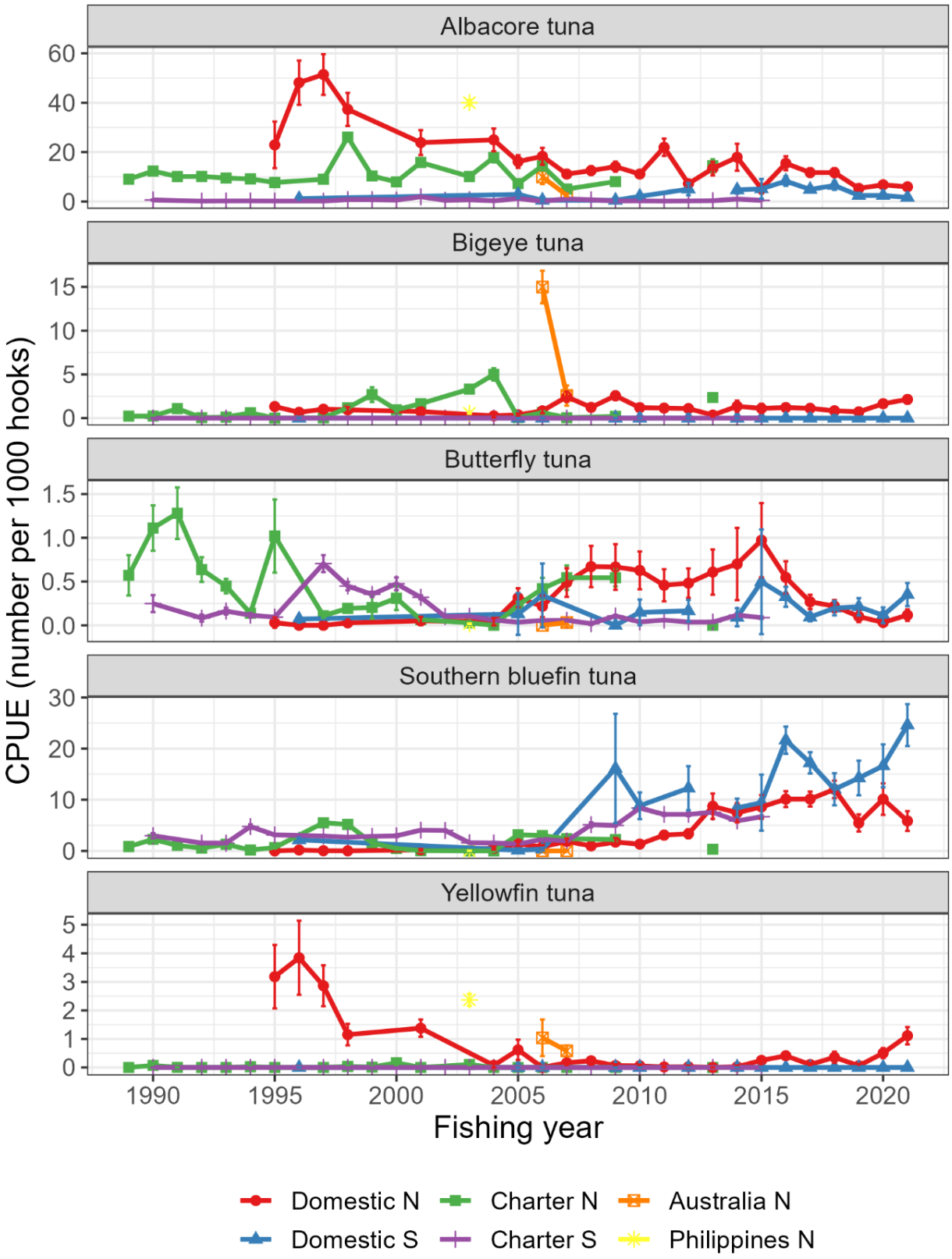


Figure 8: (*continued*). 2. Tunas.

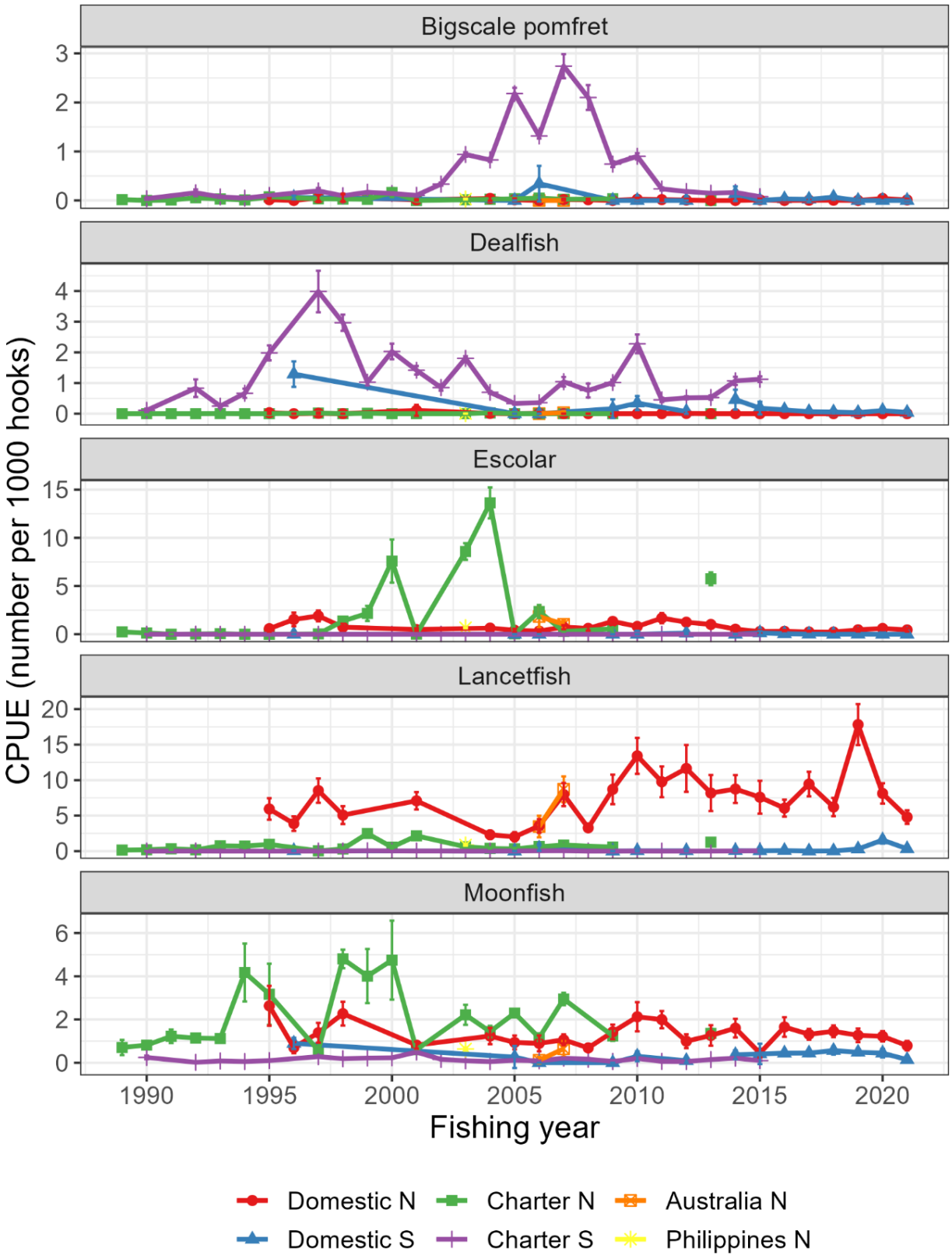


Figure 8: (*continued*). 3. Other species.

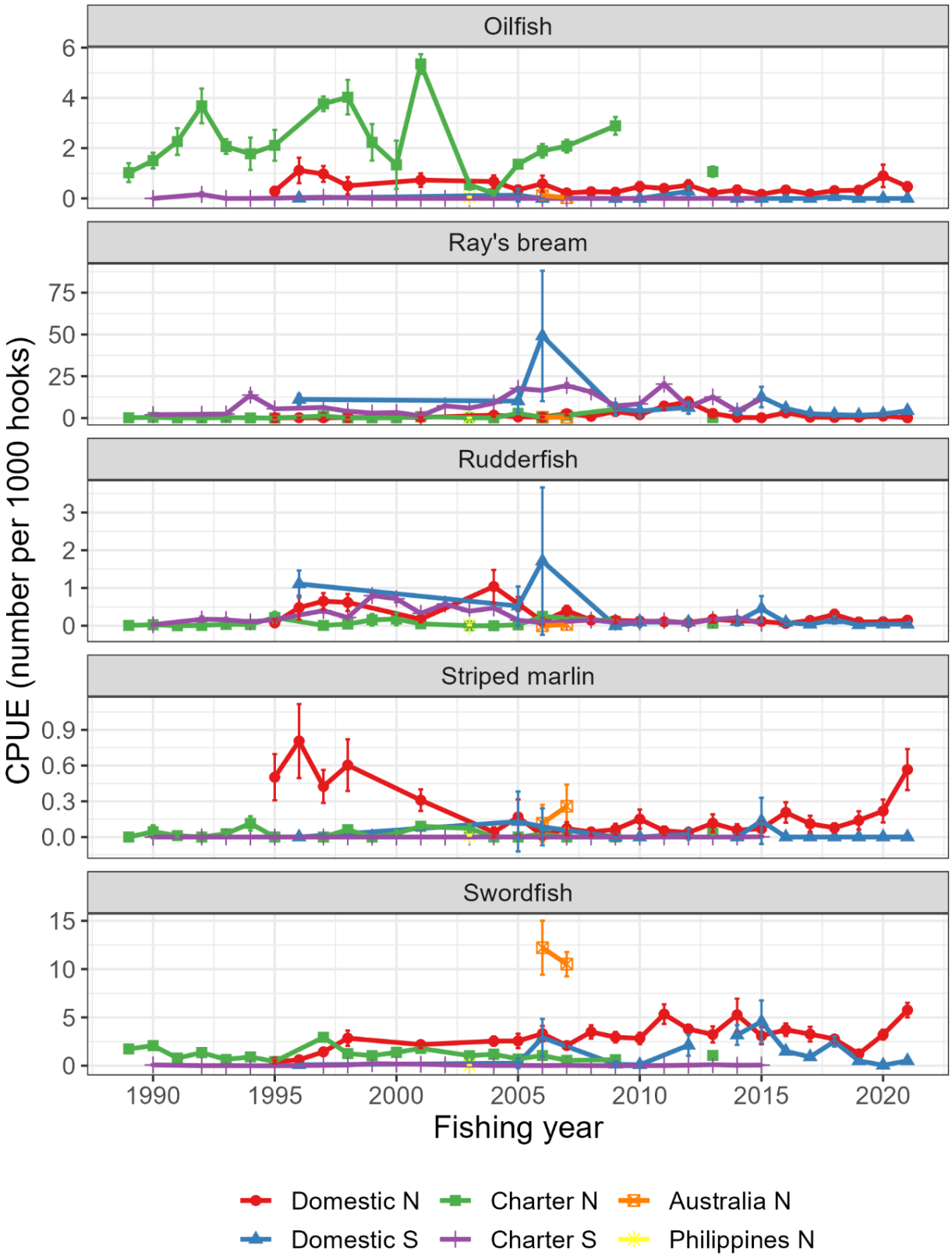


Figure 8: (*continued*). 3. Other species.

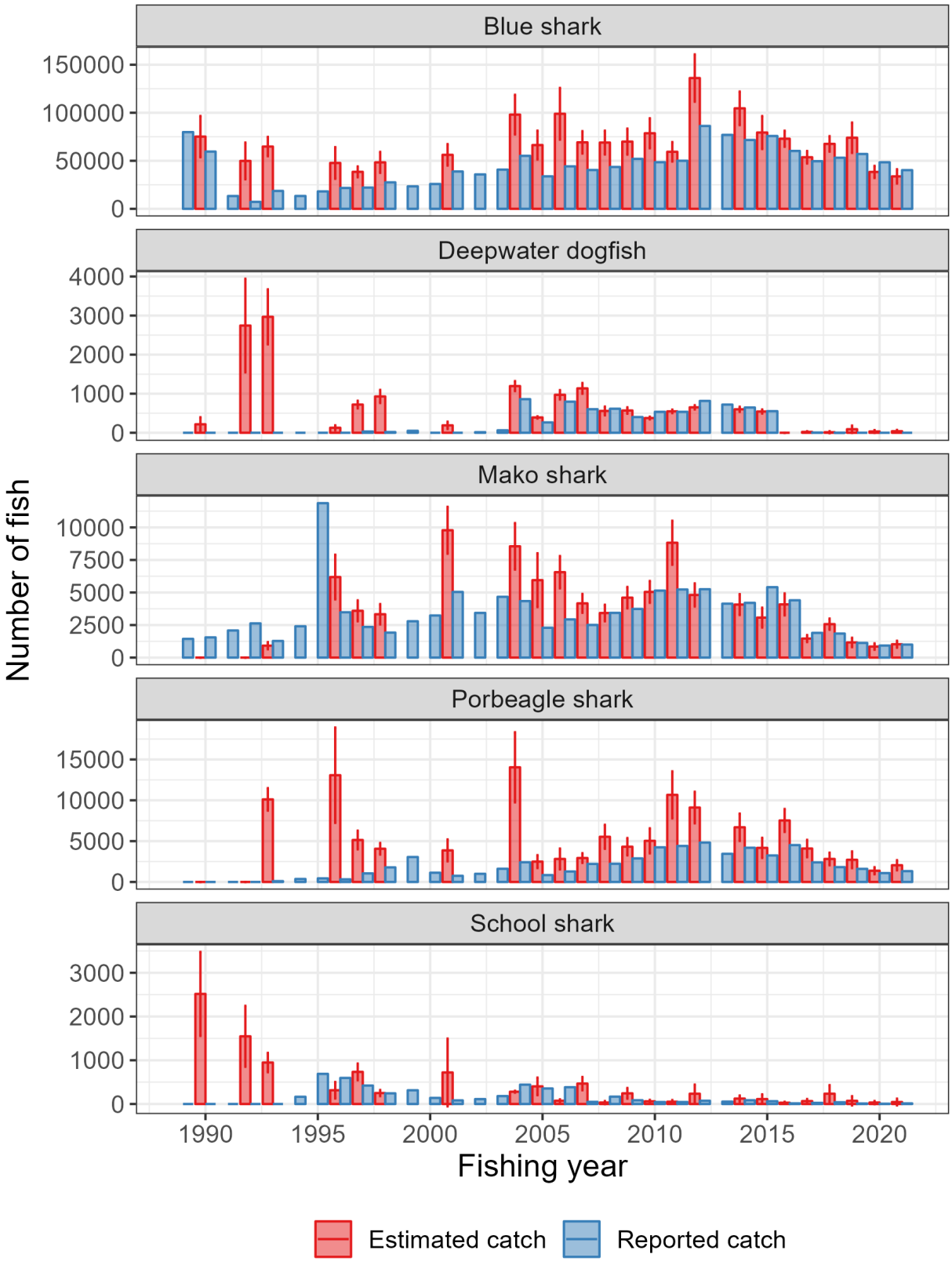


Figure 9: **Observer-based estimates of scaled total numbers of fish caught, with 95 % confidence limits, and numbers reported caught on TLCER forms. Fishing year 1989 = October 1988 to September 1989. 1. Sharks. (Continued next pages)**

Figure 9: (*continued*). 2. Tunas.

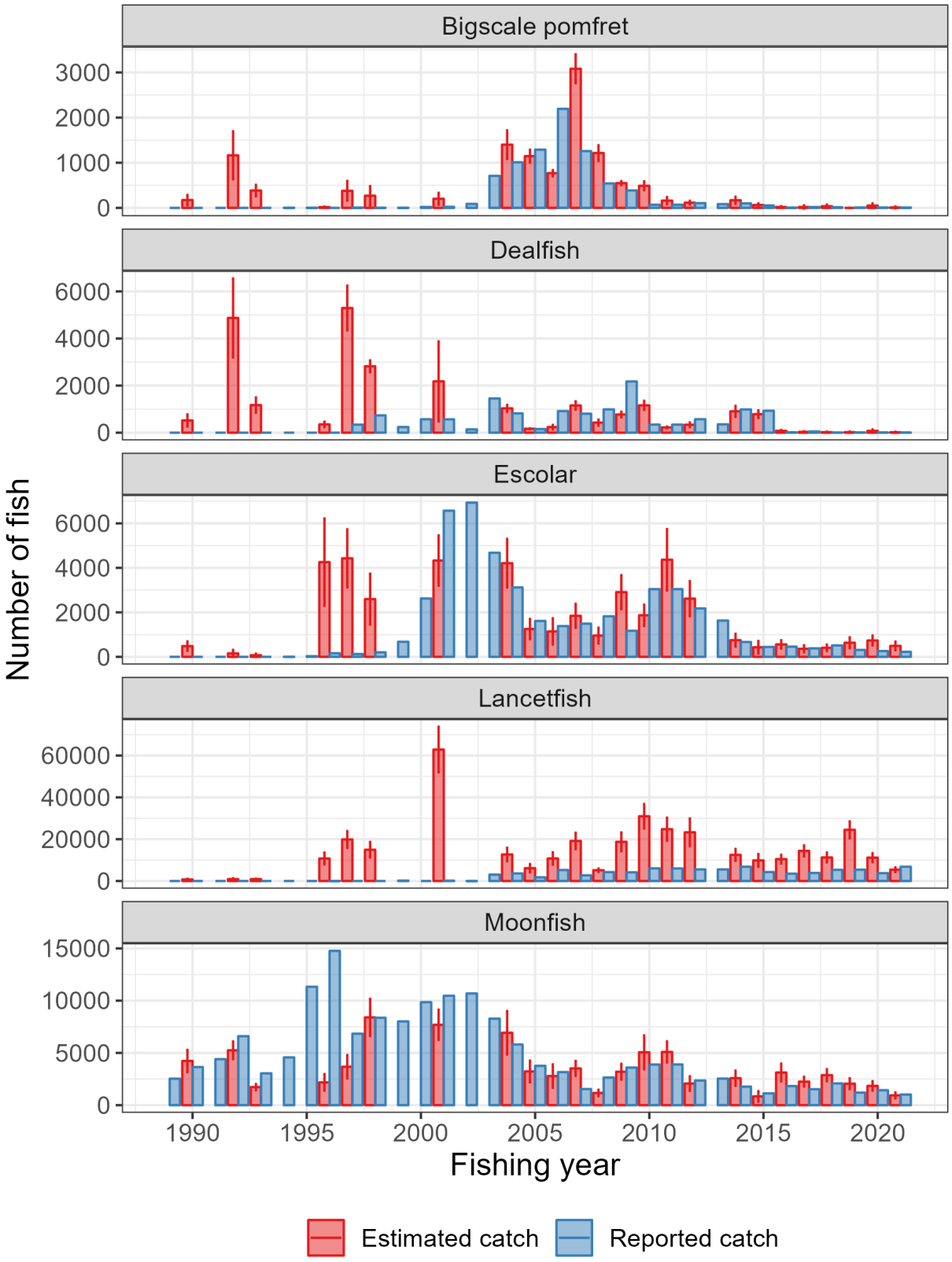


Figure 9: (*continued*). 3. Other species.

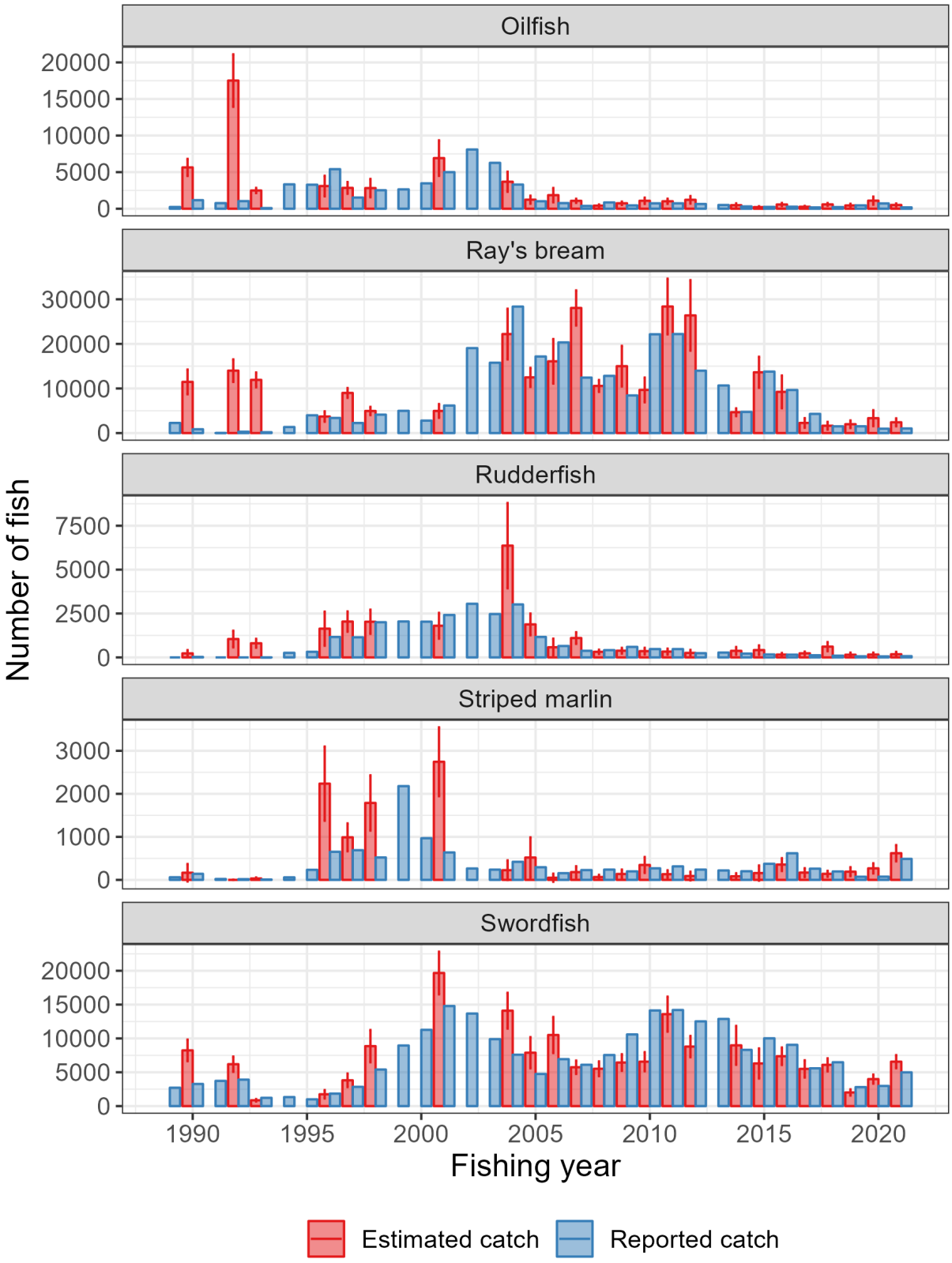


Figure 9: (*continued*). 3. Other species

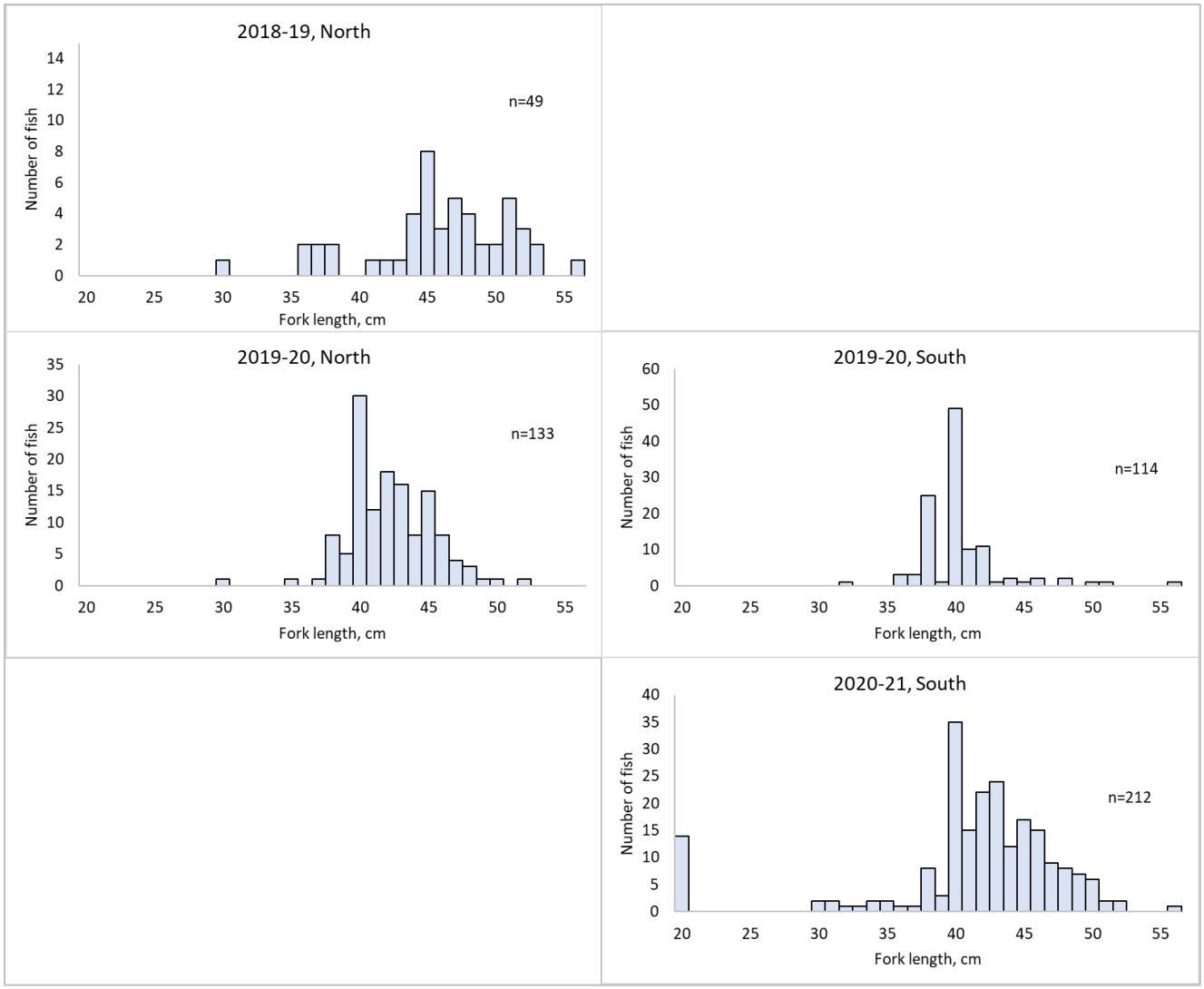


Figure 10: Length-frequency distributions of Ray's bream by fishing year, and region (both sexes and unsexed fish combined); left – North, right – South. Small sample sizes (less than 20) omitted.

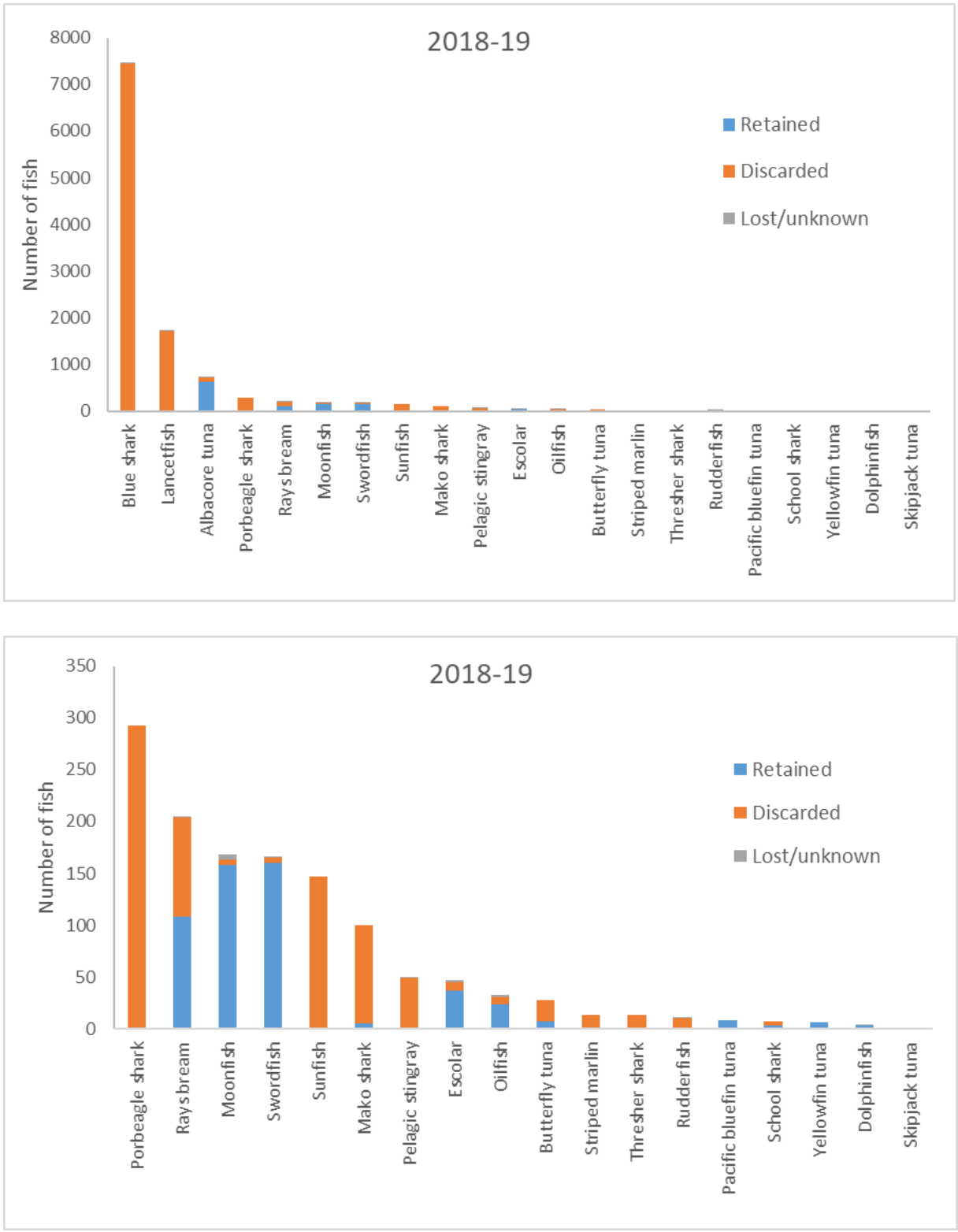
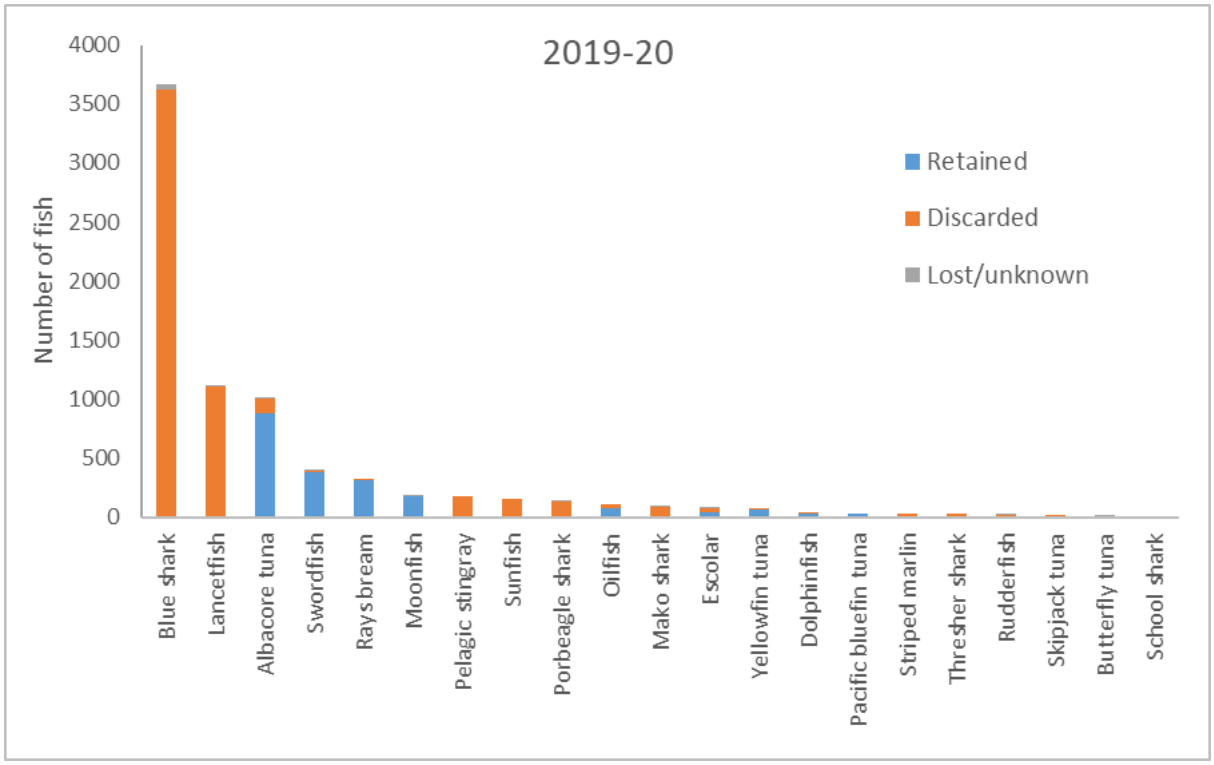


Figure 11: Number of fish on observed sets that were retained (i.e. processed in some way), discarded, and lost or unknown. Upper graph shows main bycatch species; lower graph excludes the three most abundant species. 2018–19. (Continued next pages)



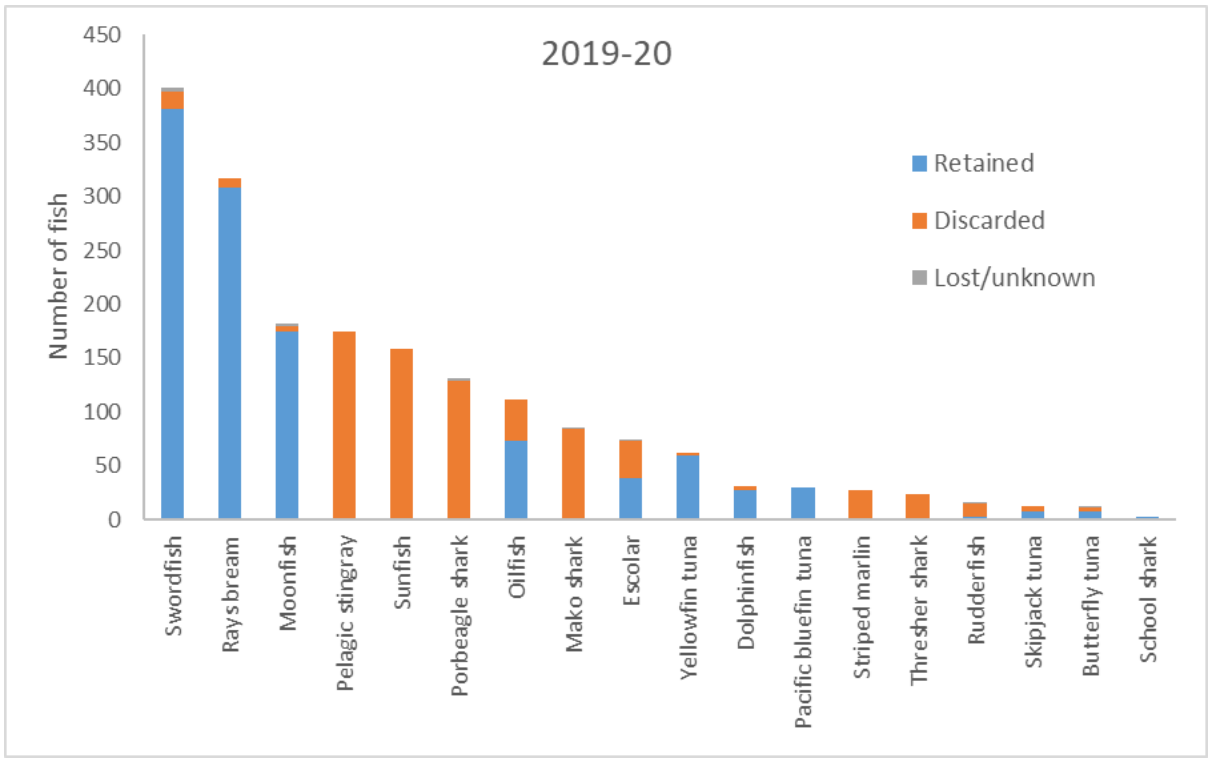
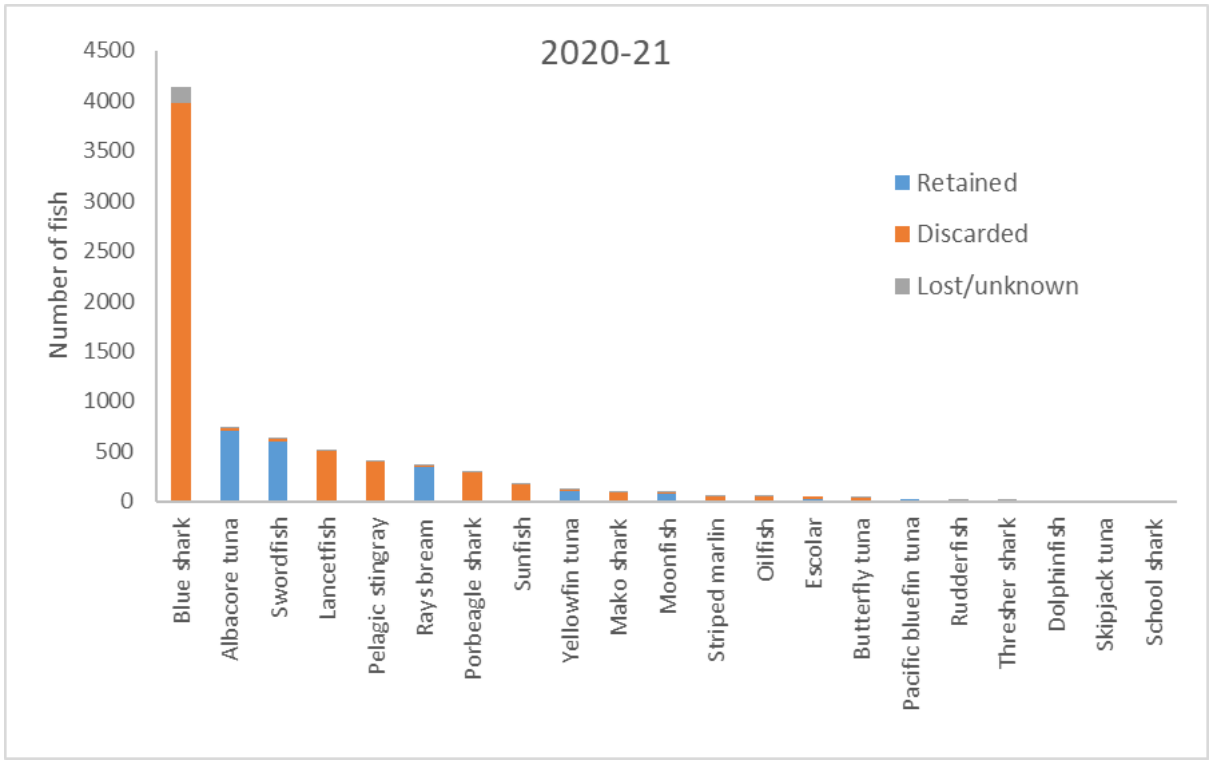


Figure 11: (*continued*). 2019–20.



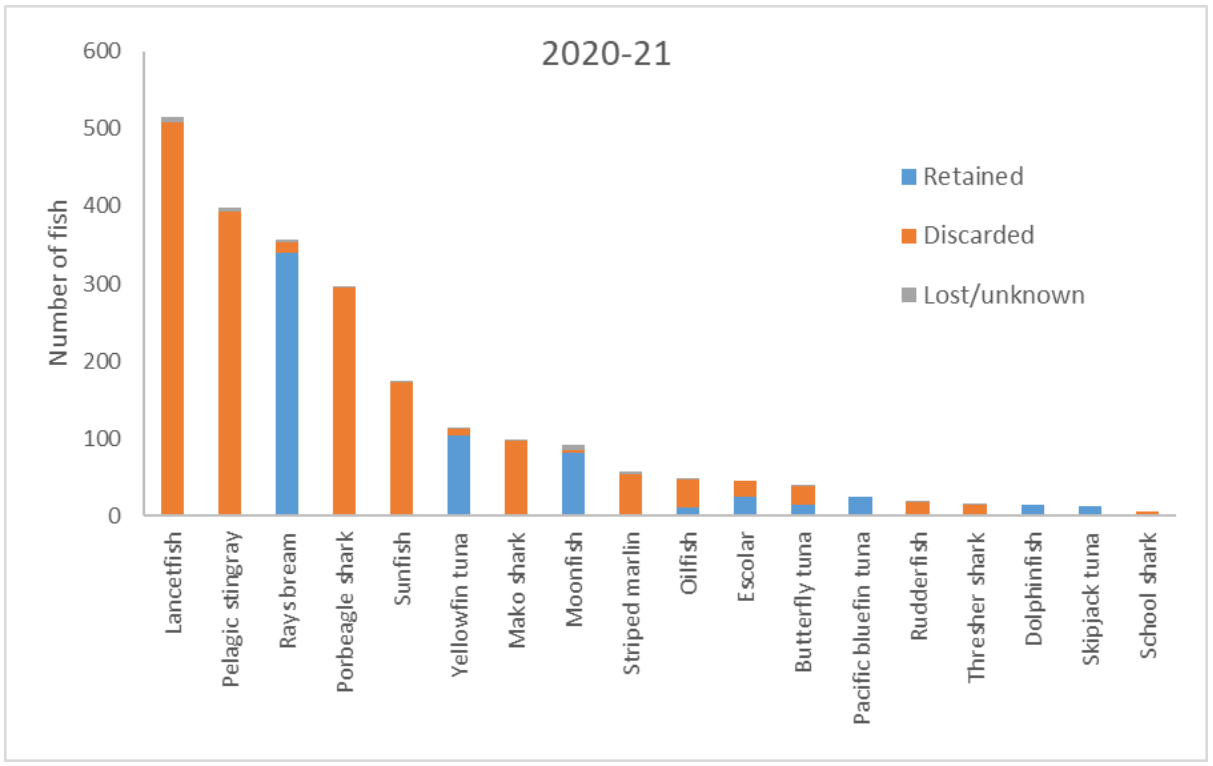
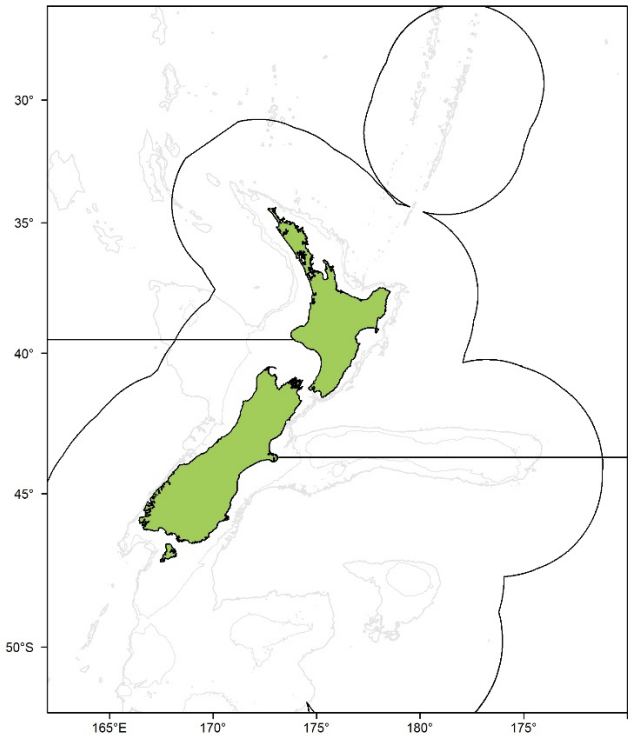


Figure 11: (*continued*). 2020–21.

9. APPENDICES

Appendix 1: Geographic strata used in analysis. The "North" region is defined as sets that began north of latitude 39.5° S on the west coast and north of 43.75° S on east coast (demarcation lines below); "South" applies to latitudes south of these lines.



Appendix 2: Life status codes and fate codes used by observers.

Life status codes

Code	Life Status
A	Alive - no condition
D	Dead
U	Unobserved
X	Alive-uninjured
Y	Alive-injured
Z	Alive-moribund

Fate codes for specimens not processed

Code	Fate
ALI	Discarded alive
DID	Discarded dead
DIS	Discarded – Use this code when you are unable to assess fish condition, but fish species and discard was observed
DIX	Discarded – alive uninjured (*refer **X** life status above*)
DIY	Discarded – alive injured (*refer **Y** life status above*)
DIZ	Discarded – alive moribund (*refer **Z** life status above*)
ACC	Lost - Use this code for all species that are lost or escape off the hook while in the water, or, before, during or after landing.
UNO	Unobserved – Use this code if you were unable to see the fish discarded, you may have been told by crew.
EAT	Retained for consumption on board
BAT	Retained on board for bait

Fate codes for processed fish

Code	Principal landed state	
GGO	Gilled and gutted, tail on (tuna species)	
GGT	Gilled and gutted, tail off (tuna species)	
GRE	Green (or whole)	
DRE	Dressed	
HGU	Headed and gutted	
HGF	Headed, gutted and finned (swordfish)	
LIV	Livers	
SFA	Shark fins attached (blue shark)	
GUT	Gutted	
FIW	Fins, wet (blue, mako or porbeagle shark)	*Retaining fins as a primary state is now illegal – if this practice is occurring it is to be captured using these codes*
FID	Fins, dried (blued, mako or porbeagle shark)	

Appendix 3: Numbers of fish reported by observers between 2018–19 and 2020–21, and the total observed catch number since 1988–89. Species are ranked in descending order of abundance since 1988–89. (Continued next pages)

Species	Scientific Name	2018–19 to 2020–21	Total number
Blue shark	*Prionace glauca*	15 285	284 336
Rays bream	*Brama* spp.	878	127 577
Albacore tuna	*Thunnus alalunga*	2 476	123 769
Southern bluefin tuna	*Thunnus maccoyii*	6 653	81 775
Lancetfish	*Alepisaurus ferox & A. brevirostris*	3 436	27 661
Porbeagle shark	*Lamna nasus*	718	24 886
Dealfish	*Trachipterus trachypterus*	13	18 987
Swordfish	*Xiphias gladius*	1 196	14 887
Moonfish	*Lampris guttatus*	442	11 725
Deepwater dogfish	Squaliformes	19	11 597
Mako shark	*Isurus oxyrinchus*	284	9 133
Big scale pomfret	*Taractichthys longipinnis*	6	8 199
Oilfish	*Ruvettus pretiosus*	192	8 166
Bigeye tuna	*Thunnus obesus*	495	6 209
Escolar	*Lepidocybium flavobrunneum*	167	5 651
Rudderfish	*Centrolophus niger*	46	5 459
Sunfish	*Mola* spp.	479	5 371
Butterfly tuna	*Gasterochisma melampus*	79	5 339
Pelagic stingray	*Pteroplatytrygon violacea*	623	4 061
School shark	*Galeorhinus galeus*	15	3 843
Yellowfin tuna	*Thunnus albacares*	182	3 732
Hoki	*Macruronus novaezelandiae*	0	2 064
Thresher shark	*Alopias vulpinus*	54	1 695
Skipjack tuna	*Katsuwonus pelamis*	26	1 280
Dolphinfish	*Coryphaena hippurus*	50	908
Striped marlin	*Kajikia audax*	99	687
Flathead pomfret	*Taractes asper*	2	638
Black barracouta	*Nesiarchus nasutus*	2	481
Pacific bluefin tuna	*Thunnus orientalis*	63	388
Barracouta	*Thyrsites atun*	1	362
Shark, unidentified	Selachii	37	282
Hāpuku and bass	*Polyprion oxygeneios & P. americanus*	10	251
Cubehead	*Cubiceps* spp.	11	232
Slender tuna	*Allothunnus fallai*	17	205
Bronze whaler shark	*Carcharhinus brachyurus*	23	203
Kingfish	*Seriola lalandi*	23	153
Shortbill spearfish	*Tetrapturus angustirostris*	10	147
Ray, unidentified	Myliobatiformes	13	108
Fanfish	*Pterycombus petersii*	0	97
Bigeye thresher	*Alopias superciliosus*	0	89

Appendix 3 ***(continued)*****.**

Species	Scientific Name	2018–19 to 2020–21	Total number
Hake	*Merluccius australis*	6	82
Frostfish	*Lepidopus caudatus*	0	77
Opah	*Lampris immaculatus*	0	72
Wahoo	*Acanthocybium solandri*	0	72
Snipe eel	Nemichthyidae	0	64
Wingfish	*Pteraclis velifera*	0	63
Gemfish	*Rexea solandri*	6	51
Broadnose seven gill shark	*Notorynchus cepedianus*	0	39
Salp	Salpidae	26	29
Blue marlin	*Makaira mazara*	4	25
Hammerhead shark	*Sphyrna zygaena*	4	25
Bluenose	*Hyperoglyphe antarctica*	1	20
Oceanic whitetip shark	*Carcharhinus longimanus*	0	20
Unicornfish	*Lophotus capellei*	0	19
Longtailed stingray	*Dasyatis thetidis*	1	15
Sixgill shark	*Hexanchus griseus*	1	15
Snake mackeral	*Gempylus serpens*	3	15
Marlin, unspecified	Isiophoridae	1	14
Pilotfish	*Naucrates ductor*	1	14
Large headed slickhead	*Rouleina* spp.	3	13
Pelagic stargazer	*Pleuroscopus pseudodorsalis*	3	13
Skate	Rajidae	0	11
Black marlin	*Makaira indica*	0	10
Barracudina	*Magnisudis prionosa*	0	9
Galapagos shark	*Carcharhinus galapagensis*	0	8
Remora	Echeneidae	0	8
Ribaldo	*Mora moro*	0	8
Seahorse	*Hippocampus* spp.	0	8
Barracuda	*Sphyraena novaehollandiae*	0	7
Pomfret, unidentified	Bramidae	0	7
Ragfish	*Icichthys australis*	0	7
Spine-tailed devil ray	*Mobula japanica*	1	8
Sawtooth eel	*Serrivomer* spp.	0	6
Squid	Cephalopoda	0	6
Scalloped dealfish	*Zu elongatus*	0	5
Scissortail	*Psenes pellucidus*	0	5
Short-tailed black ray	*Dasyatis brevicaudata*	2	4
Squaretail	*Tetragonus cuvieri*	0	4
Basking shark	*Cetorhinus maximus*	0	3
Black mackerel	*Scombrolabrax heterolepis*	0	3
Great white shark	*Carcharodon carcharias*	0	3
Octopus	Cephalopoda	0	3
Pufferfish	*Sphoeroides pachygaster*	0	3
Ribbonfish	*Agrostichthys parkeri*	1	3

Appendix 3 ***(continued)*****.**

Species	Scientific Name	2018–19 to 2020–21	Total number
Smallscaled brown slickhead	*Alepocephalus australis*	0	3
Tuna, unspecified	Scombridae	0	3
Bigeye scabbard fish	*Benthodesmus elongatus*	0	2
Black Slickhead	*Xenodermichthys* spp.	0	2
Blue cod	*Parapercis colias*	0	2
Bluntnose skate	*Notoraja* spp.	0	2
Brown stargazer	*Xenocephalus armatus*	0	2
Carpet shark	*Cephaloscyllium isabellum*	0	2
Crab	Crustacea	0	2
Pelagic butterfish	*Schedophilus maculatus*	0	2
Sea perch	*Helicolenus* spp.	0	2
Sharpnose seven gill shark	*Heptranchias perlo*	0	2
Trevally	*Pseudocaranx dentex*	0	2
Amberjack	*Seriola rivoliana*	0	1
Blue mackerel	*Scomber australasicus*	0	1
Common warehou	*Seriolella brama*	0	1
Deepwater eel	Ophichthidae	0	1
Frigate tuna	*Auxis thazard*	0	1
Globefish	*Contusus richei*	0	1
Jack mackerel	*Trachurus* spp.	0	1
Kahawai	*Arripis trutta*	0	1
Louvar	*Luvaris imperialis*	0	1
Manefish	*Caristius* spp.	0	1
Manta ray	*Manta birostris*	1	1
Manta rays and devil rays	Myliobatidae	0	1
Ocean blue-eye	*Schedophilus velaini*	0	1
Pipefish	Syngnathidae	0	1
Prickly anglerfish	*Himantolophus appelii*	0	1
Red cod	*Pseudophycis bachus*	0	1
Silky shark	*Carcharhinus falciformis*	0	1
Snapper	*Pagrus auratus*	0	1
Sprat	*Sprattus* spp.	0	1
Tasmanian ruffe	*Tubbia tasmanica*	0	1
Tiger shark	*Galeocerdo cuvier*	0	1
White warehou	*Seriolella caerulea*	0	1
Porcupine fish	*Allomycterus jaculiferus*	1	1
Sea cucumber	Holothurian, unidentified	1	1
Unidentified fish		184	5 576
Total		**34 376**	**809 160**

Appendix 4: Total reported catches of each species caught in 2018–19 to 2020–21.

	Number of fish		
	2019–19	2019–20	2020–21
Albacore tuna	12 856	17 555	9 487
Bigeye tuna	761	860	1 646
Bigscale pomfret	9	9	8
Butterfly tuna	248	466	180
Blue shark	57 088	48 445	40 273
Dealfish	5	5	3
Deepwater dogfish	0	0	0
Lancetfish	5 413	3 763	6 840
Escolar	311	260	225
Mako shark	1 126	924	999
Moonfish	1 199	1 431	1 016
Oilfish	458	723	181
Porbeagle shark	1 604	1 087	1 327
Ray's bream	1 520	978	1 029
Rudderfish	62	57	71
School shark	11	5	14
Striped marlin	73	75	488
Southern bluefin tuna	13 416	14 787	16 277
Swordfish	2 807	2 976	4 987
Yellowfin tuna	83	297	673