Fisheries New Zealand
Tini a Tangaroa

Fish bycatch in New Zealand tuna longline fisheries 2015–16 to 2017–18

New Zealand Fisheries Assessment Report 2021/20

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ISSN 1179-5352 (online)
ISBN 978-1-99-100372-0 (online)

April 2021

New Zealand Government

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EXECUTIVE SUMMARY

Griggs, L.H.; Datta, S.: Finucci, B.; Baird, S.J. (2021). Fish bycatch in New Zealand tuna longline fisheries 2015–16 to 2017–18.

***New Zealand Fisheries Assessment Report 2021/20*. 68 p.**

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 2015–16 to 2017−18 fishing years. Data were summarised by fishing fleet and geographical region. During the 2015–16 to 2017−18 fishing years the New Zealand Domestic fleet was the only fleet fishing by surface longline 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 on recovery, and the proportions that were retained and discarded. The size distribution, sex composition, and maturity composition of blue, porbeagle, and mako sharks and Ray's bream were determined.

The total number of hooks set by longline vessels fishing in the New Zealand Exclusive Economic Zone (EEZ) declined from a maximum of 27 million in 1980–81 to less than 4 million in the mid-1990s when foreign licensed vessels ceased fishing in New Zealand. The Domestic fishing fleet has been dominant since 1993–94 and the number of hooks set by this fleet increased rapidly in the late 1990s to a peak of almost 10 million in 2001–02. Total effort dropped substantially from 2002–03 onwards and reached an all-time low of 2.2 million hooks in 2007–08, of which 1.7 million hooks were set by the Domestic fleet. Effort then increased to around 3 million hooks in 2008–09 and remained about 3 million until 2011–12, followed by a gradual decline in both total hooks set and hooks set by the Domestic vessels.

During 2015–16 to 2017−18, Domestic vessels were the only fleet fishing by surface longline in New Zealand waters, with an average of 2.2 million hooks set each year. Observer coverage on Domestic vessels increased during this period to the highest percentage coverage seen on Domestic vessels, ranging between 13.7% and 16.5%. During the previous ten years coverage was 6–7%. Observer coverage appeared to represent the spatial and temporal distribution of the fishery well during 2015–16 to 2017–18.

Between 2015–16 and 2017–18, 69 349 fish and invertebrates from at least 100 species were observed. Most species were rarely observed, with only 37 species (or species groups) exceeding 100 observations between 1988–89 and 2017–18. The most commonly observed species over all years were blue shark, Ray's bream, and albacore tuna, with these three making up nearly 70% of the catch by numbers.

In the three year period 2015–16 to 2017–18 blue shark was the most abundant species in the observed catches, making up 41% of observed specimens. This was followed by southern bluefin tuna, then albacore. These top three species made up 75% of the observed catch. These trends were apparent in each of the three years, as well as in the combined total for the three years.

Other important non-target species were lancetfish, porbeagle shark, Ray's bream, sunfish, moonfish, mako shark, pelagic stingray, butterfly tuna, yellowfin tuna, oilfish, escolar, thresher shark, rudderfish, and striped marlin. Previously abundant deepwater dogfish, dealfish, bigscale pomfret, and school shark were much lower than previously seen. Tuna and billfish species are sometimes taken as bycatch in fisheries where another species was targeted, particularly swordfish and bigeye tuna when southern bluefin tuna was targeted.

Fishing effort and observed catches were stratified by region (North and South) for estimating CPUE and numbers caught, and these were added to the time series from 1988–89 onwards. For most species there were large differences in CPUE between fleets and between regions. Although observer coverage of the

Domestic vessels was higher than in previous years, coverage during 2015–16 to 2017–18 was insufficient to reliably determine trends in CPUE for the Domestic fleet.

Trends in reported catches during 2015–16 to 2017–18 are described. Reported captures of blue sharks remained high, whereas mako and porbeagle catches decreased. Southern bluefin tuna catches steadily increased; yellowfin tuna catches increased after being very low for a decade; albacore tuna catches remained relatively low; and Ray's bream, bigscale pomfret, school shark, and deepwater dogfish catches decreased.

Because of the ban on shark finning, most sharks were not landed, and few were measured. 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. Length frequency data combined with length at maturity information indicated that most of the observed catch of female Ray's bream was probably mature in 2015–16 to 2017–18.

In 2015–16 to 2017–18, most sharks were alive when landed or brought to the vessel, with the highest percentage alive for blue sharks and lowest for porbeagle sharks. Few deepwater dogfish and school shark were caught, mostly alive. Percentage alive varied with fleet and region and tended to be lower in the North than in the South. Most of the albacore tuna, swordfish, and butterfly tuna were landed dead, and most southern bluefin tuna, bigeye tuna, yellowfin tuna, and striped marlin were caught alive. Most Ray's bream, moonfish, escolar, oilfish, rudderfish, and almost all sunfish were alive when recovered. Most lancetfish were recovered dead, with variation between years

Shark discard practices that commenced in 2014–15 continued due to the ban on finning. Most blue, mako, and porbeagle sharks were discarded during 2015–16 to 2017–18. Most school sharks were retained for their flesh. Sufficient information about life status on release was recorded for blue sharks, mako sharks, and porbeagle sharks to indicate that most of these species of sharks were released uninjured or with injuries that would not be expected to be fatal. Most albacore tuna, southern bluefin tuna, bigeye tuna, yellowfin tuna, butterfly tuna, and swordfish were retained. All the striped marlin that were caught were returned to the sea. Most moonfish and Ray's bream were retained.

Trends in retention or discarding of non-quota fish bycatch species were more variable. About two thirds of escolar were retained each year, whereas just over half the oilfish were retained with some variation between years. There was year to year variation with rudderfish, with only about a third retained overall. Few bigscale pomfret were caught, and all were retained. Lancetfish, sunfish, dealfish, and deepwater dogfish were discarded.

1. INTRODUCTION

The New Zealand 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 recent years, a small Foreign Charter fleet (4 vessels) targeting southern bluefin tuna. Fisheries New Zealand (previously Ministry of Fisheries and Ministry for Primary Industries, MPI, until 2019) 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 (HMS) 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), and is expected to be reviewed again during the 2020–21 fishing year. Information on the shark bycatch from New Zealand tuna longline fisheries is crucial, ongoing input into the NPOA-Sharks.

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. 2018). 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 2004–15 (Griggs et al. 2018). The most commonly observed species for 1988–89 to 2014–15 were blue shark (*Prionace glauca*), Ray's bream (*Brama* spp.), and albacore tuna (*Thunnus alalunga*), with these three species making up 67% of the catch by numbers.

Oceanic sharks are an important bycatch of commercial fisheries throughout the Pacific Ocean, and the demand for shark fins in Asia has led to an increase in their catch over the last few decades (Bonfil 1994, Hayes 1996, Stevens 2000). More recently, bans on shark finning in many countries have resulted in many sharks being discarded rather than finned, but the post-release mortality rate of such discarded sharks is poorly understood. Recent work on mako sharks (*Isurus oxyrinchus*) tagged off New Zealand and the Pacific Islands estimated post-release mortality at about 20% after 60 days, indicating survival rates may be high (Common Oceans (ABNJ) Tuna Project 2019). Oceanic sharks generally have low reproductive rates, long life spans, possibly slow growth, and they segregate by size and sex (Cortés 2008, Dulvy et al. 2008). These features make them vulnerable to overfishing (Cortés 2008, Dulvy et al. 2008, Cortés et al. 2010). Shark bycatch on tuna longlines in temperate South Pacific waters has been analysed in the Australian Fisheries Zone (Stevens 1992, Stevens & Wayte 1999), and in New Zealand waters (Francis et al. 1999, 2000, 2001, 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018). The collection by MPI observers of more information on longline catch rates, and species-, size- and sex-composition of catches, has enabled the calculation of a series of stock status indicators for blue, porbeagle (*Lamna nasus*), and mako sharks (Clarke et al. 2013, Francis et al. 2014, Francis & Large 2017, Francis & Finucci 2019), providing insight into their response to fishing pressure. At a larger spatial scale, the population status of porbeagle shark in its entire Southern Hemisphere range has also been assessed recently (Hoyle et al. 2017).

Billfish species are commonly caught in longline fisheries targeting tunas. The species caught in tuna longline fisheries vary with region and fishery. Blue marlin are the most commonly reported billfish species in the western tropical Pacific longline fishery (Bailey et al. 1996, Molony 2005). In New Zealand, swordfish are targeted, striped marlin (*Tetrapturus audax*) are occasionally taken as bycatch, and other marlins are rarely caught (Griggs et al. 2018). 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).

In addition to tunas, billfishes, and sharks, a number of other bony fishes are caught in pelagic longline fisheries. 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 Central Pacific Ocean, 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 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.

A new Tuna Longlining Catch Effort Return (TLCER) form was introduced in 2003, and fishers were required to record discarded fish. In October 2004, several tuna and longline-caught target and bycatch species were introduced into the QMS, namely southern bluefin tuna, Pacific bluefin tuna (*Thunnus orientalis*), bigeye tuna, swordfish, blue shark, porbeagle shark, mako shark, moonfish (*Lampris guttatus*), and Ray's bream (*Brama brama*).

NIWA has reported the results of previous Ministry of Fisheries and MPI projects that investigated the bycatch of the New Zealand tuna longline fleet (Francis et al. 1999, 2000, 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018). The present study updates those previous analyses for three more years which extends the time series to 30 years.

This report addresses the following objective of MPI project HMS201601: 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 2015–16, 2016–17, and 2017–18 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 2015–16 to 2017–18 fishing years were obtained from two sources: commercial fishing records and observer data. Observer data were extracted from the centralised observer database (*cod*), and groomed commercial surface longline data were extracted from the database *tuna*.

Tuna longline vessels submit information on their fish catch to MPI (Fisheries New Zealand since 2019) on TLCER forms. 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. These returns underestimate bycatch because much of it is discarded at sea and not recorded (Francis et al. 2000, Griggs & Baird 2013).

More reliable data on the amount of bycatch from each longline set are available from the Fisheries New Zealand Observer Programme (MPI at the time the data was collected for this project), 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 on 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 on recovery, and the proportion of fish processed and discarded.

Commercial and observer data prior to 2014–15 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).

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), and 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 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 2015–16 to 2017–18 fishing years, New Zealand Domestic vessels were the only fleet fishing in New Zealand waters.

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.

As with previous years (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018), 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.

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 are distinguishing the two. 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 ($\bar{u}$). An adjusted estimator,

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

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 below 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 2015–16 to 2017–18 and added to the time series for 1988–89 to 2004–15 (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018). 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 2015–16 to 2017–18 for each of the main non-target species plus swordfish.

Prior to 2015, 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 2015 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.

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 an 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, close to the all-time low in 2007–08.

During 2015–16 to 2017–18, there were no Charter vessels from other countries, and the Domestic vessels were the only fleet fishing by surface longline in New Zealand waters, with 2.4 million hooks set in 2015–16, 2.1 million in 2016–17, and 2.2 million in 2017–18, with an average of 2.2 million hooks set over the three fishing years (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 forms are shown in Table 1. Use of CELR forms for reporting longline fishing has ceased. The last use of CELR forms on longline vessels was 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 increased during 2015–16 to 2017–18 to the highest level seen, ranging between 13.7% and 16.5%. During the previous ten years coverage was 6–7%. The percentages of hooks observed per set during 2015–16 to 2017–18 are shown in Table 3. Most Domestic sets that were observed were fully observed.

The numbers of sets and hooks reported on TLCER forms, and the percentages observed, are shown for North and South regions by fleet and fishing year in Table 4.

Fishing positions of sets reported and observed sets in 2015–16 to 2017–18 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).

In 2015–16 to 2017–18, Domestic vessels fished both North and South (Figure 3), continuing the trend seen in the previous five fishing years (Griggs et al. 2018). In 2015–16 and 2016–17, 23% of sets were in the South region, off the west coast South Island (WCSI). In 2017–18, 17% were in the South region with some effort off the east coast of the South Island (targeting southern bluefin tuna), which has 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, whereas most of the sets in the South were off the WCSI where they mainly targeted southern bluefin tuna with some sets for swordfish (Figure 3). Southern bluefin tuna was the predominant target species, with 72% of sets targeting southern bluefin over the three years, 18% targeting bigeye tuna, and 10% of sets targeting swordfish.

Domestic vessels fished for a variety of target species all year round, but with most effort between March and August (Figure 4).

A comparison of the spatial distributions of commercial and observed sets for the past 18 years is shown in Figures 5 and 6. Observer coverage represented the spatial distribution of the fishery well during 2015–16 to 2017–18 (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 2015–16 and 2017–18, 69 349 fish and invertebrates from at least 100 species were observed (Appendix 3). Non-fish bycatch (seabirds, marine mammals, and turtles) were excluded from this analysis. The most commonly observed species since 1988–89 were blue shark, Ray's bream, and albacore tuna, together constituting nearly 70% of the catch by numbers (Appendix 3). Most species were rarely observed, with only 37 species (or species groups) exceeding 100 recorded fish since 1988–89.

Observed catches by year and region during 2015–16 to 2017–18 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 also different from previous years due to lack of Charter vessels from any other countries, and therefore are based on only the Domestic fleet.

In the three-year period 2015–16 to 2017–18 blue shark was the most abundant species in the observed catches, making up 41% of observed specimens. This was followed by southern bluefin tuna, then albacore. The top three species made up 75% of the observed catch. These trends were apparent in each of the three years, as well as in the combined total for the three years (Table 5).

Southern bluefin tuna was in the top three most abundant observed species in the four years prior, 2011–12 to 2014–15 (Griggs et al. 2018), 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 seventh most abundant in observed catches during 2015–16 to 2017–18 (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: lancetfish, swordfish, porbeagle shark, Ray's bream, sunfish, moonfish, mako shark, bigeye tuna, pelagic stingray (*Pteroplatytrygon violace*), butterfly tuna (*Gasterochisma melampus*), and yellowfin tuna (*Thunnus albacares*). Observed catches of oilfish

(*Ruvettus pretiosus*), escolar (*Lepidocybium flavobrunneum*), thresher shark (*Alopias vulpinus*), rudderfish (*Centrolophus niger*), and striped marlin were next highest (Table 5).

Sunfish (*Mola* spp.) were more abundant during this period than in earlier years. Some species that were more abundant in previous years, in particular deepwater dogfish, dealfish (*Trachipterus trachypterus*), bigscale pomfret (*Taractichthys longipinnis*), and school shark (*Galeorhinus galeus*), were seen in very few numbers in 2015–16 to 2017–18. Oilfish, escolar, and rudderfish had been in the 15 most abundant species in earlier years (Francis et al. 2004, Ayers et al. 2004, Griggs et al. 2007, 2008, Griggs & Baird 2013, Griggs et al. 2018) but were relatively less abundant during 2015–16 to 2017–18.

There were 213 unidentified fish observed in 2015–16 to 2017–18. 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 caught in the North and South, with more in the North. Southern bluefin tuna was also caught in both regions. Lancetfish, sunfish, bigeye tuna, yellowfin tuna, oilfish, escolar, pelagic rays, and striped marlin were caught in the North. More albacore, swordfish, butterfly tuna, moonfish, mako sharks, and rudderfish were caught in the North. Ray's bream, bigscale pomfret, and the few dealfish and deepwater dogfish were mostly caught in the South (Table 5).

Most of the observed effort was in the North, with 60.1% of observed hooks in 2015–16, 62.9% in 2016–17, and 74.2% in 2017–18, 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

CPUE estimates were calculated for each fleet and region stratum in which 10 or more sets were observed and at least 2% of the hooks were observed. The number of hooks and sets used in the CPUE calculations are shown in Table 4.

CPUE estimates were calculated by species for each year and region in 2015–16 to 2017–18 and added to the time series for 1988–89 to 2009–10 (Griggs et al. 2018) 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, mako, and porbeagle sharks declined in the late 1900s and was low during the early 2000s. Domestic CPUE for these species increased from 2004 onwards
- After a peak in 1994–95, blue shark CPUE in the North dropped, but has been rising again for the last decade in both regions, and remained high during 2015–16 to 2017–18
- CPUE of mako sharks was higher in the North than the South
- Domestic vessels have had high but quite variable porbeagle CPUE in both regions
- CPUE for deepwater dogfish was high for the Charter fleet in the South, but very low for Domestic vessels
- CPUE of school sharks was higher in the South than the North
- CPUE has remained high for southern bluefin tuna in the South and appears to have increased in the North
- Catch rates of bigeye, yellowfin, albacore, and butterfly 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
- 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
- Escolar and oilfish catch rates have declined in recent years
- Catch rates of moonfish appear to be consistent, especially in the North

3.4 Total numbers of fish caught

The reported and estimated numbers of fish caught in 2015–16 to 2017–18 were added to the time series generated previously for 1988–89 to 2004–15 (Griggs et al. 2018) and these are shown in Figure 9.

CELR data 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 2015–16 to 2017–18 are given below:

- Reported catches of blue, mako, and porbeagle sharks have declined since the Charter fleet ceased fishing in New Zealand waters, but catches of blue shark have continued at a high level
- Catches of deepwater dogfish and school shark have declined to low numbers
- Southern bluefin tuna catches have increased steadily
- Albacore catches were low over the last twelve years
- Yellowfin tuna catches declined consistently through the 2000s to extremely low levels, with a slight re-appearance in 2014–15 and an increase in the last three years, particularly 2015–16
- Reported catches of butterfly tuna were below estimated catches for the past eleven years suggesting they may be under-reported
- Swordfish catches have remained quite high with some decrease since 2010–11 which has continued in 2015–16 to 2017–18
- Catches of striped marlin were relatively low over recent years with an increase to a peak in 2015–16 then a subsequent decrease
- Catches of Ray's bream dropped significantly from 2014–15 to a low level in 2017–18
- Bigscale pomfret peaked in 2006–07, and catches since 2010–11 have been very low, especially during 2015–16 to 2017–18
- Catches of oilfish and rudderfish have been relatively low over the last ten to twelve years
- Escolar catches decreased from a 2010–11 peak, with low catches since 2014–15
- Reported dealfish catches peaked in 2008–09 with some decrease and increase since then, but catches were very low during 2015–16 to 2017–18
- Reported catches of lancetfish were below estimated catches suggesting they were under-reported. Reported and estimated catches appear to have been steady in recent years.

Reported catches of each species caught in 2015–16 to 2017–18 are shown in Appendix 4.

3.5 Length frequency distributions

Since the ban on shark finning, 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 sharks was considered inadequate to represent the population. Few mako and porbeagle lengths were recorded. Striped marlin is 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 were usually (95.9% during 2015–16 to 2017–18) kept whole and not sexed. Differences in the North/South distributions have been shown previously, with South fish being larger, but the distributions for males and females were similar (Griggs & Baird 2013). Female Ray's bream mature at about 43 cm (Francis et al. 2004), and most females were probably mature (59.4% over the three year period), a lower proportion than in the previous five-year period when 77.2% of females were probably mature (Griggs et al. 2018).

3.6 Status of fish on recovery and discards

The percentages of the main non-target species recorded alive or dead, by year, fleet, and region are given in Table 6. The top 15 most abundant species in 2015–16 to 2017–18 (combined) are included in this table, along with school shark, deepwater dogfish, bigscale pomfret, dealfish, escolar, oilfish, 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). Sunfish were more abundant during 2015–16 to 2017–18 than seen previously and are included in Table 6.

In 2015–16 to 2017–18, most sharks were alive when landed or brought to the vessel, with the highest percentage alive for blue sharks (90% overall) and lowest for porbeagle sharks (53%). Few deepwater dogfish and school shark were caught, mostly alive. Percentage alive varied with fleet and region and was lower in the North than in the South.

Most of the albacore, swordfish, and butterfly tuna were landed dead, and most southern bluefin tuna, bigeye tuna, yellowfin tuna, and striped marlin were caught 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). Most lancetfish were recovered dead, with variation between years. 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), discarded, and lost or unknown, for each year (2015–16 to 2017–18), 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 fleet, are given in Table 7. Shark discard practices that commenced in 2014–15 continued due to the ban on finning. Most blue, mako, and porbeagle sharks were discarded during 2015–16 to 2017–18. Most school sharks were retained for their flesh and the few deepwater dogfish caught were discarded.

Most albacore, southern bluefin tuna, bigeye tuna, yellowfin tuna, butterfly tuna, and swordfish were retained. All 81 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. About two thirds of escolar were retained each year, whereas just over half the oilfish were retained with some variation between years. There was considerable year to year variation with rudderfish, with only about a third retained overall. Few bigscale pomfret were caught and these were retained. Lancetfish, sunfish, and dealfish were discarded (Table 7).

Life status of discarded fish in 2015–16 to 2017–18 is given 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 sharks this was lower, averaging 66% over the three-year period. Half the discarded porbeagle sharks were dead, though this varied by year (39.1% in 2016–17 to 58.1% in 2017–18).

Most of the discarded albacore, bigeye tuna, and butterfly tuna were dead on recovery. Most southern bluefin tuna and all yellowfin discards were recovered alive. Just over half of swordfish discards were recovered alive, and two thirds of striped marlin were alive on capture. Most of the Ray's bream and moonfish discards were dead.

Discarding of some QMS species can be explained by damage, which applies to only a few dead sharks (1.4% blue sharks, 2.6% mako sharks, and 3.6% porbeagle sharks), moonfish (7.0%), Ray's bream (0.9%), and a higher proportion of swordfish (21.2%). There were observer authorised discards in 2017–18 of 5 bigeye tuna, 5 swordfish, and 17 southern bluefin tuna.

Of the non-QMS fish species, most of the dealfish and lancetfish discards were recovered dead, and most oilfish, rudderfish, and sunfish were alive.

Observers record 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. The numbers of fish that were brought to the vessel alive, then released or discarded with a known subsequent fate are given in Table 9. Some fish were recorded as 'discarded' with life status unknown and these fish were not included. Some were recorded as 'alive' but with no injury status; these are included in '% alive', but not in the 'number of discarded fish with known fate', or 'percentage of those alive with non-fatal injuries'.

Sufficient information about life status on release was recorded for blue sharks, mako sharks, and porbeagle sharks to indicate that most of these species of sharks were released uninjured or with injuries that would not be expected to be fatal. The percentage of the sharks released alive with injuries considered to be survivable is given in Table 9 by fishing year. Blue sharks were most likely to survive and porbeagle sharks least likely (Table 6, Table 9), but of those released alive over 80% were uninjured or expected to survive their injuries.

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, MPI Observer Programme, pers. comm.).

4. SUMMARY AND DISCUSSION

During 2015–16 to 2017–18, for the first time over the time series, New Zealand Domestic fleet was the only fleet fishing in New Zealand waters by surface longline. There has been a decline in fishing effort since 2002−03, particularly for the Domestic fleet, and total effort has been low for the last 14 years, with an all-time low in 2007–08. During the last ten years, effort has been fairly constant with an average of 2.2 million hooks set each year. Charter vessels have not fished in New Zealand waters since 2014–15. In 2017–18, there was some fishing effort off the east coast of the South Island, an area not fished since 2003–04.

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). In recent years, southern bluefin tuna were in the top three most abundant observed species (Griggs et al. 2018), and this was seen again during 2015–16 to 2017–18.

Over the three years combined, blue shark was still most abundant in observed catches (41%) followed by southern bluefin tuna and then albacore. Catch composition varied with region fished, and with greater observer coverage in the northern region than in the south, there was a greater proportion of northern species including lancetfish, sunfish, swordfish, and yellowfin tuna, and less of southern species such as

Ray's bream, bigscale pomfret, dealfish, and deepwater dogfish in the observed catches. There was an increase of yellowfin tuna, a species almost absent in catches for about eight years prior to 2015–16.

Trends in reported catches during 2015–16 to 2017–18 include: blue shark captures continued to be high, whereas mako and porbeagle catches decreased. Southern bluefin tuna catches have steadily increassed, yellowfin tuna catches have increased after being very low for about a decade, albacore catches remained low, and Ray's bream, bigscale pomfret, school shark, and deepwater dogfish catches decreased.

Observer coverage on Domestic vessels has improved in recent years and appears 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.

Discard practices varied 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.

There have been changes in fishing practices since shark finning was banned. Most blue, mako, and porbeagle sharks were discarded during 2015–16 to 2017–18, and most were alive when brought to the vessel with the highest survival rate for blue sharks and 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. No sharks were observed finned as a primary state since 2014–15 after the ban on finning.

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. The proportion of each species recovered alive varied with region and tended to be lower in the North than in the South.

Indicator analyses have shown that the populations of blue, porbeagle, and mako sharks have been responding well to the reduced levels of fishing effort present around New Zealand during the last decade. 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). 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. Furthermore, many pelagic sharks now survive capture by surface longline vessels because they are released alive, thus fishing related mortality has likely declined substantially since 2015. A stock status assessment of the entire Southern Hemisphere range of the porbeagle population further supports this reasoning and found that the impact of fishing on the population is low (Hoyle et al. 2017).

Francis & Finucci (2019) analysed trends in the median length and sex ratio of blue, porbeagle, and mako sharks measured by observers aboard tuna longliners up to 2017–18. They noted that:
'Blue sharks showed no temporal trends in median length for either sex or region. The sex ratio of blue shark appeared to follow a regular cycle of about 7 years, with inverse patterns in North and South regions. This suggests there may be inter-annual variation in movement of male and/or female blue sharks throughout the EEZ. Sample sizes of mako and porbeagle sharks were too small (<50-shark threshold) in recent years and any trends in median length or sex ratio could not be evaluated beyond 2012. Male porbeagles in both regions and female porbeagles in South region showed reduced median lengths from 2002. Similarly, mako sharks of both sexes in North region showed a decline in median length through

time and an upswing in 2012. However, the interpretation of shark length-frequency distributions obtained from observer data is unfortunately confounded by trends in fisher and observer practices.'

In particular, pelagic sharks have increasingly been released alive or discarded dead by fishers following a ban on shark finning in 2015, to the extent that few sharks are now hauled aboard or processed by tuna longliners (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 longline fishery on stocks of non-target bony fish. There is considerable variation between vessels in fishing gear and fishing methods, variation in reporting and discard practices, especially in the wider range of the stock and other fisheries in the Western Central Pacific Ocean 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 tunas, 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 (Clarke at al. 2014, Clarke 2015, Chapman 2001).

5. ACKNOWLEDGMENTS

We are grateful for the hard work and dedication of all the observers who were involved in the government Observer Programme. Thanks to Owen Anderson and Ian Tuck (NIWA) and John Annala (Fisheries New Zealand) who made helpful comments on the manuscript. This study was funded by MPI under research project HMS2016-01.

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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

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
Total	4.0	25.0	13.5

Table 3: Percentage of the hooks that were observed on observed sets on Domestic vessels during 2015–16 to 2017–18. Values are the numbers of sets in each category.

Fishing year	% hooks observed	Number of sets
2015–16	90–99	1
	100	341
	Total	342
2016–17	100	378
	Total	378
2017–18	80–89	2
	90–99	1
	100	322
	Total	325

Table 4: 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. 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). (Continued next page)

North 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	N	1 284	3.7	3 701	3.3	12	0.0	12	0.0
1989–90	N	1 294	6.0	3 752	6.0	265	0.0	117	0.0
1990–91	N	2 052	5.9	6 032	5.6	447	0.0	319	0.0
1991–92	N	1 550	5.4	4 500	5.4	691	0.0	540	0.0
1992–93	N	445	28.8	1 207	27.5	1 117	0.0	944	0.0
1993–94	N	49	65.3	137	63.4	1 978	0.0	1 649	0.0
1994–95	N	23	56.5	61	44.9	2 705	1.8	2 210	3.0
1995–96	N	0	–	0	–	3 154	2.1	2 775	2.3
1996–97	N	48	91.7	136	87.0	2 792	3.6	2 328	3.4
1997–98	N	123	76.4	328	73.9	3 267	2.4	2 930	2.4
1998–99	N	53	54.7	167	50.0	5 383	0.7	5 376	0.7
1999–00	N	46	54.3	134	50.5	6 547	0.0	7 087	0.0
2000–01	N	31	100.0	83	93.5	7 731	2.6	8 842	2.7
2001–02	N	4	100.0	12	97.9	8 196	1.5	9 683	1.5
2002–03	N	27	100.0	80	86.0	7 120	0.0	8 539	0.0
2003–04	N	16	100.0	52	79.6	4 722	2.1	5 487	2.2
2004–05	N	42	100.0	138	84.8	2 754	4.9	3 017	4.7
2005–06	N	18	100.0	50	82.1	2 769	2.3	2 992	2.6
2006–07	N	82	68.3	274	61.0	2 275	7.2	2 289	7.4
2007–08	N	0	–	0	–	1 675	8.5	1 572	9.0
2008–09	N	23	100.0	73	80.5	2 233	6.6	2 150	6.6
2009–10	N	0	–	0	–	2 454	6.7	2 307	6.9
2010–11	N	2	100.0	7	71.1	2 582	6.7	2 538	6.8
2012–12	N	2	100.0	7	72.2	2 080	6.4	1 997	6.5
2012–13	N	11	100.0	37	83.5	2 006	4.0	1 904	3.6
2013–14	N	0	–	0	–	1 641	6.7	1 425	6.0
2014–15	N	0	–	0	–	1 565	6.3	1 291	6.6
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

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	1.8	6 253	1.8	0	–	0	–
1989–90	S	1 628	4.7	4 801	4.6	2	0.0	<1	0.0
1990–91	S	3 127	0.9	9 285	0.9	23	0.0	31	0.0
1991–92	S	1 995	4.6	5 862	4.6	7	0.0	5	0.0
1992–93	S	1 563	15.7	4 763	15.2	29	0.0	53	0.0
1993–94	S	560	37.7	1 626	37.3	129	0.0	150	0.0
1994–95	S	540	51.1	1 580	49.9	798	0.0	793	0.0
1995–96	S	96	0.0	258	0.0	323	25.1	274	35.9
1996–97	S	457	61.1	1 320	57.9	14	0.0	9	0.0
1997–98	S	318	82.7	950	78.7	16	0.0	14	0.0
1998–99	S	436	77.1	1 338	72.5	34	0.0	19	0.0
1999–00	S	334	63.8	1 016	58.3	60	0.0	56	0.0
2000–01	S	277	87.0	860	86.2	79	0.0	65	0.0
2001–02	S	320	84.7	973	78.3	283	0.0	291	0.0
2002–03	S	348	100.0	1 134	92.7	150	0.0	137	0.0
2003–04	S	431	100.0	1 420	91.2	410	1.2	448	1.4
2004–05	S	157	100.0	504	88.4	107	7.5	97	7.9
2005–06	S	164	100.0	556	89.9	109	11.0	104	11.2
2006–07	S	321	59.5	1 107	53.1	3	0.0	3	0.0
2007–08	S	167	49.7	568	44.7	101	0.0	93	0.0
2008–09	S	216	96.8	736	81.3	160	3.1	159	3.9
2009–10	S	144	100.0	479	80.9	238	7.1	204	10.0
2010–11	S	149	100.0	497	73.6	172	0.0	164	0.0
2012–12	S	162	100.0	548	83.7	542	7.2	556	7.6
2012–13	S	137	100.0	450	77.6	490	0.8	489	0.4
2013–14	S	186	100.0	653	83.5	473	9.9	453	9.6
2014–15	S	181	100.0	622	80.8	484	5.0	494	4.5
2015–16	S	–		–		624	21	634	20
2016–17	S	–		–		558	24	558	23
2017–18	S	–		–		432	19	430	18

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 2015–16 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, –, most of the unidentified fish were lost and life status was usually unknown). (Continued next pages)

	Domestic		Total	% of	%	discards
Species	North	South	number	catch	retained	% dead
Blue shark	5 928	4 110	10 038	38.9	0.1	13.3
Southern bluefin tuna	1 959	2 787	4 746	18.4	87.1	11.5
Albacore tuna	2 994	1 064	4 058	15.7	97.4	91.9
Ray's bream	626	746	1 372	5.3	98.5	89.5
Lancetfish	1 172	10	1 182	4.6	0.2	81.2
Porbeagle shark	672	316	988	3.8	1.5	43.8
Swordfish	722	193	915	3.5	98.0	44.4
Sunfish	486	84	570	2.2	0.0	0.4
Mako shark	429	55	484	1.9	2.5	37.0
Moonfish	320	57	377	1.5	98.1	71.4
Bigeye tuna	235	0	235	0.9	98.3	50.0
Butterfly tuna	106	42	148	0.6	89.2	75.0
Pelagic stingray	85	24	109	0.4	0.0	26.0
Yellowfin tuna	79	0	79	0.3	96.2	0.0
Escolar	59	7	66	0.3	71.4	50.0
Oilfish	65	0	65	0.3	51.6	31.6
Thresher shark	56	8	64	0.2	0.0	20.3
Striped marlin	40	0	40	0.2	0.0	35.9
Pacific bluefin tuna	27	9	36	0.1	97.1	100.0
Rudderfish	12	11	23	0.1	84.2	50.0
Dealfish	0	16	16	0.1	0.0	78.6
Dolphinfish	13	0	13	0.1	100.0	n/a
Skipjack tuna	13	0	13	0.1	92.3	0.0
Longtailed stingray	0	10	10	<0.1	0.0	0.0
Bigeye thresher	9	0	9	<0.1	0.0	55.6
Opah	0	7	7	<0.1	83.3	100.0
Hāpuku and bass	6	0	6	<0.1	100.0	n/a
School shark	0	6	6	<0.1	83.3	0.0
Black barracouta	4	1	5	<0.1	0.0	100.0
Flathead pomfret	0	5	5	<0.1	20.0	0.0
Big scale pomfret	0	4	4	<0.1	100.0	n/a
Bronze whaler shark	4	0	4	<0.1	0.0	0.0
Kingfish	4	0	4	<0.1	75.0	0.0
Gemfish	4	0	4	<0.1	75.0	0.0
Cubehead	2	1	3	<0.1	0.0	66.7
Hake	0	2	2	<0.1	100.0	n/a
Pilotfish	2	0	2	<0.1	0.0	100.0
Blue marlin	1	0	1	<0.1	0.0	100.0
Black marlin	1	0	1	<0.1	0.0	100.0
Short-tailed black ray	1	0	1	<0.1	0.0	0.0
Brown stargazer	1	0	1	<0.1	0.0	0.0
Hammerhead shark	1	0	1	<0.1	0.0	0.0
Pelagic stargazer	1	0	1	<0.1	0.0	0.0
Seahorse	0	1	1	<0.1	0.0	0.0
Shortbill spearfish	1	0	1	<0.1	0.0	100.0
Wingfish	0	1	1	<0.1	0.0	100.0
Unidentified fish	107	6	113	0.4	0.0	–
Total	**16 247**	**9 583**	**25 830**			

Table 5: (*continued*). 2016–17.

	Domestic		Total	% of	%	discards
Species	North	South	number	catch	retained	% dead
Blue shark	5 282	3 760	9 042	40.4	0.2	11.8
Southern bluefin tuna	2 188	2 195	4 383	19.6	94.8	13.8
Albacore tuna	2 532	621	3 153	14.1	94.8	95.0
Lancetfish	2 041	1	2 042	9.1	0.1	64.0
Swordfish	707	117	824	3.7	97.2	43.5
Porbeagle shark	412	272	684	3.1	0.0	60.9
Ray's bream	121	324	445	2.0	98.9	80.0
Moonfish	284	57	341	1.5	97.9	71.4
Sunfish	268	55	323	1.4	0.6	0.3
Bigeye tuna	242	0	242	1.1	95.9	90.0
Mako shark	185	36	221	1.0	7.5	32.7
Pelagic stingray	178	8	186	0.8	0.0	0.0
Butterfly tuna	58	12	70	0.3	80.9	92.3
Escolar	50	2	52	0.2	68.6	37.5
Thresher shark	28	14	42	0.2	0.0	36.6
Oilfish	38	0	38	0.2	28.9	7.4
Rudderfish	30	5	35	0.2	43.8	16.7
Dolphinfish	25	0	25	0.1	100.0	n/a
Striped marlin	24	0	24	0.1	0.0	33.3
Yellowfin tuna	22	0	22	0.1	100.0	n/a
Bronze whaler shark	17	1	18	0.1	0.0	27.8
School shark	2	12	14	0.1	85.7	0.0
Hoki	4	9	13	0.1	61.5	80.0
Skipjack tuna	12	1	13	0.1	84.6	0.0
Large headed slickhead	9	0	9	<0.1	0.0	0.0
Pacific bluefin tuna	8	1	9	<0.1	100.0	n/a
Dealfish	0	8	8	<0.1	0.0	50.0
Broadnose sevengill shark	0	6	6	<0.1	0.0	0.0
Flathead pomfret	0	6	6	<0.1	33.3	100.0
Deepwater dogfish	0	5	5	<0.1	0.0	20.0
Big scale pomfret	1	3	4	<0.1	100.0	n/a
Marlin, unspecified	4	0	4	<0.1	0.0	25.0
Gemfish	4	0	4	<0.1	25.0	100.0
Bigeye thresher	3	0	3	<0.1	0.0	50.0
Bluenose	3	0	3	<0.1	100.0	n/a
Ribbonfish	0	2	2	<0.1	0.0	100.0
Hake	0	2	2	<0.1	0.0	100.0
Hammerhead shark	2	0	2	<0.1	0.0	0.0
Hāpuku and bass	2	0	2	<0.1	100.0	n/a
Ray, unidentified	1	1	2	<0.1	0.0	50.0
Ribaldo	0	2	2	<0.1	0.0	100.0
Longtailed stingray	2	0	2	<0.1	0.0	0.0
Fanfish	0	1	1	<0.1	0.0	0.0
Snake mackerel	1	0	1	<0.1	0.0	0.0
Sharpnose sevengill shark	0	1	1	<0.1	0.0	0.0
Sixgill shark	0	1	1	<0.1	0.0	0.0
Kingfish	1	0	1	<0.1	0.0	0.0
Tuna, unspecified	1	0	1	<0.1	0.0	0.0
Common warehou	1	0	1	<0.1	100.0	n/a
Scalloped dealfish	0	1	1	<0.1	0.0	0.0
Unidentified fish	22	40	62	0.3	0.0	–
Total	**14 815**	**7 582**	**22 397**			

Table 5: (*continued*). 2017–18.

	Domestic		Total	% of	%	Discards
Species	North	South	number	catch	retained	% dead
Blue shark	5 473	3 958	9 431	44.7	0.0	12.0
Southern bluefin tuna	2 634	919	3 553	16.8	96.6	42.4
Albacore tuna	2 564	495	3 059	14.5	95.6	94.7
Lancetfish	1 360	2	1 362	6.5	0.0	86.0
Swordfish	606	192	798	3.8	94.6	51.2
Sunfish	478	20	498	2.4	0.2	0.6
Porbeagle shark	156	271	427	2.0	0.0	41.9
Moonfish	318	43	361	1.7	97.7	75.0
Mako shark	286	36	322	1.5	2.2	30.4
Pelagic stingray	269	1	270	1.3	0.4	2.6
Ray’s bream	88	162	250	1.2	99.6	100.0
Bigeye tuna	184	0	184	0.9	97.3	20.0
Rudderfish	66	12	78	0.4	36.1	15.4
Yellowfin tuna	78	0	78	0.4	87.0	0.0
Oilfish	68	5	73	0.3	58.0	17.2
Butterfly tuna	48	15	63	0.3	73.0	100.0
Escolar	49	0	49	0.2	63.8	40.0
Thresher shark	30	5	35	0.2	0.0	18.2
School shark	23	8	31	0.1	80.6	16.7
Skipjack tuna	26	1	27	0.1	96.3	100.0
Dolphinfish	20	0	20	0.1	63.2	0.0
Striped marlin	17	0	17	0.1	0.0	47.1
Pacific bluefin tuna	8	8	16	0.1	93.8	100.0
Sixgill shark	0	12	12	0.1	0.0	0.0
Hoki	0	10	10	0.0	90.0	100.0
Broadnose sevengill shark	0	7	7	0.0	0.0	0.0
Big scale pomfret	1	5	6	0.0	83.3	0.0
Bronze whaler shark	6	0	6	0.0	0.0	16.7
Black barracouta	2	2	4	0.0	25.0	66.7
Bigeye thresher	4	0	4	0.0	0.0	0.0
Dealfish	0	4	4	0.0	0.0	50.0
Gemfish	3	0	3	0.0	0.0	100.0
Flathead pomfret	3	0	3	0.0	0.0	0.0
Black slickhead	2	0	2	0.0	0.0	0.0
Deepwater dogfish	1	1	2	0.0	0.0	0.0
Kingfish	2	0	2	0.0	0.0	0.0
Longtailed stingray	2	0	2	0.0	0.0	0.0
Barracuda	0	1	1	0.0	100.0	n/a
Bluenose	1	0	1	0.0	0.0	0.0
Hake	0	1	1	0.0	100.0	n/a
Hāpuku and bass	1	0	1	0.0	100.0	n/a
Shark, unidentified	1	0	1	0.0	0.0	100.0
Pilotfish	1	0	1	0.0	0.0	100.0
Pelagic stargazer	1	0	1	0.0	0.0	0.0
Unidentified fish	38	0	38	0.2	0.0	–
Total	**14 918**	**6 196**	**21 114**			

Table 5: (*continued*). 2015–16 to 2017–18 combined.

	Domestic		Total	% of	%	discards
Species	North	South	number	catch	retained	% dead
Blue shark	16 683	11 828	28 511	41.1	0.1	12.4
Southern bluefin tuna	6 781	5 901	12 682	18.3	92.5	15.9
Albacore tuna	8 090	2 180	10 270	14.8	96.1	94.1
Lancetfish	4 573	13	4 586	6.6	0.1	74.7
Swordfish	2 035	502	2 537	3.7	96.7	47.6
Porbeagle shark	1 240	859	2 099	3.0	0.7	49.0
Ray's bream	835	1 232	2 067	3.0	98.7	88.0
Sunfish	1 232	159	1 391	2.0	0.2	0.4
Moonfish	922	157	1 079	1.6	97.9	72.7
Mako shark	900	127	1 027	1.5	3.5	34.0
Bigeye tuna	661	0	661	1.0	97.1	64.7
Pelagic stingray	532	33	565	0.8	0.2	5.9
Butterfly tuna	212	69	281	0.4	83.5	89.1
Yellowfin tuna	179	0	179	0.3	92.7	0.0
Oilfish	171	5	176	0.3	49.1	17.3
Escolar	158	9	167	0.2	68.3	41.5
Thresher shark	114	27	141	0.2	0.0	24.8
Rudderfish	108	28	136	0.2	46.4	16.9
Striped marlin	81	0	81	0.1	0.0	37.5
Pacific bluefin tuna	43	18	61	0.1	96.7	100.0
Dolphinfish	58	0	58	0.1	86.8	0.0
Skipjack tuna	51	2	53	0.1	92.5	25.0
School shark	25	26	51	0.1	82.4	11.1
Bronze whaler shark	27	1	28	<0.1	0.0	21.4
Dealfish	0	28	28	<0.1	0.0	65.4
Hoki	4	19	23	<0.1	73.9	83.3
Bigeye thresher	16	0	16	<0.1	0.0	42.9
Big scale pomfret	2	12	14	<0.1	92.9	0.0
Flathead pomfret	3	11	14	<0.1	21.4	36.4
Longtailed stingray	4	10	14	<0.1	0.0	0.0
Sixgill Shark	0	13	13	<0.1	0.0	0.0
Broadnose sevengill shark	0	13	13	<0.1	0.0	0.0
Gemfish	11	0	11	<0.1	36.4	100.0
Large Headed slickhead	9	0	9	<0.1	0.0	0.0
Black barracouta	6	3	9	<0.1	11.1	85.7
Hāpuku and bass	9	0	9	<0.1	100.0	n/a
Deepwater dogfish	1	6	7	<0.1	0.0	14.3
Kingfish	7	0	7	<0.1	42.9	0.0
Opah	0	7	7	<0.1	83.3	100.0
Hake	0	5	5	<0.1	60.0	100.0
Bluenose	4	0	4	<0.1	75.0	0.0
Marlin, unspecified	4	0	4	<0.1	0.0	25.0
Cubehead	2	1	3	<0.1	0.0	66.7
Hammerhead shark	3	0	3	<0.1	0.0	0.0
Pilotfish	3	0	3	<0.1	0.0	100.0

Table 5: (*continued*). 2015–16 to 2017–18 combined, continued.

Species	Domestic North	Domestic South	Total number	% of catch	% retained	discards % dead
Ribbonfish	0	2	2	<0.1	0.0	100.0
Black slickhead	2	0	2	<0.1	0.0	0.0
Pelagic stargazer	2	0	2	<0.1	0.0	0.0
Ray, unidentified	1	1	2	<0.1	0.0	50.0
Ribaldo	0	2	2	<0.1	0.0	100.0
Barracuda	0	1	1	<0.1	100.0	0.0
Blue marlin	1	0	1	<0.1	0.0	100.0
Black marlin	1	0	1	<0.1	0.0	100.0
Short-Tailed black ray	1	0	1	<0.1	0.0	0.0
Brown stargazer	1	0	1	<0.1	0.0	0.0
Fanfish	0	1	1	<0.1	0.0	0.0
Snake mackerel	1	0	1	<0.1	0.0	0.0
Sharpnose sevengill shark	0	1	1	<0.1	0.0	0.0
Shark, unidentified	1	0	1	<0.1	0.0	100.0
Seahorse	0	1	1	<0.1	0.0	0.0
Shortbill spearfish	1	0	1	<0.1	0.0	100.0
Tuna, unspecified	1	0	1	<0.1	n/a	n/a
Common warehou	1	0	1	<0.1	100.0	n/a
Wingfish	0	1	1	<0.1	0.0	100.0
Scalloped dealfish	0	1	1	<0.1	0.0	0.0
Unidentified fish	167	46	213	0.3	4.2	29.4
Total	**45 980**	**23 361**	**69 341**			

Table 6: Percentage of main non-target species (including discards) that were alive or dead when observed during 2015–16 to 2017–18, by fishing year and region. Small sample sizes (number observed < 20) omitted. (Continued next pages)

1. Sharks

Species	Year	Region	% Alive	% Dead	Number
Blue shark	**2015–16**	North	84.9	15.1	5 850
		South	92.8	7.2	3 762
		Total	**88.0**	**12.0**	**9 612**
	2016–17	North	86.6	13.4	5 239
		South	93.9	6.1	3 722
		Total	**89.6**	**10.4**	**8 961**
	2017–18	North	88.5	11.5	5 406
		South	94.8	5.2	3 953
		Total	**91.2**	**8.8**	**9 359**
	Total all strata		**89.6**	**10.4**	**27 932**
Mako shark	**2015–16**	North	63.2	36.8	427
		South	68.5	31.5	54
		Total	**63.8**	**36.2**	**481**
	2016–17	North	68.3	31.7	183
		South	58.3	41.7	36
		Total	**66.7**	**33.3**	**219**
	2017–18	North	71.1	28.9	284
		South	75.0	25.0	36
		Total	**71.6**	**28.4**	**320**
	Total all strata		**66.9**	**33.1**	**1 020**
Porbeagle shark	**2015–16**	North	54.2	45.8	671
		South	67.1	32.9	313
		Total	**58.3**	**41.7**	**984**
	2016–17	North	32.0	68.0	410
		South	55.4	44.6	269
		Total	**41.2**	**58.8**	**679**
	2017–18	North	48.7	51.3	156
		South	64.2	35.8	271
		Total	**58.5**	**41.5**	**427**
	Total all strata		**52.8**	**47.2**	**2 090**
School shark	**2015–16**	**Total**	**50.0**	**50.0**	**6**
	2016–17	**Total**	**85.7**	**14.3**	**14**
	2017–18	North	69.6	30.4	23
		Total	**67.7**	**32.3**	**31**
	Total all strata		**70.6**	**29.4**	**51**
Deepwater dogfish	**2015–16**	**Total**	**–**	**–**	**0**
	2016–17	**Total**	**80.0**	**20.0**	**5**
	2017–18	**Total**	**100.0**	**0.0**	**2**
	Total all strata		**85.7**	**14.3**	**7**

Table 6 (*continued*).

2. Tuna and billfish

Species	Year	Region	% Alive	% Dead	Number
Albacore	**2015–16**	North	28.5	71.5	2 981
		South	33.9	66.1	1 060
		Total	**29.9**	**70.1**	**4 041**
	2016–17	North	24.3	75.7	2 532
		South	26.0	74.0	608
		Total	**24.6**	**75.4**	**3 140**
	2017–18	North	28.4	71.6	2 539
		South	21.6	78.4	491
		Total	**27.3**	**72.7**	**3 030**
	Total all strata		**27.5**	**72.5**	**10 211**
Bigeye tuna	**2015–16**	North	80.9	19.1	235
		Total	**80.9**	**19.1**	**235**
	2016–17	North	71.5	28.5	242
		Total	**71.5**	**28.5**	**242**
	2017–18	North	74.5	25.5	184
		Total	**74.5**	**25.5**	**184**
	Total all strata		**75.6**	**24.4**	**661**
Butterfly tuna	**2015–16**	North	6.6	93.4	106
		South	21.4	78.6	42
		Total	**10.8**	**89.2**	**148**
	2016–17	North	15.5	84.5	58
		Total	**25.7**	**74.3**	**70**
	2017–18	North	0.0	100.0	48
		Total	**1.6**	**98.4**	**63**
	Total all strata		**12.5**	**87.5**	**281**
Southern bluefin tuna	**2015–16**	North	70.3	29.7	1 938
		South	76.3	23.7	2 778
		Total	**73.8**	**26.2**	**4 716**
	2016–17	North	73.5	26.5	2 163
		South	78.7	21.3	2 151
		Total	**76.1**	**23.9**	**4 314**
	2017–18	North	70.4	29.6	2 629
		South	73.7	26.3	919
		Total	**71.3**	**28.7**	**3 548**
	Total all strata		**73.9**	**26.1**	**12 578**

Table 6 (*continued*).

Tuna and billfish (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Yellowfin tuna	**2015–16**	North	77.2	22.8	79
		Total	**77.2**	**22.8**	**79**
	2016–17	North	72.7	27.3	22
		Total	**72.7**	**27.3**	**22**
	2017–18	North	80.8	19.2	78
		Total	**80.8**	**19.2**	**78**
	Total all strata		**78.2**	**21.8**	**179**
Striped marlin	**2015–16**	North	65.0	35.0	40
		Total	**65.0**	**35.0**	**40**
	2016–17	North	70.8	29.2	24
		Total	**70.8**	**29.2**	**24**
	2017–18	**Total**	**52.9**	**47.1**	**17**
	Total all strata		**64.2**	**35.8**	**81**
Swordfish	**2015–16**	North	26.0	74.0	715
		South	35.2	64.8	193
		Total	**28.0**	**72.0**	**908**
	2016–17	North	24.8	75.2	705
		South	44.2	55.8	113
		Total	**27.5**	**72.5**	**818**
	2017–18	North	24.3	75.7	605
		South	39.1	60.9	192
		Total	**27.9**	**72.1**	**797**
	Total all strata		**27.8**	**72.2**	**2 523**

Table 6: (*continued*).

3. Teleosts

Species	Year	Region	% Alive	% Dead	Number
Bigscale pomfret	**2015–16**	**Total**	**66.7**	**33.3**	**3**
	2016–17	**Total**	**100.0**	**0.0**	**4**
	2017–18	**Total**	**50.0**	**50.0**	**6**
	Total all strata		**69.2**	**30.8**	**13**
Dealfish	**2015–16**	**Total**	**25.0**	**75.0**	**16**
	2016–17	**Total**	**50.0**	**50.0**	**8**
	2017–18	**Total**	**50.0**	**50.0**	**4**
	Total all strata		**35.7**	**64.3**	**28**
Lancetfish	**2015–16**	North	58.5	41.5	1 124
		Total	**58.3**	**41.7**	**1 134**
	2016–17	North	37.2	62.8	1 974
		Total	**37.3**	**62.7**	**1 975**
	2017–18	North	18.2	81.8	1 325
		Total	**18.2**	**81.8**	**1 327**
	Total all strata		**36.9**	**63.1**	**4 436**
Escolar	**2015–16**	**Total**	**79.4**	**20.6**	**63**
	2016–17	North	67.3	32.7	50
		Total	**67.3**	**32.7**	**52**
	2017–18	North	81.6	18.4	49
		Total	**81.6**	**18.4**	**49**
	Total all strata		**76.2**	**23.8**	**164**
Moonfish	**2015–16**	North	60.3	39.7	315
		South	86.0	14.0	57
		Total	**64.2**	**35.8**	**372**
	2016–17	North	55.8	44.2	283
		South	55.4	44.6	56
		Total	**55.8**	**44.2**	**339**
	2017–18	North	61.7	38.3	316
		South	74.4	25.6	43
		Total	**63.2**	**36.8**	**359**
	Total all strata		**61.2**	**38.8**	**1 070**
Oilfish	**2015–16**	North	76.6	23.4	64
		Total	**76.6**	**23.4**	**64**
	2016–17	North	89.5	10.5	38
		Total	**89.5**	**10.5**	**38**
	2017–18	North	77.6	22.4	67
		Total	**77.8**	**22.2**	**72**
	Total all strata		**79.9**	**20.1**	**174**

Table 6 (*continued*).

Teleosts (*continued*)

Species	Year	Region	% Alive	% Dead	Number
Ray's bream	**2015–16**	North	78.1	21.9	626
		South	90.4	9.6	648
		Total	**84.4**	**15.6**	**1 274**
	2016–17	North	80.8	19.2	120
		South	84.5	15.5	304
		Total	**83.5**	**16.5**	**424**
	2017–18	North	80.7	19.3	88
		South	88.3	11.7	162
		Total	**85.6**	**14.4**	**250**
	Total all strata		**84.3**	**15.7**	**1 948**
Rudderfish	**2015–16**	**Total**	**82.6**	**17.4**	**23**
	2016–17	North	86.7	13.3	30
		Total	**85.7**	**14.3**	**35**
	2017–18	North	84.1	15.9	63
		Total	**86.7**	**13.3**	**75**
	Total all strata		**85.7**	**14.3**	**133**
Sunfish	**2015–16**	North	99.8	0.2	480
		South	100.0	0.0	82
		Total	**99.8**	**0.2**	**562**
	2016–17	North	99.6	0.4	264
		South	100.0	0.0	55
		Total	**99.7**	**0.3**	**319**
	2017–18	North	99.4	0.6	476
		South	100.0	0.0	20
		Total	**99.4**	**0.6**	**496**
	Total all strata		**99.6**	**0.4**	**1 377**

Table 7: Percentage of main non-target species that were retained, or discarded or lost, when observed during 2015–16 to 2017–18, by fishing year and fleet. Small sample sizes (number observed < 20) omitted. (Continued next pages)

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1. Sharks

Species	Year	Region	% Retained	% Discarded or lost	Number
Blue shark	**2015–16**	North	0.1	99.9	5 905
		South	0.0	100.0	4 089
		Total	**0.1**	**99.9**	**9 994**
	2016–17	North	0.1	99.9	5 250
		South	0.4	99.6	3 727
		Total	**0.2**	**99.8**	**8 977**
	2017–18	North	0.1	99.9	5 440
		South	0.0	100.0	3 955
		Total	**0.0**	**100.0**	**9 395**
	Total all strata		**0.1**	**99.9**	**28 366**
Mako shark	**2015–16**	North	2.1	97.9	428
		South	5.5	94.5	55
		Total	**2.5**	**97.5**	**483**
	2016–17	North	3.3	96.7	183
		South	27.8	72.2	36
		Total	**7.3**	**92.7**	**219**
	2017–18	North	2.5	97.5	284
		South	0.0	100.0	36
		Total	**2.2**	**97.8**	**320**
	Total all strata		**3.4**	**96.6**	**1 022**
Porbeagle shark	**2015–16**	North	0.0	100.0	672
		South	4.8	95.2	315
		Total	**1.5**	**98.5**	**987**
	2016–17	North	0.0	100.0	411
		South	0.0	100.0	269
		Total	**0.0**	**100.0**	**680**
	2017–18	North	0.0	100.0	156
		South	0.0	100.0	271
		Total	**0.0**	**100.0**	**427**
	Total all strata		**0.7**	**99.3**	**2 094**
School shark	**2015–16**	**Total**	**83.3**	**16.7**	**6**
	2016–17	**Total**	**85.7**	**14.3**	**14**
	2017–18	North	73.9	26.1	23
		Total	**80.6**	**19.4**	**31**
	Total all strata		**82.4**	**17.6**	**51.0**
Deepwater dogfish	**2015–16**	**Total**	**–**	**–**	**0**
	2016–17	**Total**	**0.0**	**100.0**	**5**
	2017–18	**Total**	**0.0**	**100.0**	**2**
	Total all strata		**0.0**	**100.0**	**7**

Table 7: (*continued*).

2. Tuna and billfish

Species	Year	Region	% Retained	% Discarded or lost	Number
Albacore	**2015–16**	North	95.4	4.6	2 993
		South	97.7	2.3	1 064
		Total	**96.0**	**4.0**	**4 057**
	2016–17	North	93.0	7.0	2 531
		South	96.1	3.9	619
		Total	**93.6**	**6.4**	**3 150**
	2017–18	North	93.0	7.0	2 564
		South	98.8	1.2	490
		Total	**93.9**	**6.1**	**3 054**
	Total all strata		**94.6**	**5.4**	**10 261**
Bigeye tuna	**2015–16**	North	97.0	3.0	235
		Total	**97.0**	**3.0**	**235**
	2016–17	North	95.5	4.5	242
		Total	**95.5**	**4.5**	**242**
	2017–18	North	96.7	3.3	184
		Total	**96.7**	**3.3**	**184**
	Total all strata		**96.4**	**3.6**	**661**
Butterfly tuna	**2015–16**	North	86.8	13.2	106
		Total	**89.2**	**10.8**	**148**
	2016–17	North	74.1	25.9	58
		Total	**78.6**	**21.4**	**70**
	2017–18	North	66.7	33.3	48
		Total	**73.0**	**27.0**	**63**
	Total all strata		**82.9**	**17.1**	**281**
Southern bluefin tuna	**2015–16**	North	83.6	16.4	1 957
		South	87.1	12.9	2 787
		Total	**85.6**	**14.4**	**4 744**
	2016–17	North	91.6	8.4	2 187
		South	96.2	3.8	2 195
		Total	**93.9**	**6.1**	**4 382**
	2017–18	North	95.2	4.8	2 634
		South	97.5	2.5	919
		Total	**95.8**	**4.2**	**3 553**
	Total all strata		**91.3**	**8.7**	**12 679**

Table 7 (*continued*).

Tuna and billfish (*continued*)

Species	Year	Region	% Retained	% Discarded or lost	Number
Yellowfin tuna	**2015–16**	North	96.2	3.8	79
		Total	**96.2**	**3.8**	**79**
	2016–17	North	100.0	0.0	22
		Total	**100.0**	**0.0**	**22**
	2017–18	North	85.9	14.1	78
		Total	**85.9**	**14.1**	**78**
	Total all strata		**92.2**	**7.8**	**179**
Striped marlin	**2015–16**	North	0.0	100.0	40
		Total	**0.0**	**100.0**	**40**
	2016–17	North	0.0	100.0	24
		Total	**0.0**	**100.0**	**24**
	2017–18	**Total**	**0.0**	**100.0**	**17**
	Total all strata		**0.0**	**100.0**	**81**
Swordfish	**2015–16**	North	96.7	3.3	719
		South	100.0	0.0	193
		Total	**97.4**	**2.6**	**912**
	2016–17	North	96.3	3.7	707
		South	100.0	0.0	117
		Total	**96.8**	**3.2**	**824**
	2017–18	North	92.6	7.4	606
		South	98.4	1.6	192
		Total	**94.0**	**6.0**	**798**
	Total all strata		**96.1**	**3.9**	**2 534**

Table 7: (*continued*).

3. Teleosts

Species	Year	Region	% Retained	% Discarded or lost	Number
Bigscale pomfret	**2015–16**	**Total**	**100.0**	**0.0**	**4**
	2016–17	**Total**	**100.0**	**0.0**	**4**
	2017–18	**Total**	**83.3**	**16.7**	**6**
	Total all strata		**92.9**	**7.1**	**14**
Dealfish	**2015–16**	**Total**	**0.0**	**100.0**	**16**
	2016–17	**Total**	**0.0**	**100.0**	**8**
	2017–18	**Total**	**0.0**	**100.0**	**4**
	Total all strata		**0.0**	**100.0**	**28**
Lancetfish	**2015–16**	North	0.2	99.8	1 172
		Total	**0.2**	**99.8**	**1 182**
	2016–17	North	0.0	100.0	2 037
		Total	**0.0**	**100.0**	**2 038**
	2017–18	North	0.0	100.0	1 358
		Total	**0.0**	**100.0**	**1 360**
	Total all strata		**0.1**	**99.9**	**4 580**
Escolar	**2015–16**	North	66.1	33.9	59
		Total	**68.2**	**31.8**	**66**
	2016–17	North	66.0	34.0	50
		Total	**67.3**	**32.7**	**52**
	2017–18	North	61.2	38.8	49
		Total	**61.2**	**38.8**	**49**
	Total all strata		**65.9**	**34.1**	**167**
Moonfish	**2015–16**	North	95.3	4.7	320
		South	96.5	3.5	57
		Total	**95.5**	**4.5**	**377**
	2016–17	North	96.5	3.5	284
		South	94.7	5.3	57
		Total	**96.2**	**3.8**	**341**
	2017–18	North	95.0	5.0	318
		South	100.0	0.0	43
		Total	**95.6**	**4.4**	**361**
	Total all strata		**95.7**	**4.3**	**1 079**

Table 7 (*continued*).

Teleosts (*continued*)

Species	Year	Region	% Retained	% Discarded or lost	Number
Oilfish	**2015–16**	North	50.0	50.0	64
		Total	**50.0**	**50.0**	**64**
	2016–17	North	28.9	71.1	38
		Total	**28.9**	**71.1**	**38**
	2017–18	North	54.4	45.6	68
		Total	**54.8**	**45.2**	**73**
	Total all strata		**47.4**	**52.6**	**175**
Ray's bream	**2015–16**	North	97.0	3.0	625
		South	99.1	0.9	648
		Total	**98.0**	**2.0**	**1 273**
	2016–17	North	98.3	1.7	120
		South	98.1	1.9	323
		Total	**98.2**	**1.8**	**443**
	2017–18	North	98.9	1.1	88
		South	100.0	0.0	162
		Total	**99.6**	**0.4**	**250**
	Total all strata		**98.3**	**1.7**	**1 966**
Rudderfish	**2015–16**	**Total**	**69.6**	**30.4**	**23**
	2016–17	North	30.0	70.0	30
		Total	**40.0**	**60.0**	**35**
	2017–18	North	25.8	74.2	66
		Total	**28.6**	**71.4**	**77**
	Total all strata		**38.5**	**61.5**	**135**
Sunfish	**2015–16**	North	0.0	100.0	483
		South	0.0	100.0	83
		Total	**0.0**	**100.0**	**566**
	2016–17	North	0.4	99.6	264
		South	1.8	98.2	55
		Total	**0.6**	**99.4**	**319**
	2017–18	North	0.2	99.8	475
		South	0.0	100.0	20
		Total	**0.2**	**99.8**	**495**
	Total all strata		**0.2**	**99.8**	**1 380**

Table 8: Percentage of discarded main non-target species that were alive or dead when recovered on observed sets during 2015–16 to 2017–18, by fishing year and fleet. Small sample sizes (number observed < 20) omitted. (Continued next pages)

1. Sharks

Species	Year	Region	% Alive	% Dead	Number
Blue shark	**2015–16**	North	83.7	16.3	5 801
		South	91.4	8.6	3 651
		Total	**86.7**	**13.3**	**9 452**
	2016–17	North	85.6	14.4	5 211
		South	92.0	8.0	3 630
		Total	**88.2**	**11.8**	**8 841**
	2017–18	North	83.1	16.9	5 260
		South	94.5	5.5	3 938
		Total	**88.0**	**12.0**	**9 198**
	Total all strata		**87.6**	**12.4**	**27 491**
Mako shark	**2015–16**	North	61.9	38.1	412
		South	72.0	28.0	50
		Total	**63.0**	**37.0**	**462**
	2016–17	North	66.1	33.9	171
		South	76.0	24.0	25
		Total	**67.3**	**32.7**	**196**
	2017–18	North	68.9	31.1	270
		South	75.0	25.0	36
		Total	**69.6**	**30.4**	**306**
	Total all strata		**66.0**	**34.0**	**964**
Porbeagle shark	**2015–16**	North	52.4	47.6	668
		South	65.1	34.9	289
		Total	**56.2**	**43.8**	**957**
	2016–17	North	31.7	68.3	410
		South	50.8	49.2	258
		Total	**39.1**	**60.9**	**668**
	2017–18	North	48.7	51.3	156
		South	63.5	36.5	271
		Total	**58.1**	**41.9**	**427**
	Total all strata		**51.0**	**49.0**	**2 052**
School shark	**2015–16**	**Total**	**100.0**	**0.0**	**1**
	2016–17	**Total**	**100.0**	**0.0**	**2**
	2017–18	**Total**	**83.3**	**16.7**	**6**
	Total all strata		**88.9**	**11.1**	**9**
Deepwater dogfish	**2015–16**	**Total**			**0**
	2016–17	**Total**	**80.0**	**20.0**	**5**
	2017–18	**Total**	**100.0**	**0.0**	**2**
	Total all strata		**85.7**	**14.3**	**7**

Table 8 (*continued*)

2. Tuna and billfish

Species	**Year**	Region	% Alive	% Dead	Number
Albacore	**2015–16**	North	4.5	95.5	89
		Total	**8.1**	**91.9**	**99**
	2016–17	North	5.5	94.5	145
		Total	**5.0**	**95.0**	**161**
	2017–18	North	4.7	95.3	129
		Total	**5.3**	**94.7**	**131**
	Total all strata		**5.9**	**94.1**	**391**
Bigeye tuna	**2015–16**	**Total**	**50.0**	**50.0**	**2**
	2016–17	**Total**	**10.0**	**90.0**	**10**
	2017–18	**Total**	**80.0**	**20.0**	**5**
	Total all strata		**35.3**	**64.7**	**17**
Butterfly tuna	**2015–16**	**Total**	**25.0**	**75.0**	**16**
	2016–17	**Total**	**7.7**	**92.3**	**13**
	2017–18	**Total**	**0.0**	**100.0**	**17**
	Total all strata		**10.9**	**89.1**	**46**
Southern bluefin tuna	**2015–16**	North	86.1	13.9	288
		South	90.7	9.3	311
		Total	**88.5**	**11.5**	**599**
	2016–17	North	91.8	8.2	159
		South	72.3	27.7	65
		Total	**86.2**	**13.8**	**224**
	2017–18	North	55.9	44.1	102
		South	68.8	31.3	16
		Total	**57.6**	**42.4**	**118**
	Total all strata		**84.1**	**15.9**	**941**
Yellowfin tuna	**2015–16**	**Total**	**100.0**	**0.0**	**2**
	2016–17	**Total**			**0**
	2017–18	**Total**	**100.0**	**0.0**	**10**
	Total all strata		**100.0**	**0.0**	**12**

Table 8 (*continued*)

Tuna and billfish (*continued*)

Species	**Year**	Region	% Alive	% Dead	Number
Striped marlin	**2015–16**	North	64.1	35.9	39
		Total	**64.1**	**35.9**	**39**
	2016–17	North	66.7	33.3	24
		Total	**66.7**	**33.3**	**24**
	2017–18	**Total**	**52.9**	**47.1**	**17**
	Total all strata		**62.5**	**37.5**	**80**
Swordfish	**2015–16**	**Total**	**55.6**	**44.4**	**18**
	2016–17	North	56.5	43.5	23
		Total	**56.5**	**43.5**	**23**
	2017–18	North	50.0	50.0	42
		Total	**48.8**	**51.2**	**43**
	Total all strata		**52.4**	**47.6**	**84**

Table 8 (*continued*)

3. Teleosts

Species	Year	Region	% Alive	% Dead	Number
Bigscale pomfret	**2015–16**				**0**
	2016–17				**0**
	2017–18		**100.0**	**0.0**	**1**
	Total all strata		**100.0**	**0.0**	**1**
Dealfish	**2015–16**	**Total**	**21.4**	**78.6**	**14**
	2016–17	**Total**	**50.0**	**50.0**	**8**
	2017–18	**Total**	**50.0**	**50.0**	**4**
	Total all strata		**34.6**	**65.4**	**26**
Lancetfish	**2015–16**	North	18.9	81.1	822
		Total	**18.8**	**81.2**	**831**
	2016–17	North	36.0	64.0	1 916
		Total	**36.0**	**64.0**	**1 917**
	2017–18	North	14.1	85.9	1 344
		Total	**14.0**	**86.0**	**1 346**
	Total all strata		**25.3**	**74.7**	**4 094**
Escolar	**2015–16**	**Total**	**50.0**	**50.0**	**10**
	2016–17	**Total**	**62.5**	**37.5**	**16**
	2017–18	**Total**	**60.0**	**40.0**	**15**
	Total all strata		**58.5**	**41.5**	**41**
Moonfish	**2015–16**	**Total**	**28.6**	**71.4**	**7**
	2016–17	**Total**	**28.6**	**71.4**	**7**
	2017–18	**Total**	**25.0**	**75.0**	**8**
	Total all strata		**27.3**	**72.7**	**22**
Oilfish	**2015–16**	**Total**	**68.4**	**31.6**	**19**
	2016–17	North	92.6	7.4	27
		Total	**92.6**	**7.4**	**27**
	2017–18	North	81.5	18.5	27
		Total	**82.8**	**17.2**	**29**
	Total all strata		**82.7**	**17.3**	**75**
Ray’s bream	**2015–16**	**Total**	**10.5**	**89.5**	**19**
	2016–17	**Total**	**20.0**	**80.0**	**5**
	2017–18	**Total**	**0.0**	**100.0**	**1**
	Total all strata		**12.0**	**88.0**	**25**

Table 8 (*continued*).

Teleosts (*continued*)

Species	**Year**	Region	% Alive	% Dead	Number
Rudderfish	**2015–16**	**Total**	**50.0**	**50.0**	**2**
	2016–17	**Total**	**83.3**	**16.7**	**18**
	2017–18	North	84.2	15.8	38
		Total	**84.6**	**15.4**	**39**
	Total all strata		**83.1**	**16.9**	**59**
Sunfish	**2015–16**	North	99.6	0.4	464
		South	100.0	0.0	77
		Total	**99.6**	**0.4**	**541**
	2016–17	North	99.6	0.4	260
		South	100.0	0.0	51
		Total	**99.7**	**0.3**	**311**
	2017–18	North	99.4	0.6	467
		South	100.0	0.0	20
		Total	**99.4**	**0.6**	**487**
	Total all strata		**99.6**	**0.4**	**1 339**

Table 9: Percentage of observed main non-target species that were recovered alive and released alive or discarded dead during 2015–16 to 2017–18. '% Dead' refers to those discarded dead or near death and unlikely to survive, '% Alive' includes those released alive and uninjured and those with injuries considered survivable. Also shown is the percentage of those released alive that were released with injuries considered survivable. The criteria used by observers are shown in Appendix 2.

Species	Fishing year	% Dead	% Alive	% of those alive, with non-fatal injuries	Number of discarded fish with known life fate
Blue shark	2015–16	12.8	87.2	11.9	6831
	2016–17	11.2	88.8	13.4	7616
	2017–18	11.8	88.2	2.1	9171
	All years	**12**	**88**	**8.5**	**23 618**
Mako shark	2015–16	34.9	65.1	10.8	354
	2016–17	28.9	71.1	9.7	179
	2017–18	28.6	71.4	7.9	289
	All years	**31.7**	**68.3**	**9.4**	**822**
Porbeagle shark	2015–16	41.8	58.2	20.9	788
	2016–17	60.2	39.8	18.7	616
	2017–18	40.3	59.7	3.6	424
	All years	**47.5**	**52.5**	**15.3**	**1 828**

8. FIGURES

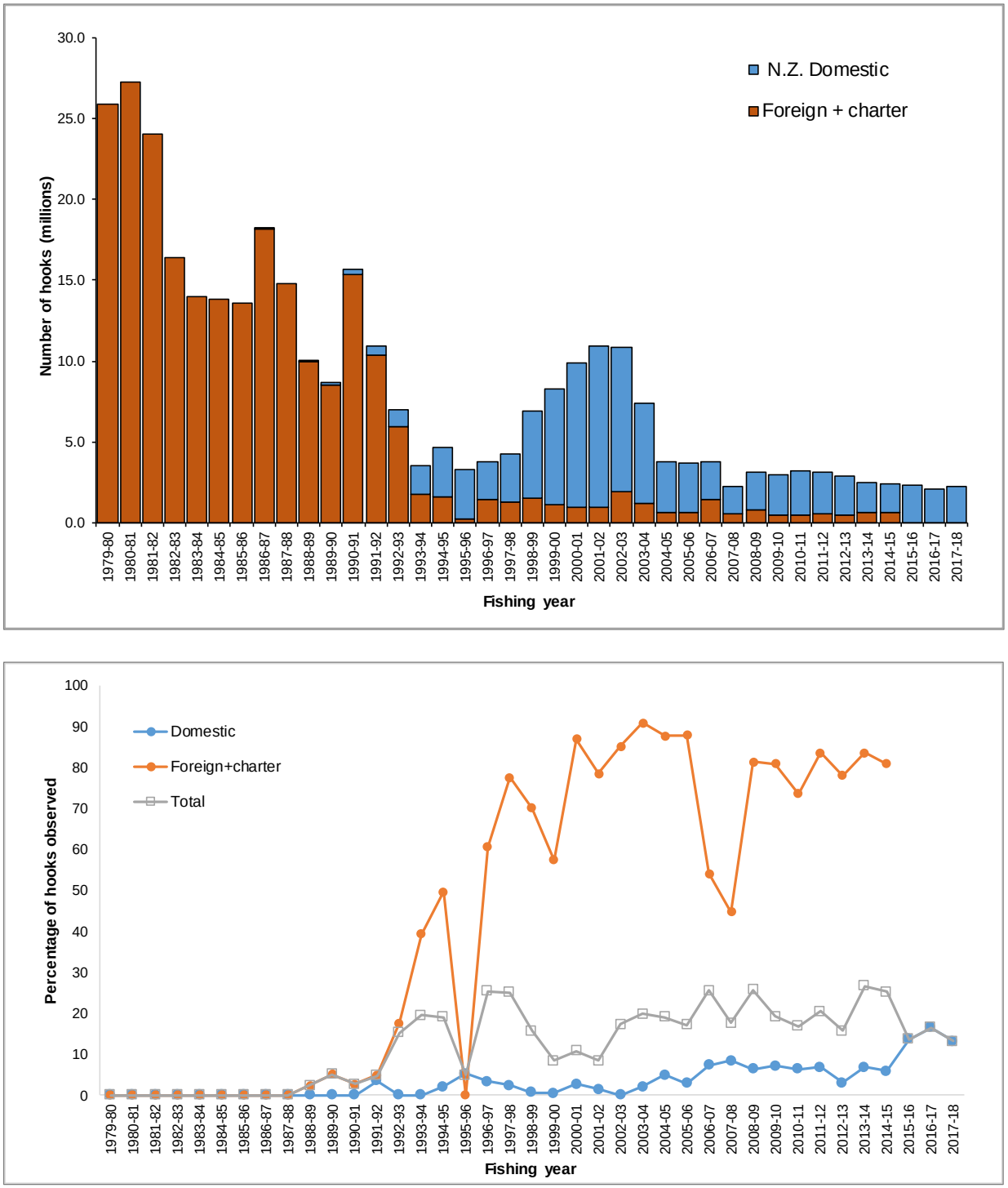


Figure 1: Number of reported hooks set by fishing year and fleet from 1979–80 to 2017–18 (above) and percentage of hooks observed (below). "Foreign + Charter" includes Japanese foreign licensed and Charter vessels, Korean foreign licensed vessels, Philippine Charter vessels, Australian Charter vessels, and one large New Zealand Domestic vessel which fished with the Charter fleet.

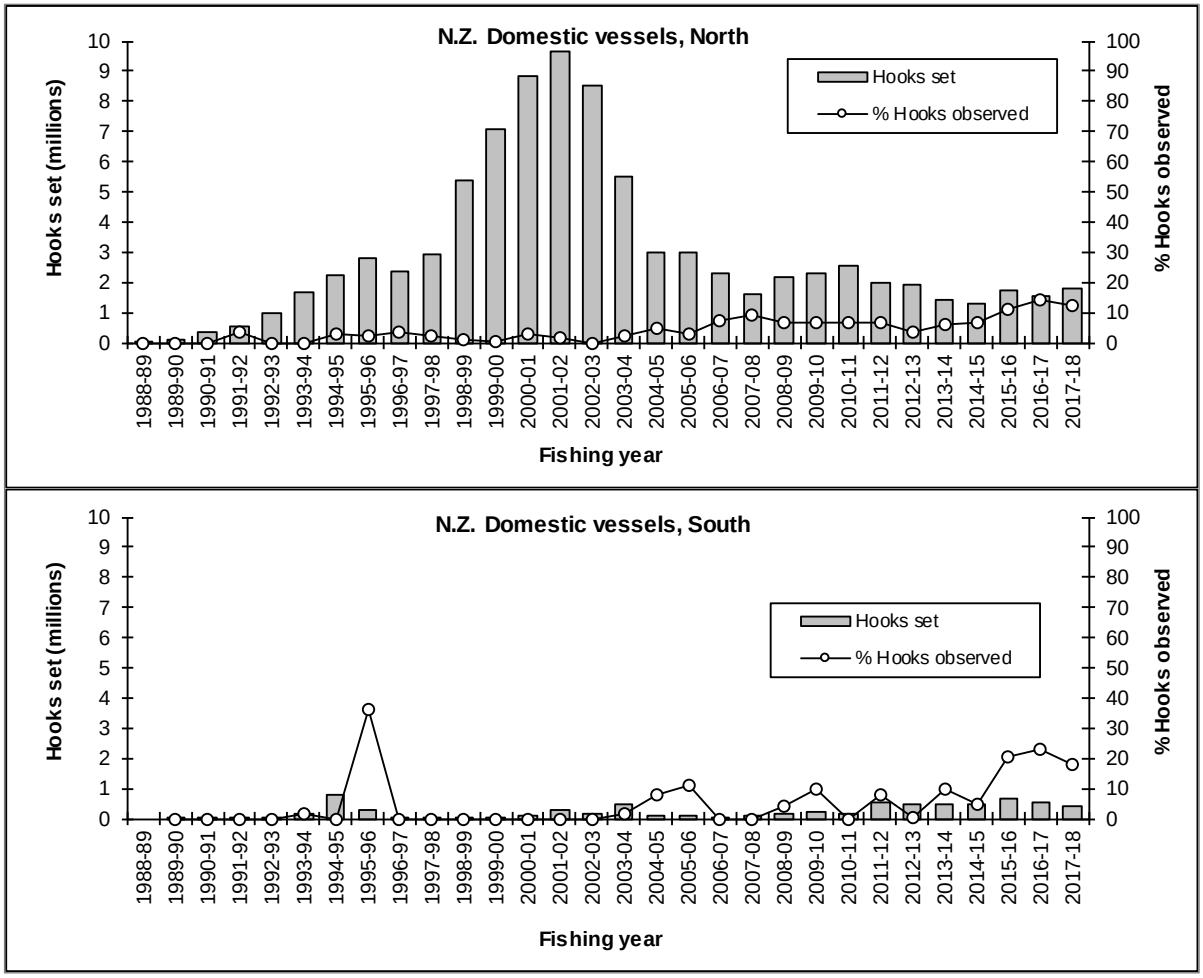


Figure 2: Numbers of hooks set, and percentage of hooks observed, by the Domestic fleet, by region and fishing year.

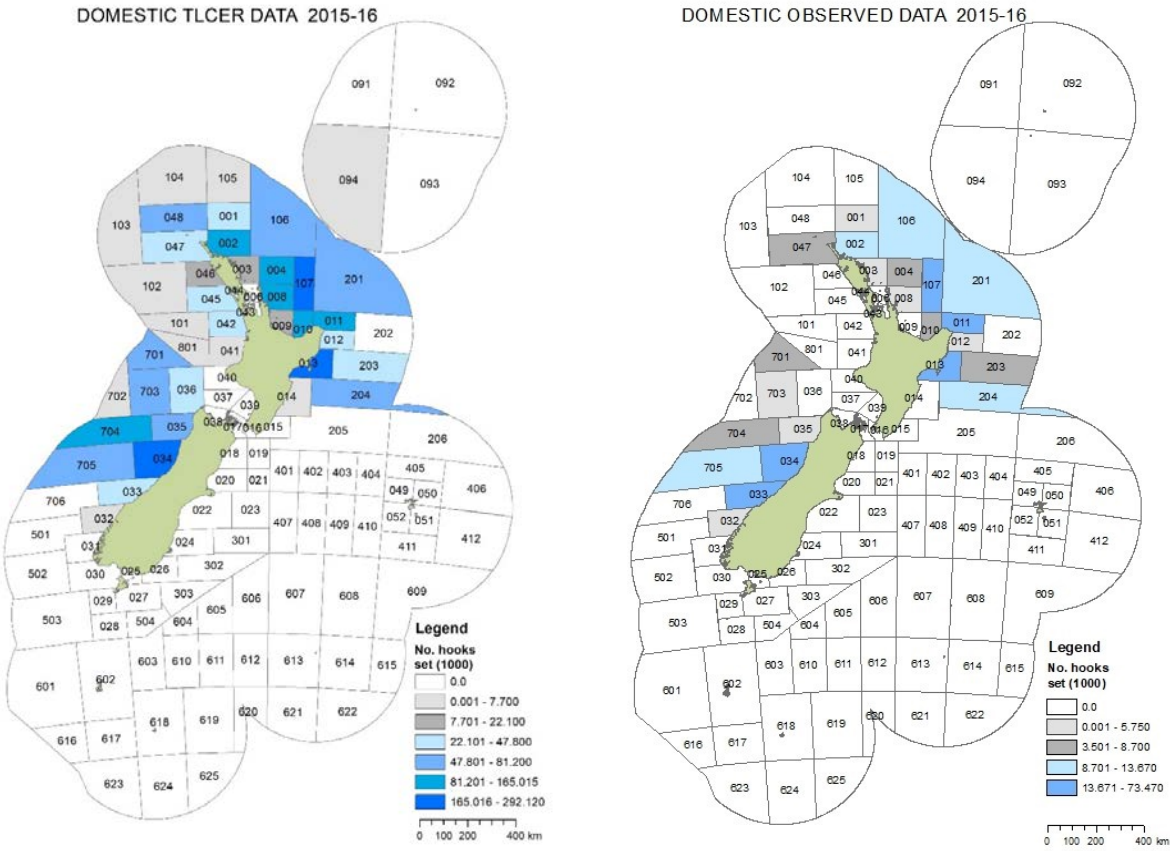


Figure 3: Numbers of hooks set (thousands) based on commercial returns (left) and observed (right) for longlines set by Domestic vessels shown as Statistical Area density plots. Colour legend shows number of hooks (differs among maps). Numerals are statistical area codes. 2015–16. (Continued next pages)

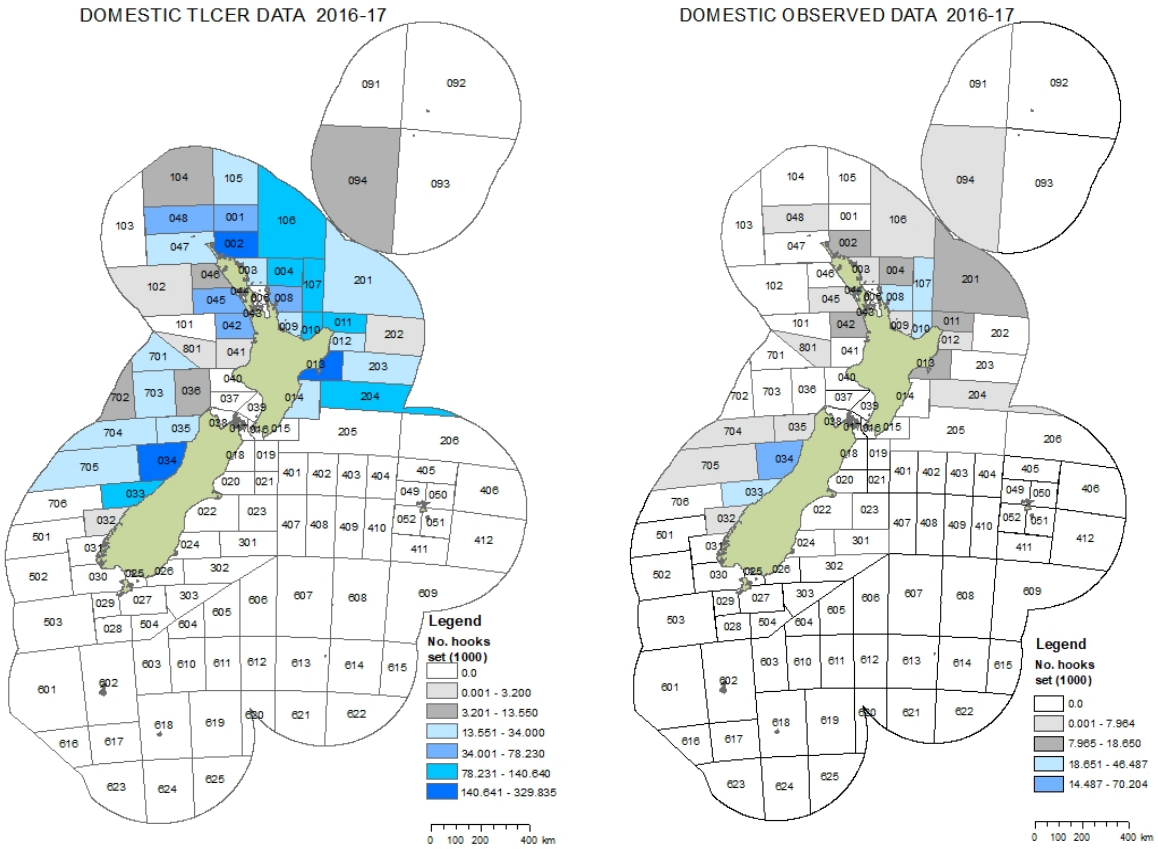
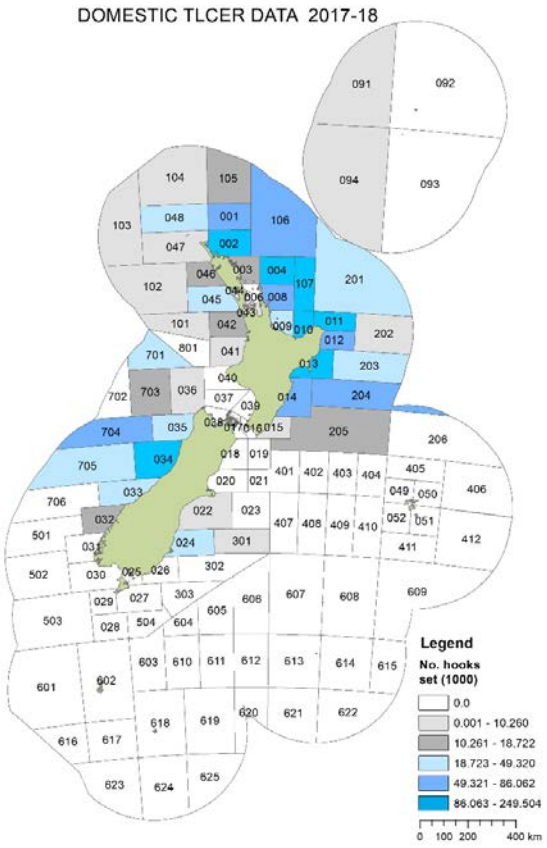


Figure 3: (*continued*). 2016–17.



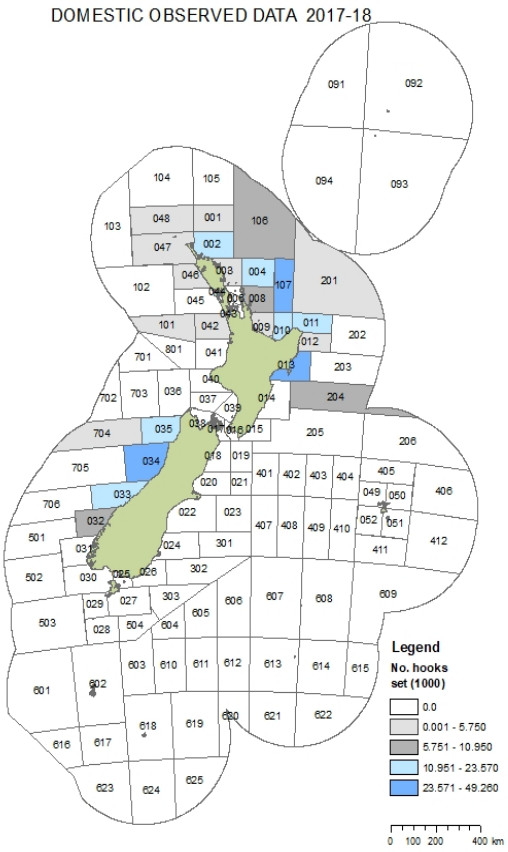


Figure 3: (*continued*). 2017–18.

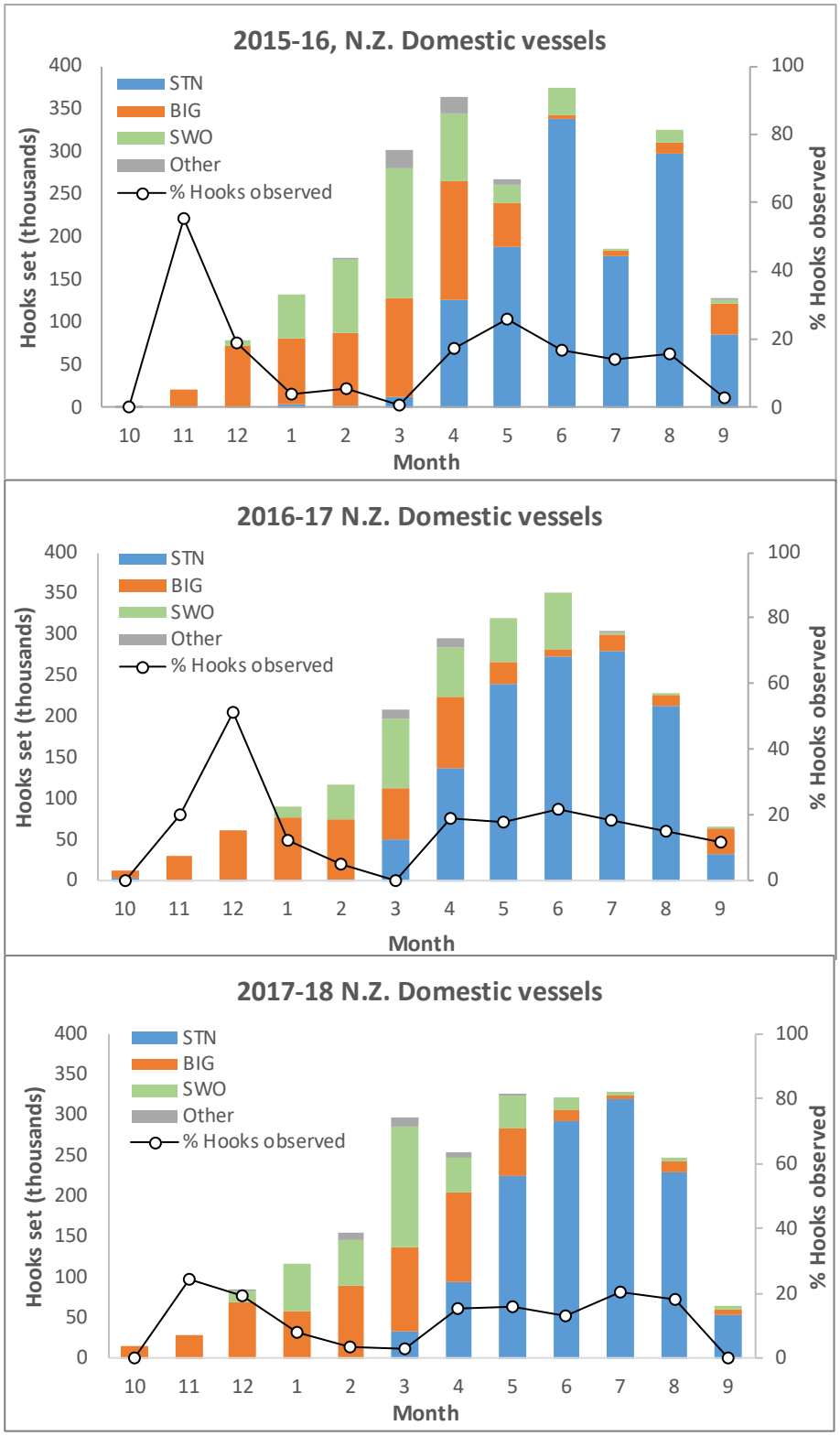


Figure 4: Monthly distribution of reported hooks and the percentage observed in 2015–16 to 2017–18 by Domestic vessels by month and target species. Colours show number of hooks set by each target species. The percentage of hooks observed is shown on the right-hand axes (white circles).

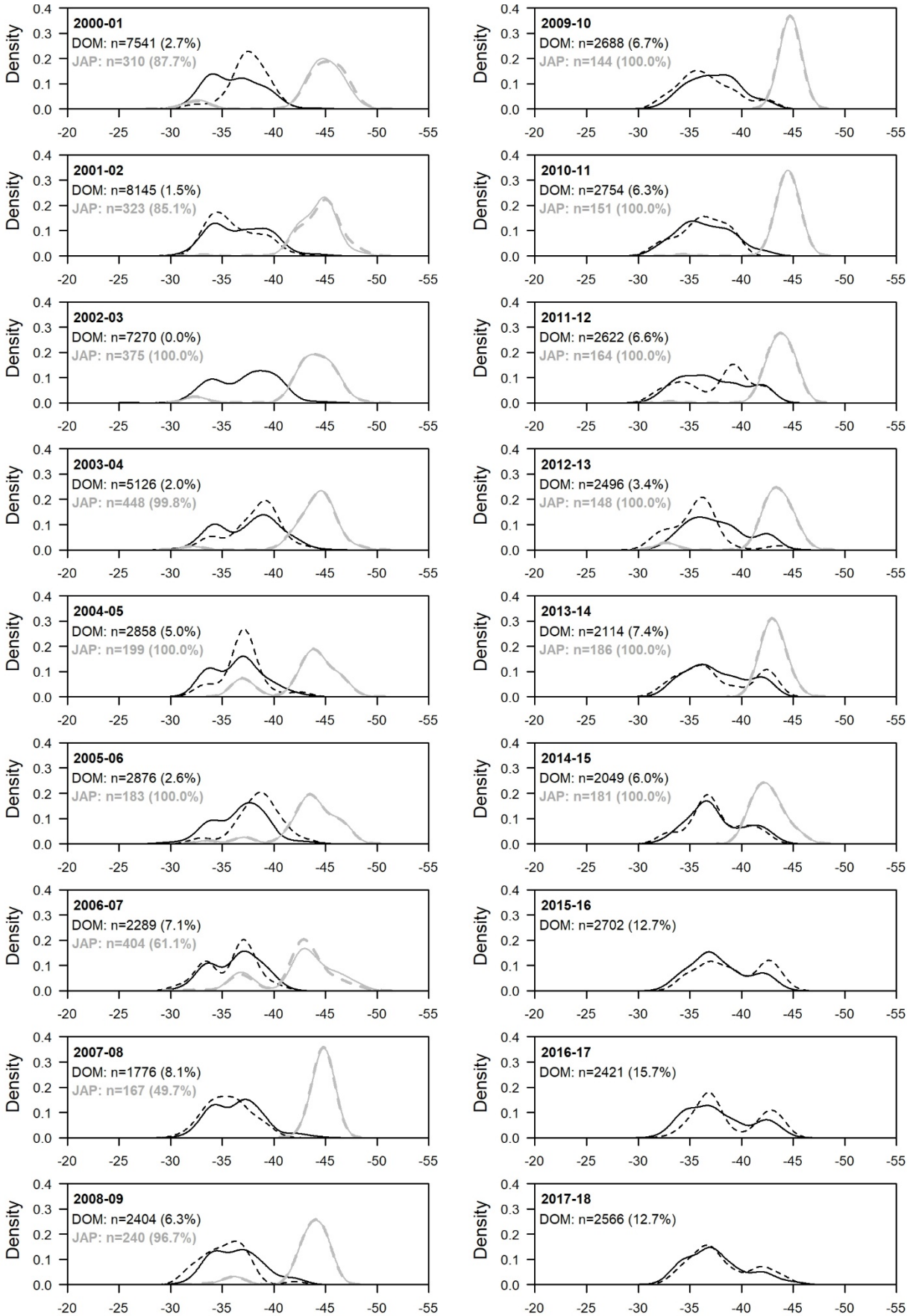


Figure 5: Distribution of start latitude positions for commercial and observed numbers of sets, for Domestic vessels (black lines) and Chartered Japanese vessels (grey lines), 2000–01 to 2017–18. Solid lines represent commercial data and dashed lines represent observed data. The total number of sets 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.

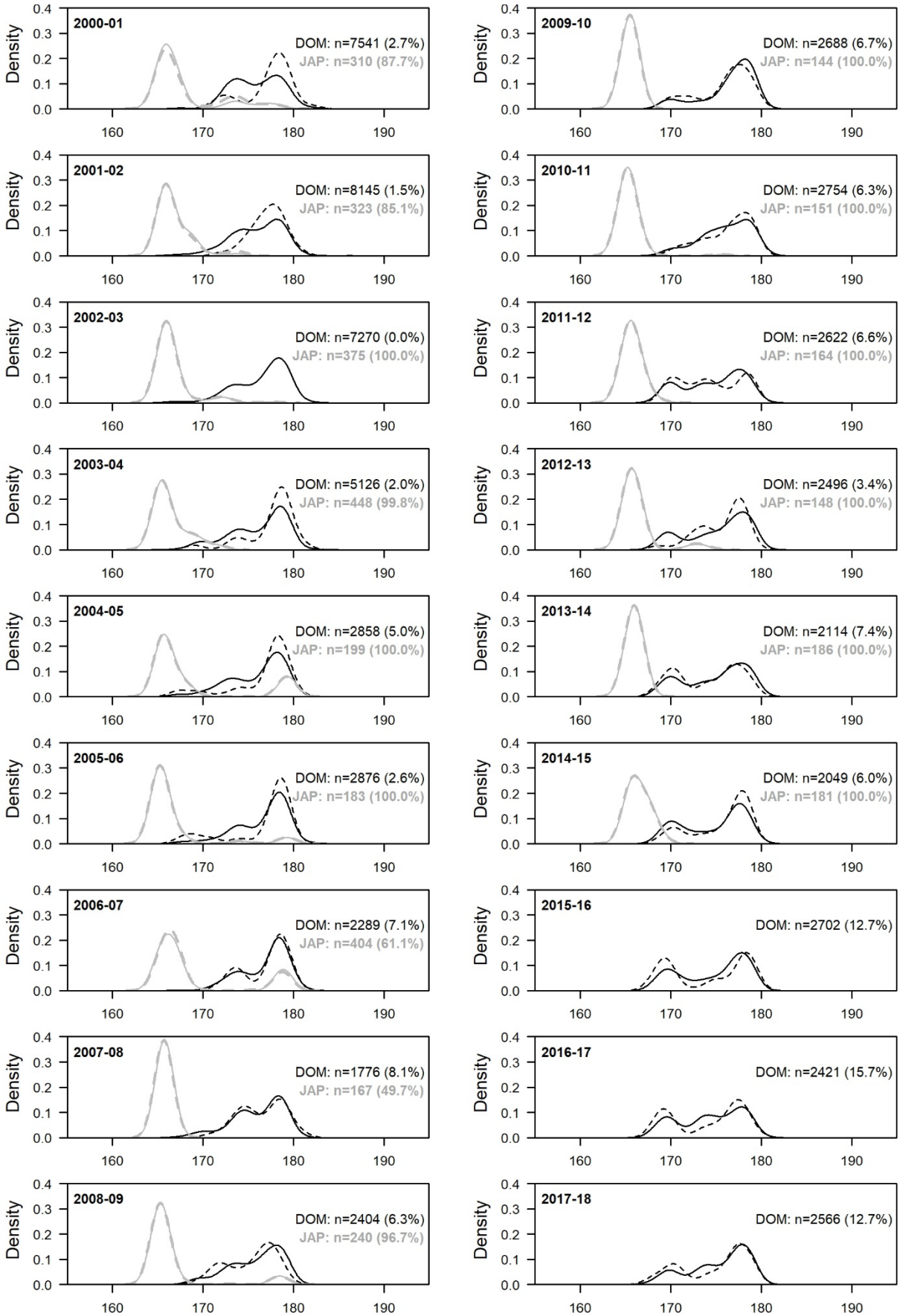


Figure 6: Distribution of start longitude positions for commercial and observed numbers of sets, for Domestic vessels (black lines) and Chartered Japanese vessels (grey lines), 2000–01 to 2017–18. Solid lines represent commercial data and dashed lines represent observed data. The total number of sets 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.

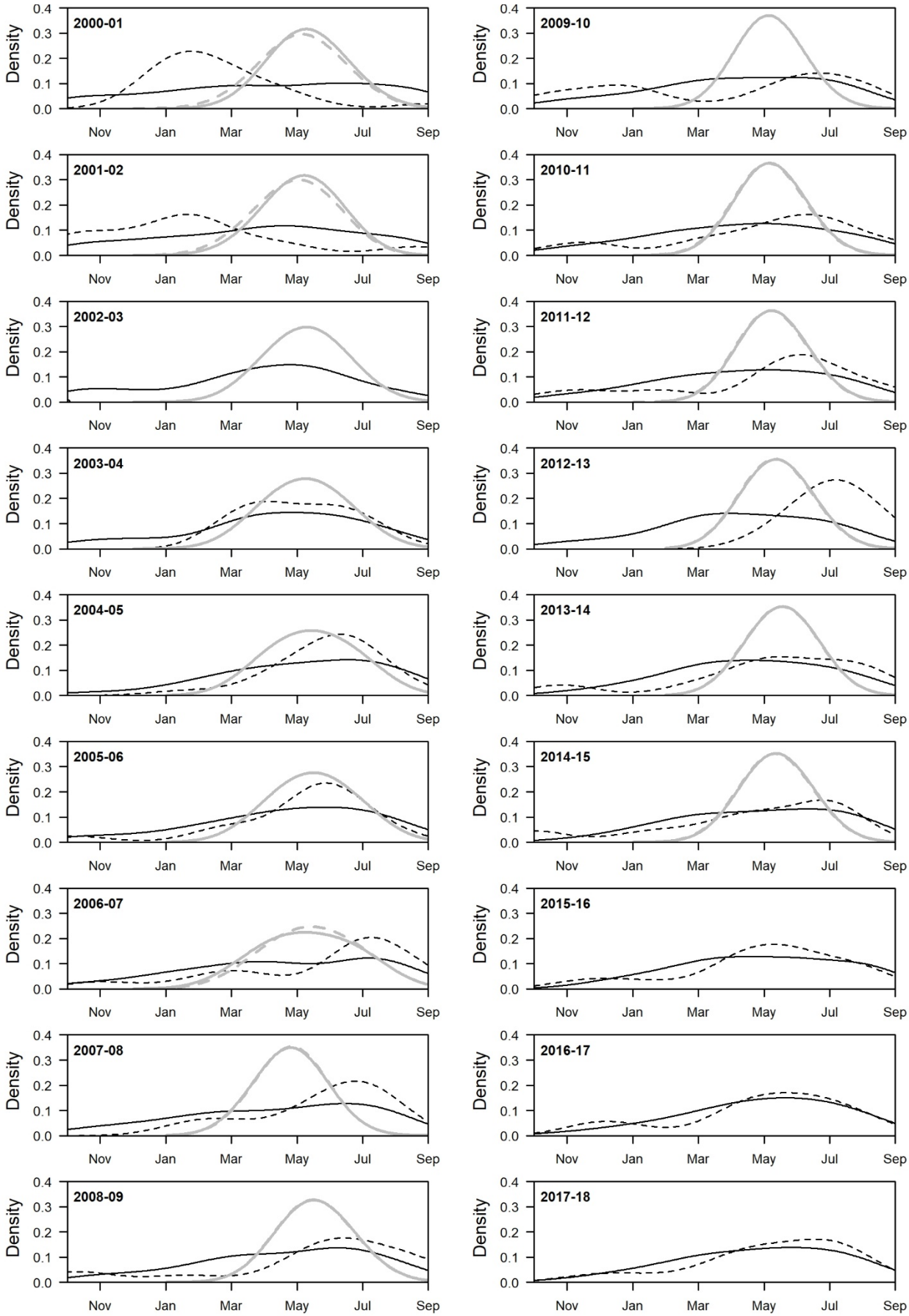


Figure 7: Distribution of month of fishing year (October to September) for commercial and observed numbers of sets, for Domestic vessels (black lines) and Chartered Japanese vessels (grey lines), 2000–01 to 2017–18. Solid lines represent commercial data and dashed lines represent observed data. Note: 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.

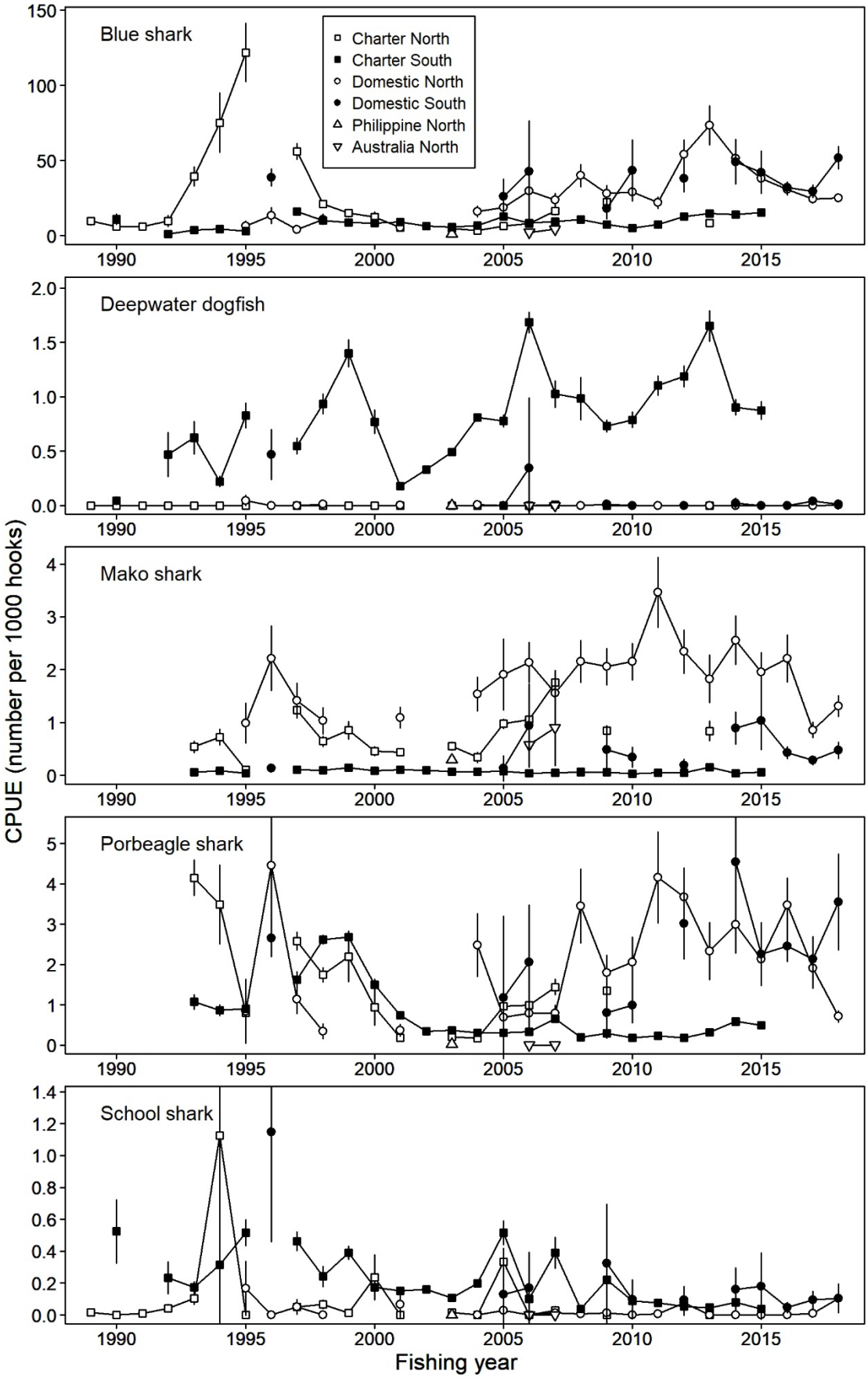


Figure 8: Annual variation in CPUE by fleet and region. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989. 1. Sharks.
(Continued next pages)

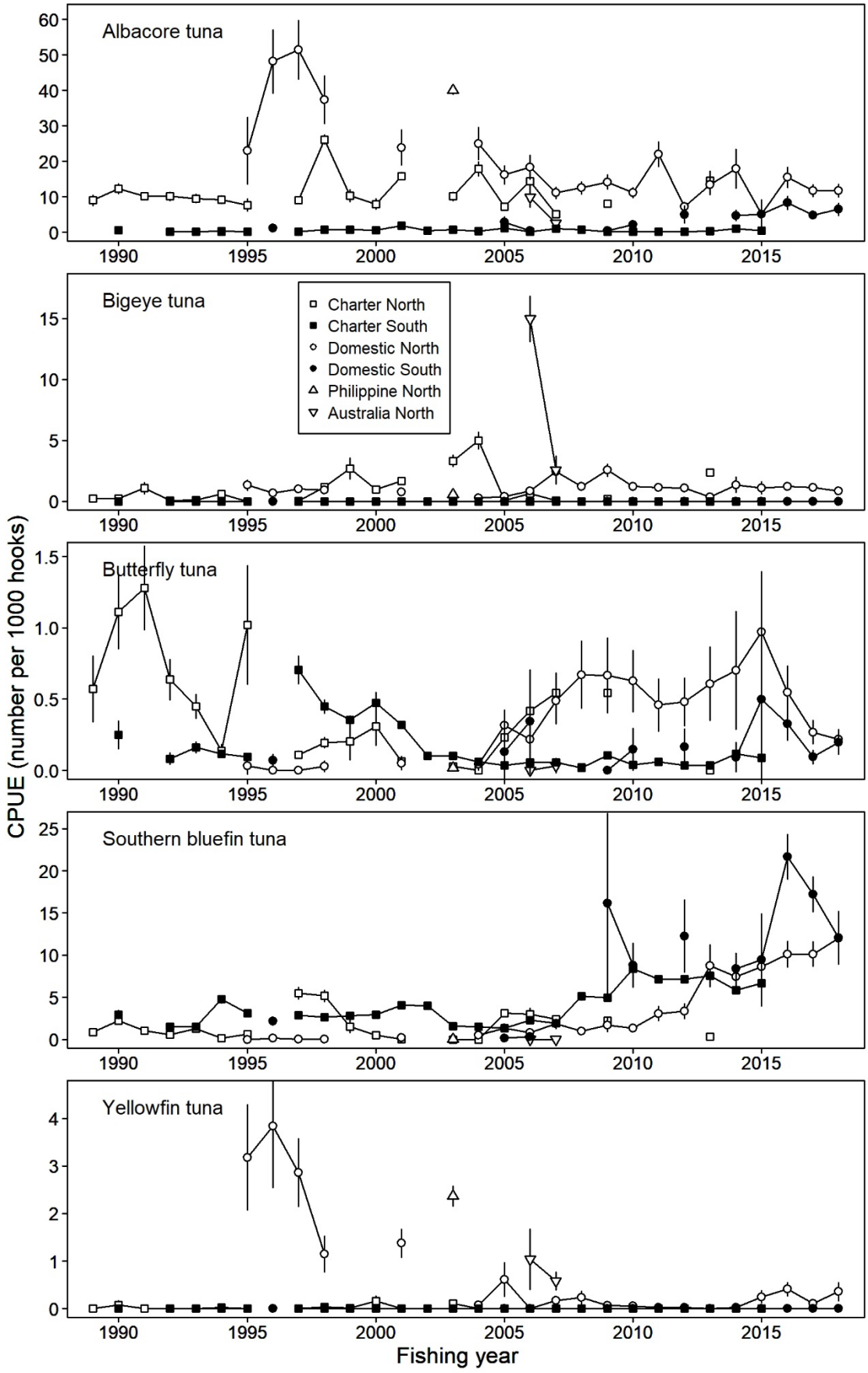


Figure 8: (*continued*). 2. Tunas.

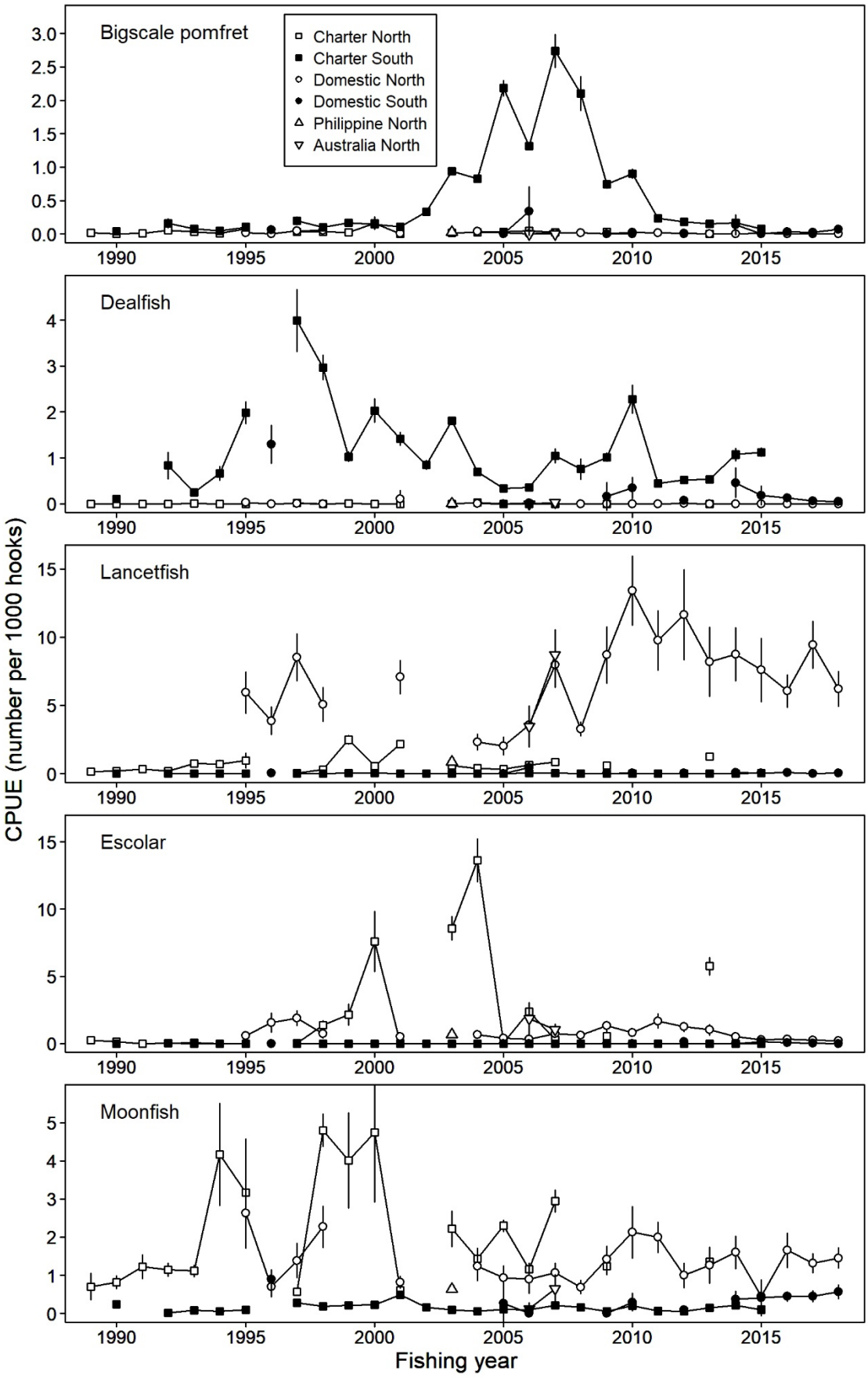


Figure 8: (*continued*). 3. Other species.

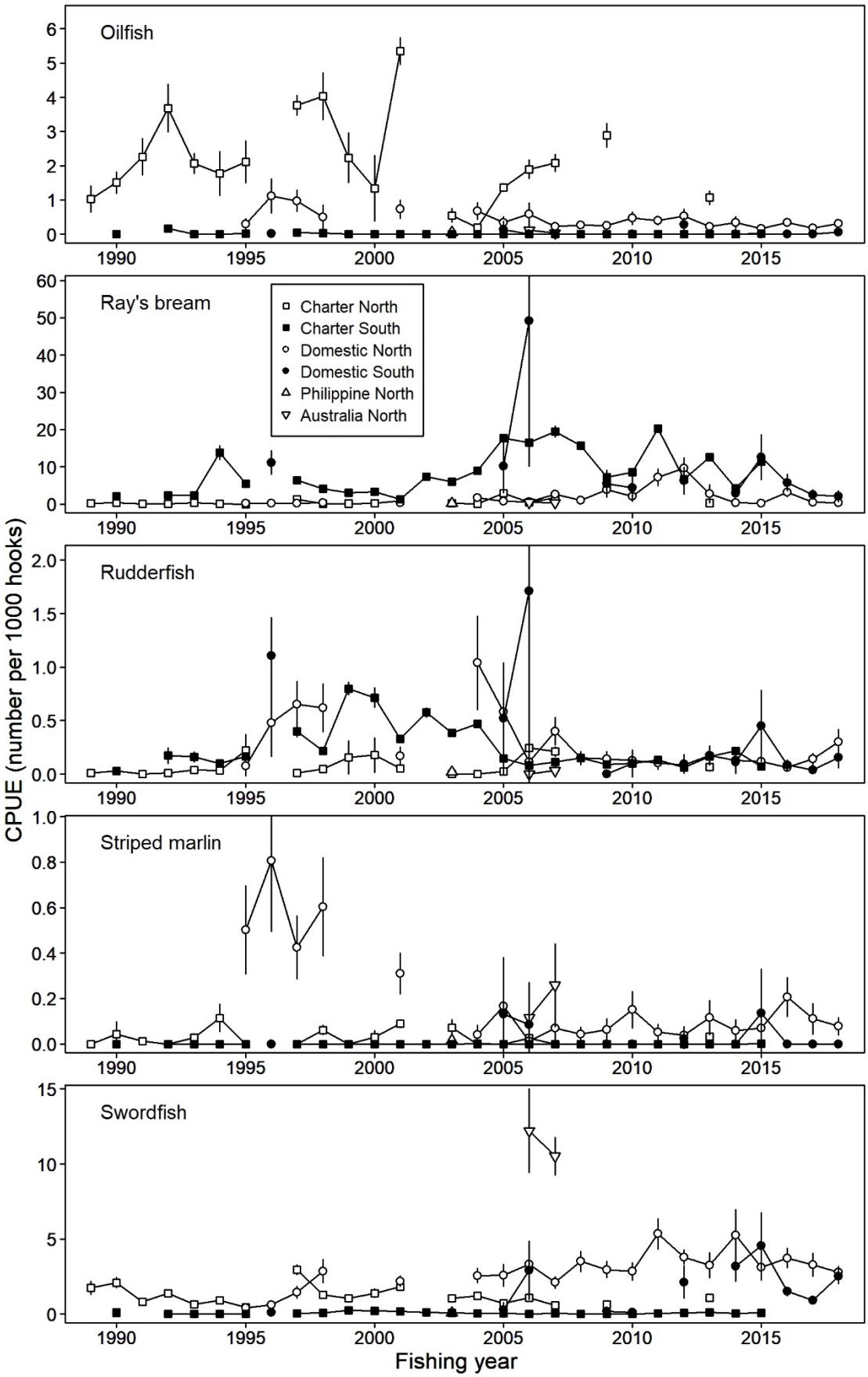


Figure 8: (*continued*). 3. Other species.

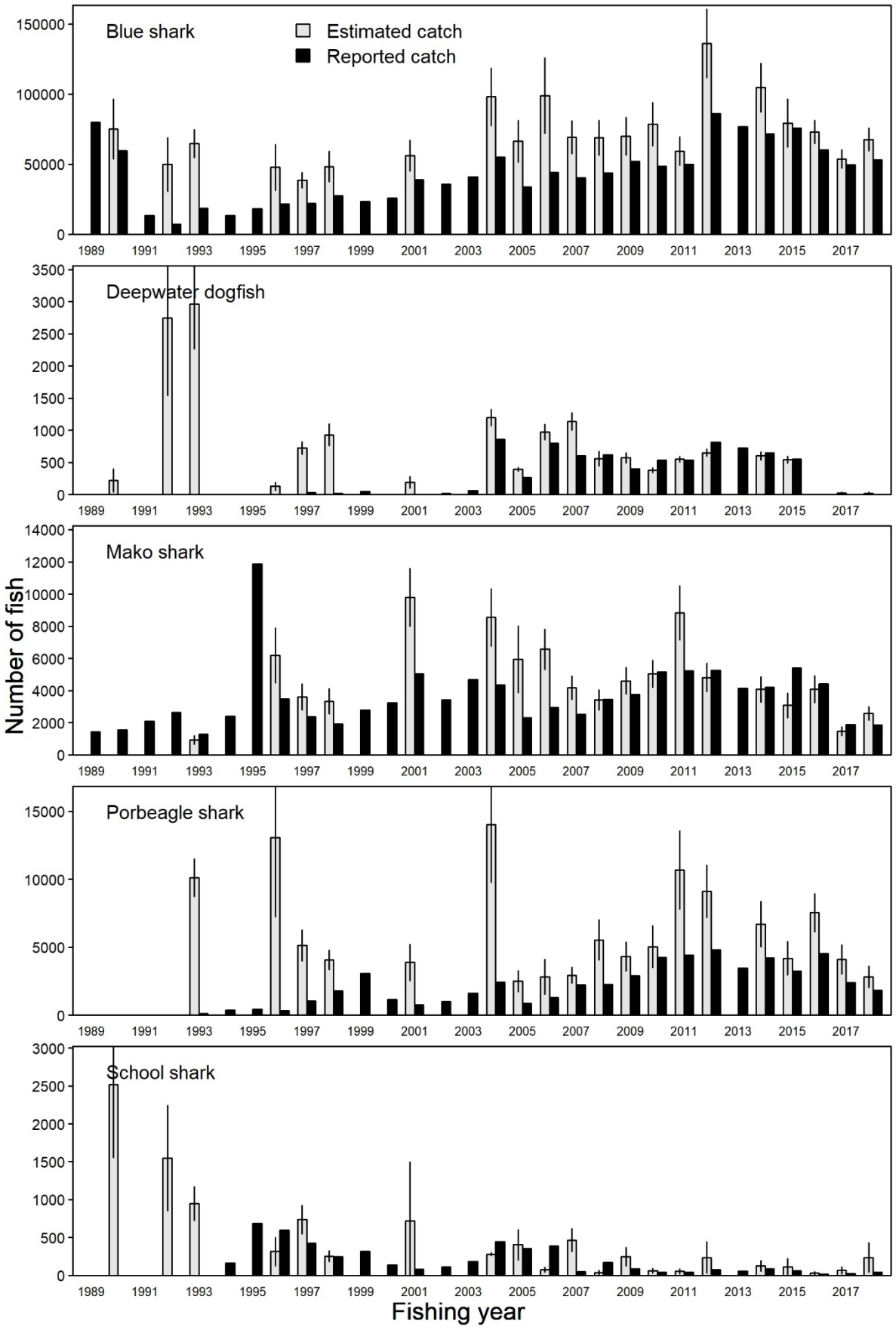


Figure 9: Observer-based estimates of scaled total numbers of fish caught, with 95 % confidence limits, and numbers reported caught on TLCER forms. Fishing year 1989 = October 1988 to September 1989. 1. Sharks. (Continued next pages)

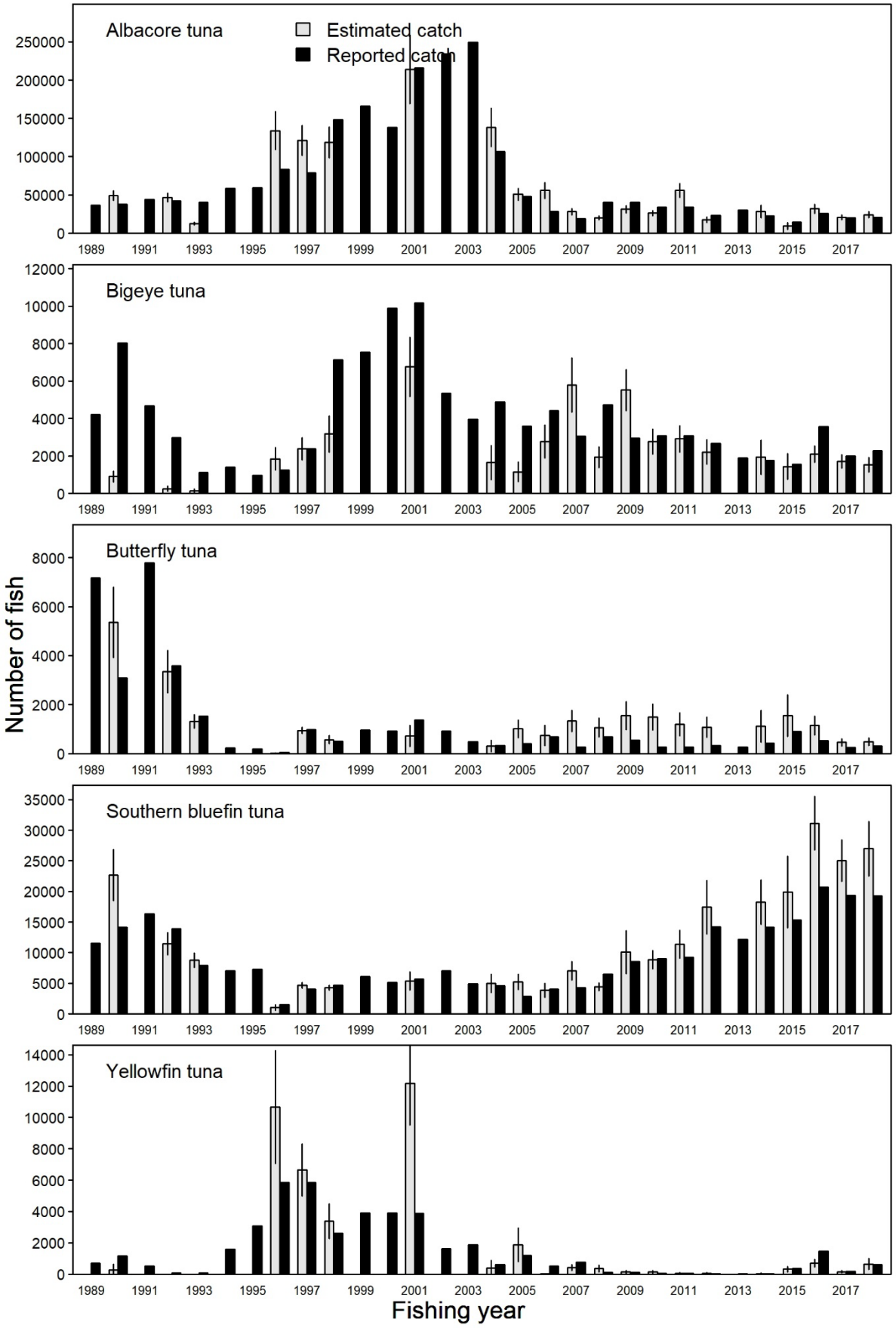


Figure 9: (*continued*). 2. Tunas.

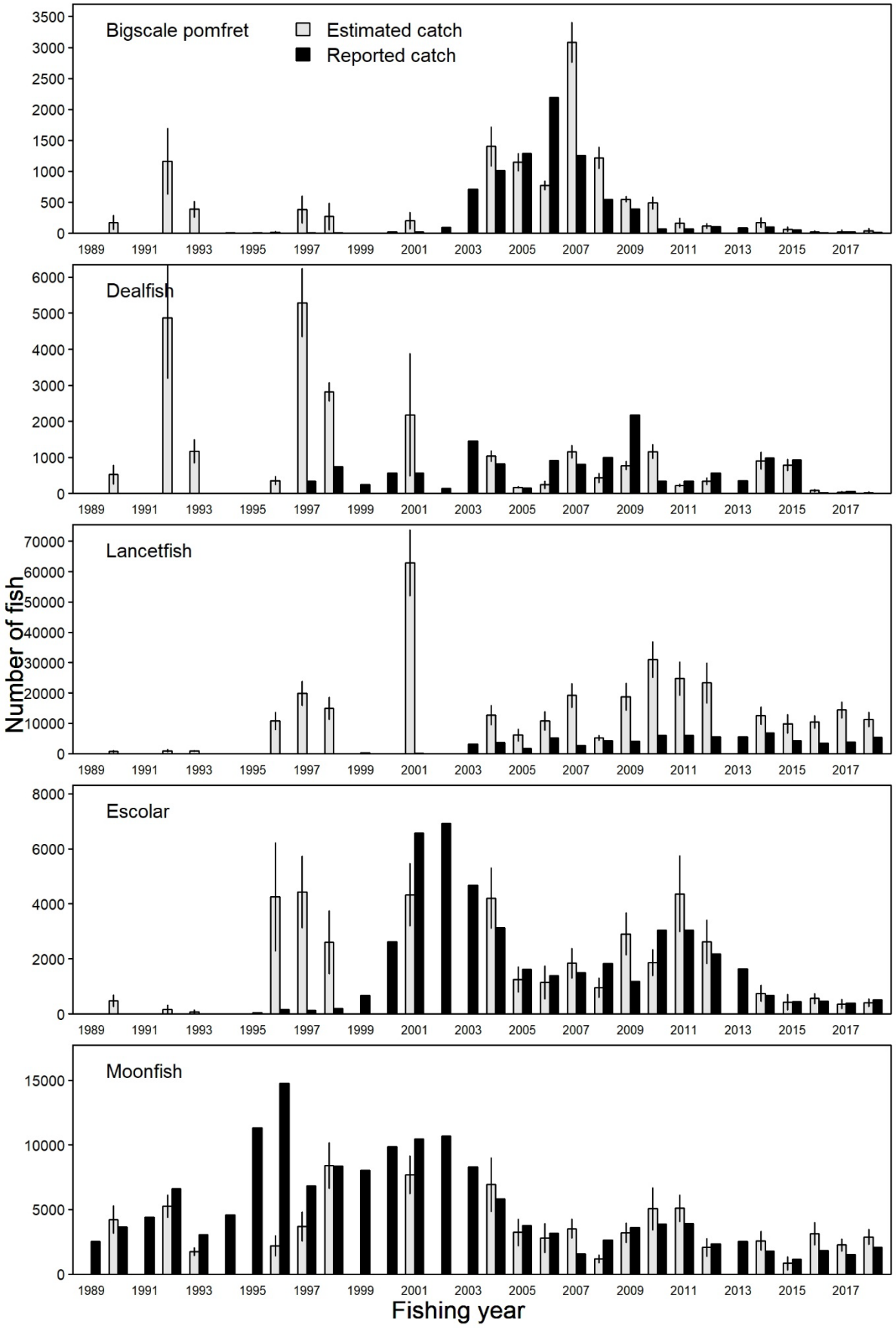


Figure 9: (*continued*). 3. Other species.

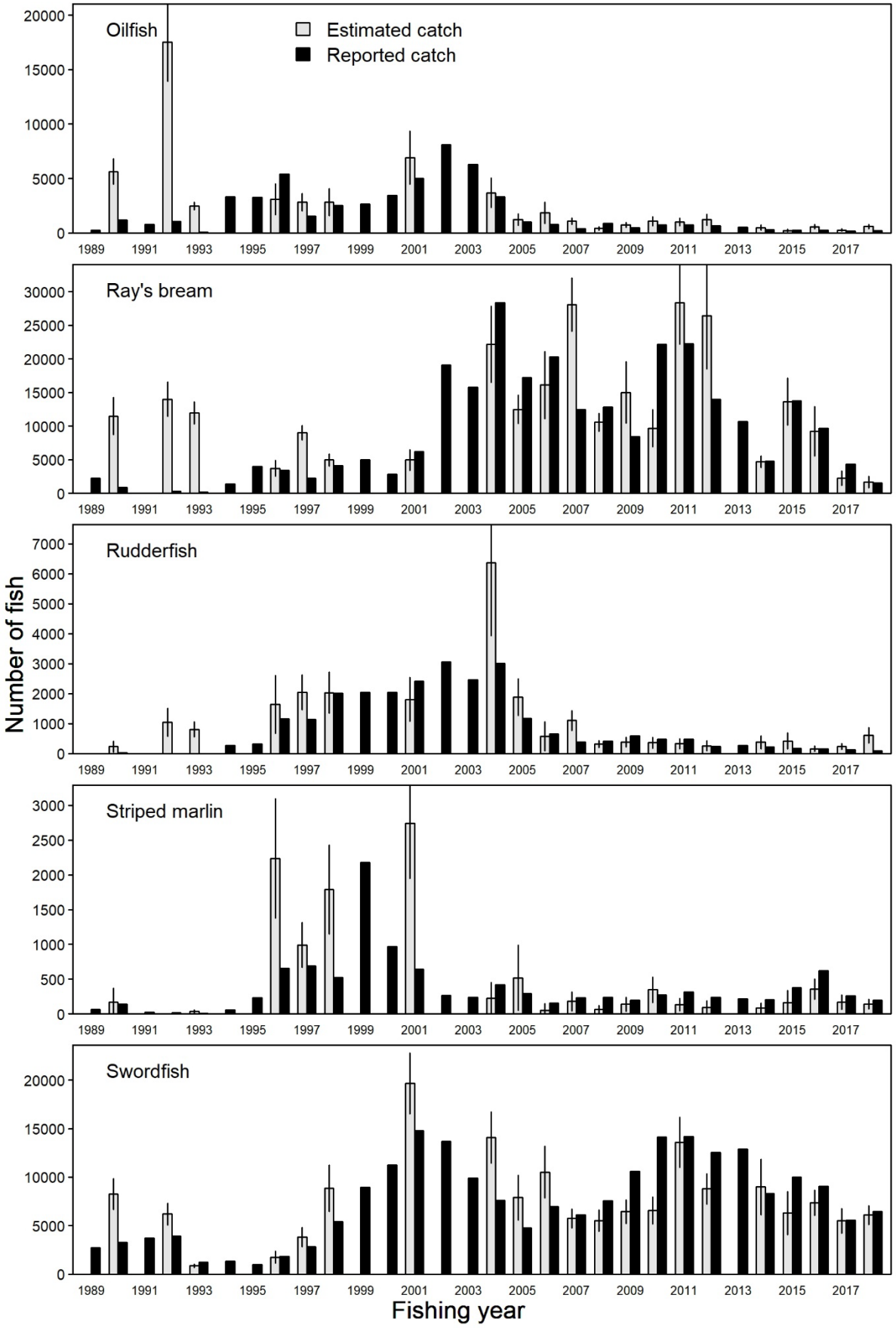


Figure 9: (*continued*). 3. Other species

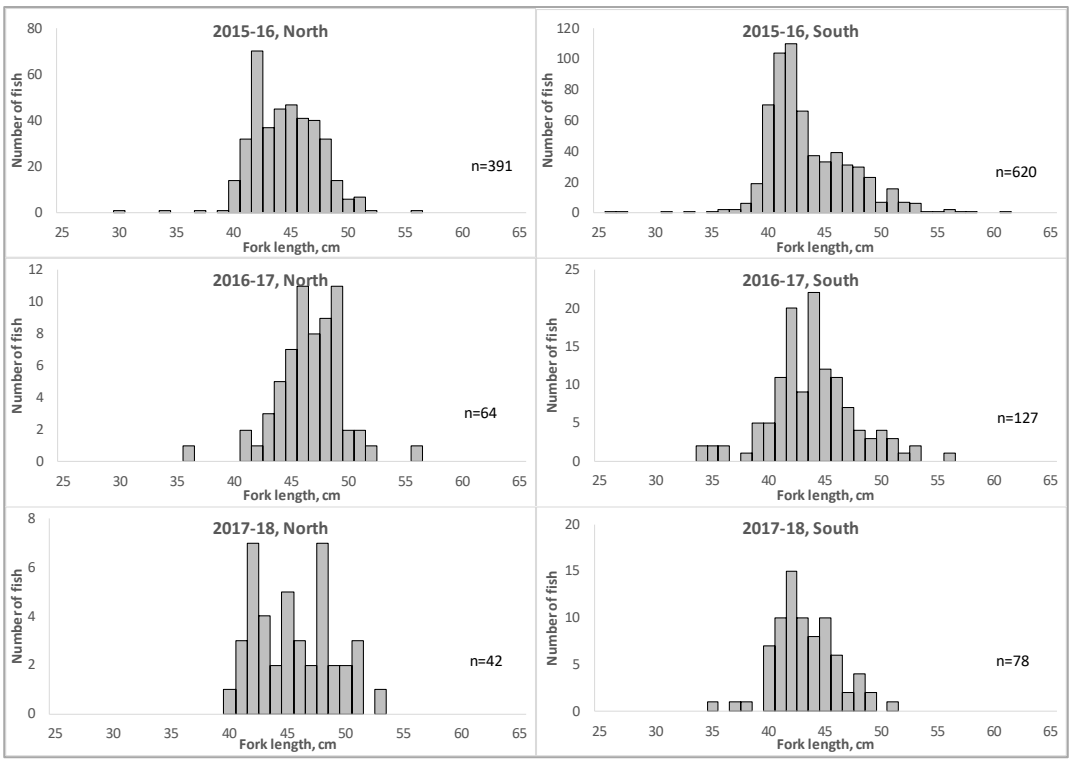


Figure 10: Length-frequency distributions of Ray's bream by fishing year, and region (both sexes and unsexed fish combined).

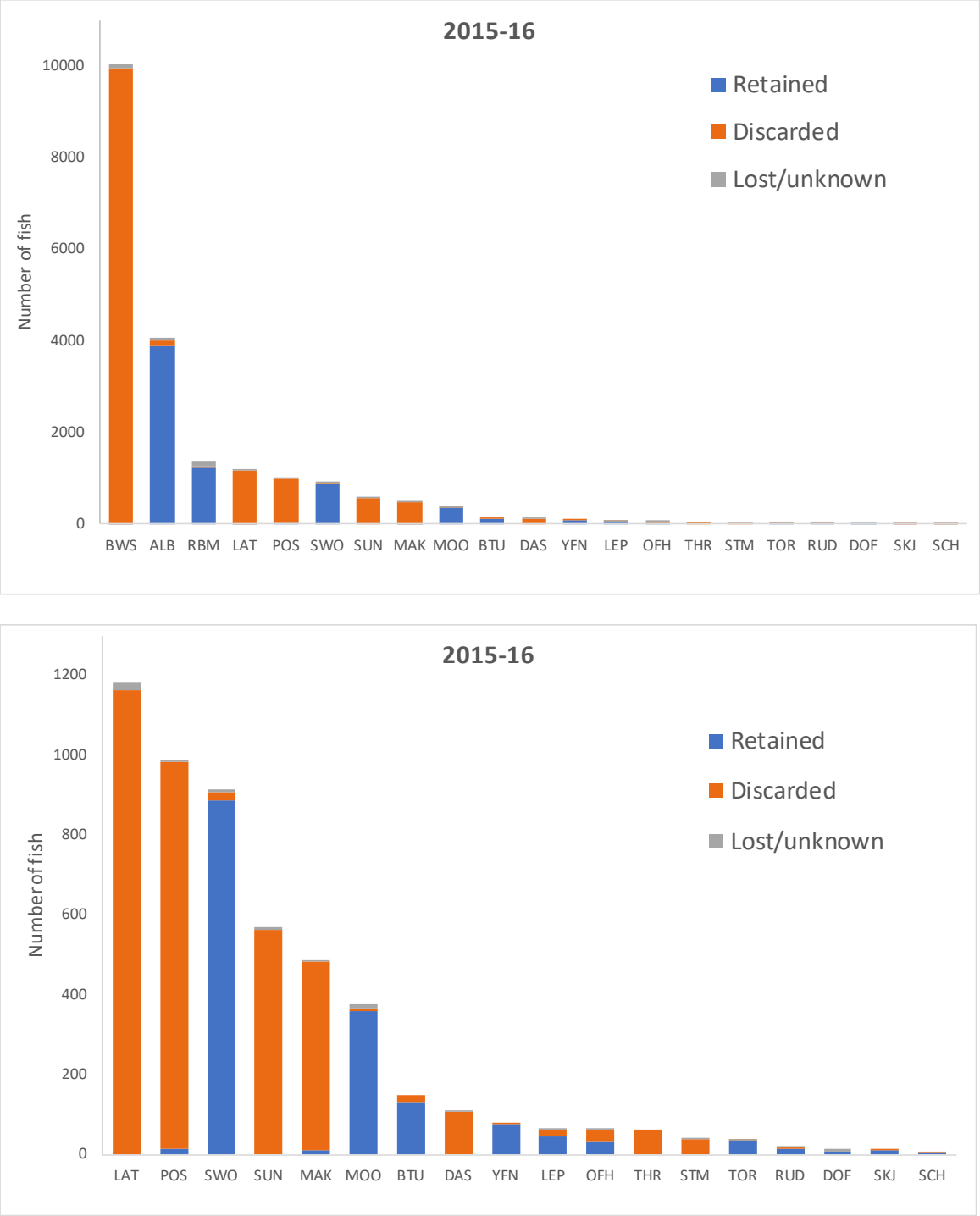
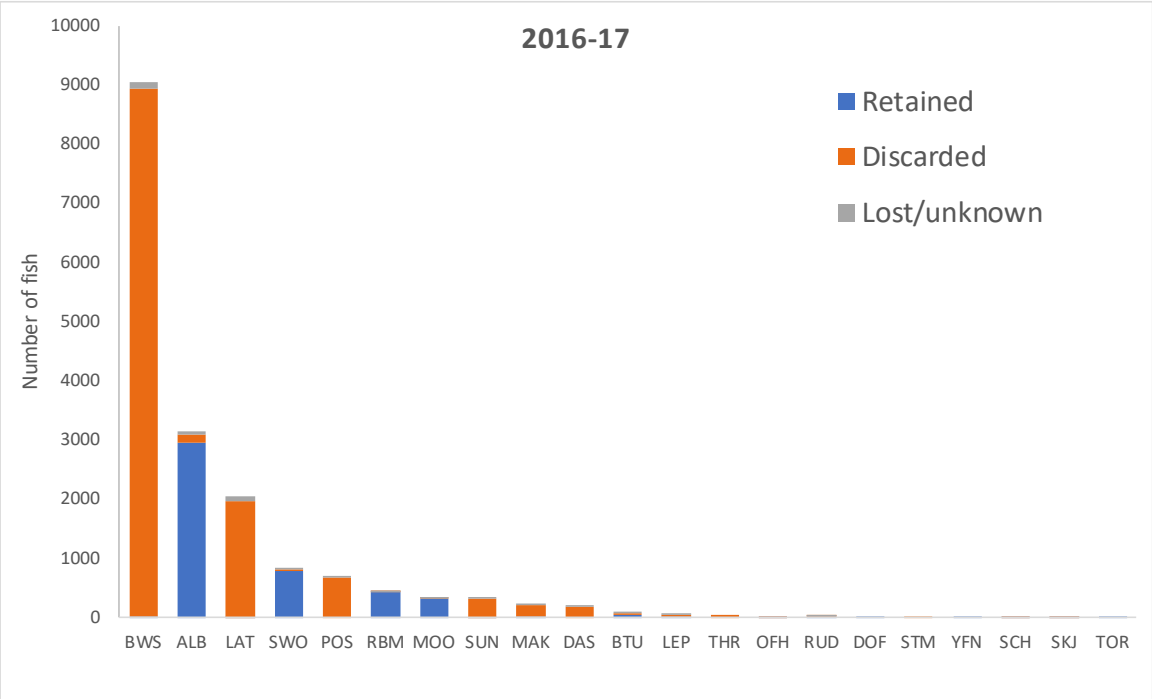


Figure 11: Number of fish on observed sets that were retained (i.e. processed in some way), discarded, and lost or unknown. Upper graph shows main bycatch species; lower graph excludes the three most abundant species. 2015–16. (Continued next pages)

BWS	Blue shark	MAK	Mako shark	LEP	Escolar
ALB	Albacore tuna	DAS	Pelagic stingray	THR	Thresher shark
LAT	Lancetfish	RBM	Ray's bream	SCH	School shark
SWO	Swordfish	RUD	Rudderfish	SKJ	Skipjack tuna
SUN	Sunfish	YFN	Yellowfin tuna	DOF	Dolphinfish
POS	Porbeagle shark	OFH	Oilfish	STM	Striped marlin
MOO	Moonfish	BTU	Butterfly tuna	TOR	Pacific bluefin tuna



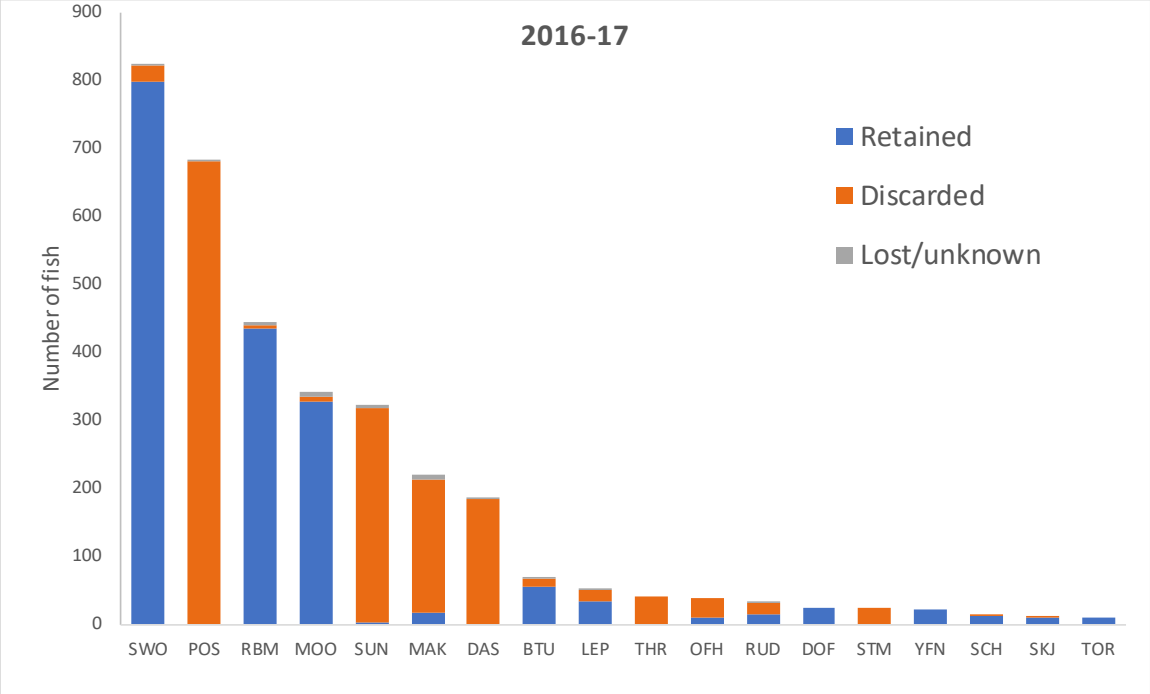
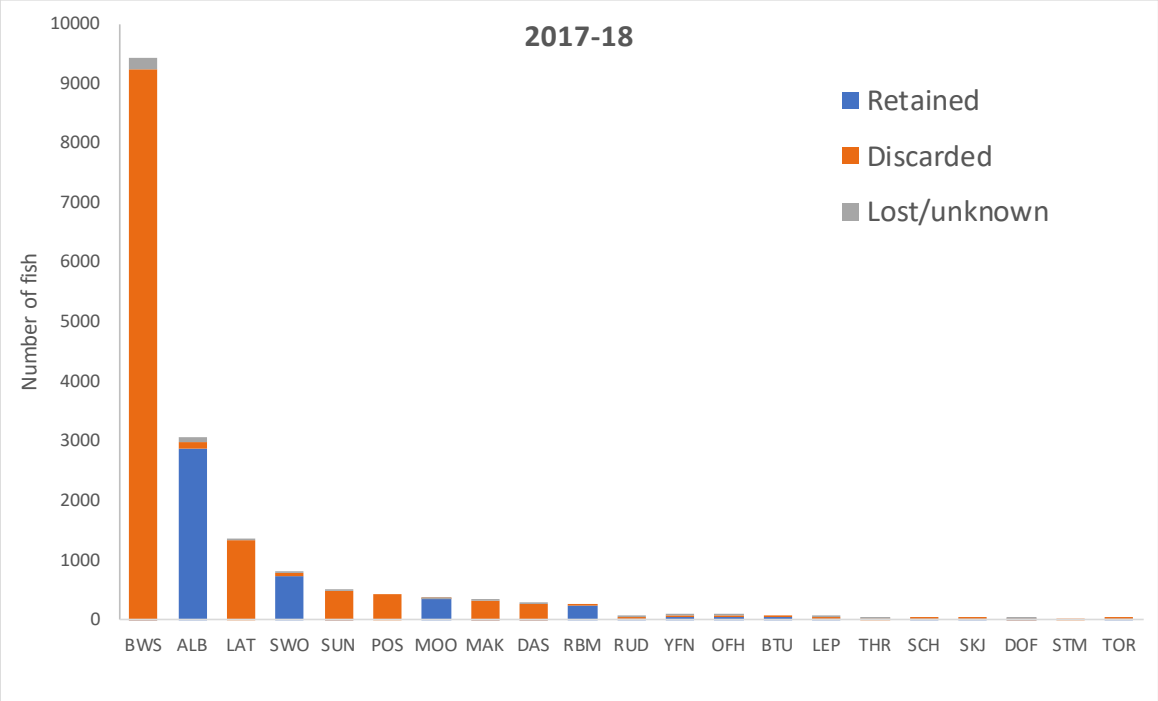


Figure 11: (*continued*). 2016–17.

BWS	Blue shark	MAK	Mako shark	LEP	Escolar
ALB	Albacore tuna	DAS	Pelagic stingray	THR	Thresher shark
LAT	Lancetfish	RBM	Ray's bream	SCH	School shark
SWO	Swordfish	RUD	Rudderfish	SKJ	Skipjack tuna
SUN	Sunfish	YFN	Yellowfin tuna	DOF	Dolphinfish
POS	Porbeagle shark	OFH	Oilfish	STM	Striped marlin
MOO	Moonfish	BTU	Butterfly tuna	TOR	Pacific bluefin tuna



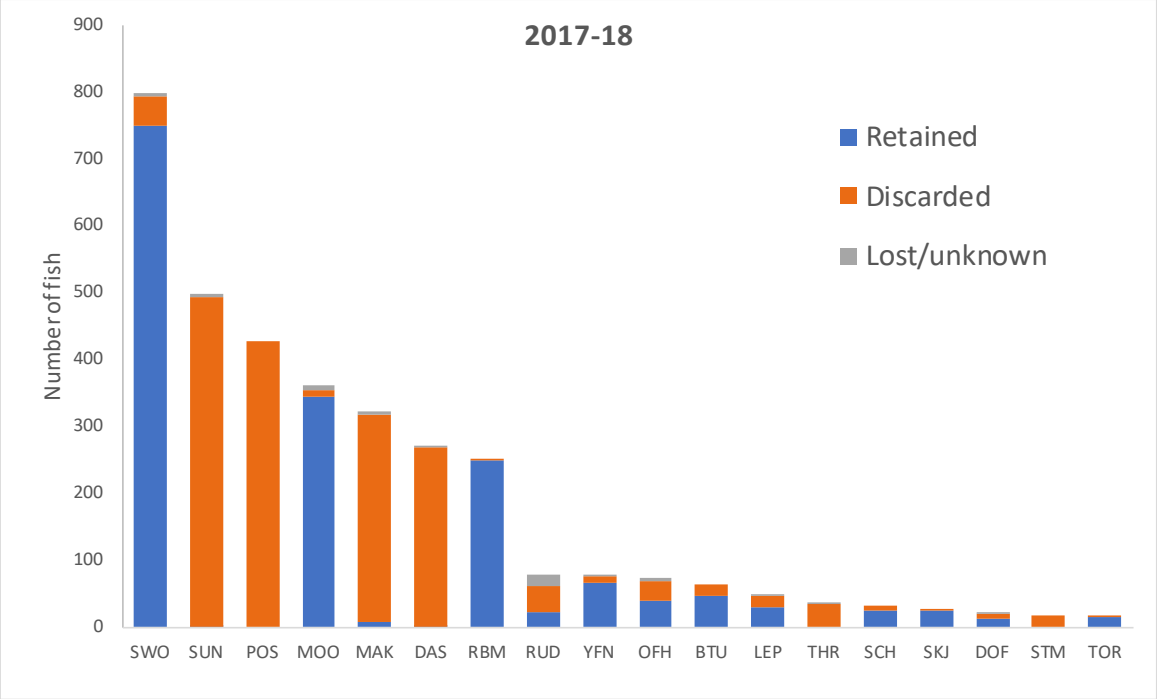
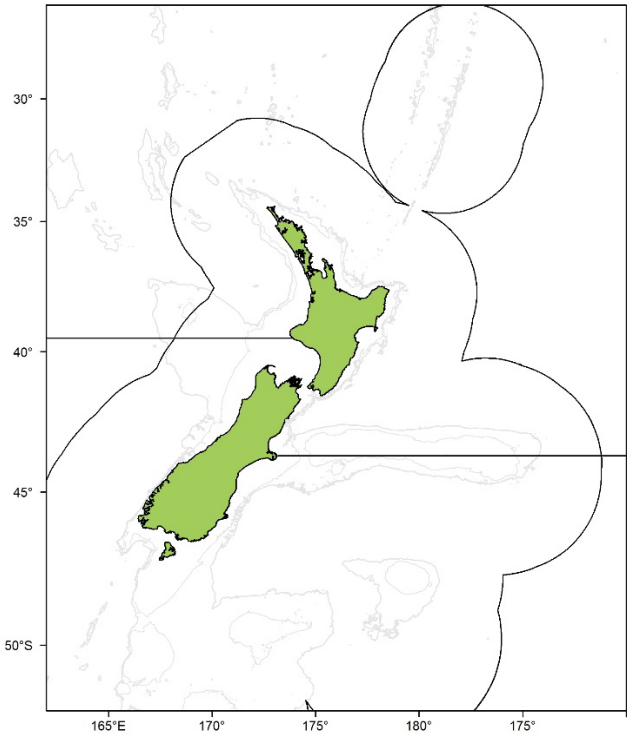


Figure 11: (*continued*). 2017–18.

BWS	Blue shark	MAK	Mako shark	LEP	Escolar
ALB	Albacore tuna	DAS	Pelagic stingray	THR	Thresher shark
LAT	Lancetfish	RBM	Ray's bream	SCH	School shark
SWO	Swordfish	RUD	Rudderfish	SKJ	Skipjack tuna
SUN	Sunfish	YFN	Yellowfin tuna	DOF	Dolphinfish
POS	Porbeagle shark	OFH	Oilfish	STM	Striped marlin
MOO	Moonfish	BTU	Butterfly tuna	TOR	Pacific bluefin tuna

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), and "South" applies to latitudes south of these lines.



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

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 FID	Fins, wet (blue, mako or porbeagle shark) Fins, dried (blued, 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*

Appendix 3: Numbers of fish reported by observers during 2015–16 to 2017–18, and the total observed catch since 1988–89. Species are ranked in descending order of abundance since 1988–89. (Continued next pages)

Species	Scientific Name	2015-16 to 2017-18	Total number
Blue shark	*Prionace glauca*	28 511	269 051
Ray's bream	*Brama* spp.	2 067	126 699
Albacore tuna	*Thunnus alalunga*	10 270	121 293
Southern bluefin tuna	*Thunnus maccoyii*	12 682	75 122
Lancetfish	*Alepisaurus ferox & A. brevirostris*	4 586	24 225
Porbeagle shark	*Lamna nasus*	2 099	24 168
Dealfish	*Trachipterus trachypterus*	28	18 974
Swordfish	*Xiphias gladius*	2 537	13 691
Deepwater dogfish	Squaliformes	7	11 578
Moonfish	*Lampris guttatus*	1 079	11 283
Mako shark	*Isurus oxyrinchus*	1 027	8 849
Big scale pomfret	*Taractichthys longipinnis*	14	8 193
Oilfish	*Ruvettus pretiosus*	176	7 974
Bigeye tuna	*Thunnus obesus*	661	5 714
Escolar	*Lepidocybium flavobrunneum*	167	5 484
Rudderfish	*Centrolophus niger*	136	5 413
Butterfly tuna	*Gasterochisma melampus*	281	5 260
Sunfish	*Mola* spp.	1 391	4 892
School shark	*Galeorhinus galeus*	51	3 828
Yellowfin tuna	*Thunnus albacares*	179	3 550
Pelagic stingray	*Pteroplatytrygon violacea*	565	3 438
Hoki	*Macruronus novaezelandiae*	23	2 064
Thresher shark	*Alopias vulpinus*	141	1 641
Skipjack tuna	*Katsuwonus pelamis*	53	1 254
Dolphinfish	*Coryphaena hippurus*	58	858
Flathead pomfret	*Taractes asper*	14	636
Striped marlin	*Tetrapturus audax*	81	588
Black barracouta	*Nesiarchus nasutus*	9	479
Barracouta	*Thyrsites atun*	1	361
Pacific bluefin tuna	*Thunnus orientalis*	61	325
Shark, unidentified	Selachii	1	245
Hāpuku and bass	*Polyprion oxygeneios & P. americanus*	9	241
Cubehead	*Cubiceps* spp.	3	221
Slender tuna	*Allothunnus fallai*	0	188
Bronze whaler shark	*Carcharhinus brachyurus*	28	180
Shortbill spearfish	*Tetrapturus angustirostris*	1	137
Kingfish	*Seriola lalandi*	7	130
Fanfish	*Pterycombus petersii*	1	97
Ray, unidentified	Myliobatiformes	2	95
Bigeye thresher	*Alopias superciliosus*	16	89
Frostfish	*Lepidopus caudatus*	0	77
Hake	*Merluccius australis*	5	76
Wahoo	*Acanthocybium solandri*	0	72

Appendix 3: (*continued*).

Species	Scientific Name	2015-16 to 2017-18	Total number
Opah	*Lampris immaculatus*	7	72
Snipe eel	Nemichthyidae	0	64
Wingfish	*Pteraclis velifera*	1	63
Gemfish	*Rexea solandri*	11	45
Broadnose seven gill shark	*Notorynchus cepedianus*	13	39
Hammerhead shark	*Sphyrna zygaena*	0	21
Blue marlin	*Makaira mazara*	1	21
Oceanic whitetip shark	*Carcharhinus longimanus*	1	20
Unicornfish	*Lophotus capellei*	0	19
Bluenose	*Hyperoglyphe antarctica*	4	19
Sixgill shark	*Hexanchus griseus*	13	14
Longtailed stingray	*Dasyatis thetidis*	14	14
Pilotfish	*Naucrates ductor*	3	13
Marlin, unspecified	Isiophoridae	4	13
Snake mackerel	*Gempylus serpens*	1	12
Skate	Rajidae	0	11
Black marlin	*Makaira indica*	1	10
Pelagic stargazer	*Pleuroscopus pseudodorsalis*	2	10
Large headed slickhead	*Rouleina* spp.	9	10
Barracudina	*Magnisudis prionosa*	0	9
Remora	Echeneidae	0	8
Galapagos shark	*Carcharhinus galapagensis*	0	8
Seahorse	*Hippocampus* spp.	1	8
Ribaldo	*Mora moro*	2	8
Pomfret, unidentified	Bramidae	0	7
Barracuda	*Sphyraena novaehollandiae*	0	7
Ragfish	*Icichthys australis*	0	7
Spinetail devil ray	*Mobula mobula*	3	7
Sawtooth eel	*Serrivomer* spp.	0	6
Squid	Cephalopoda	1	6
Scissortail	*Psenes pellucidus*	0	5
Scalloped dealfish	*Zu elongatus*	1	5
Squaretail	*Tetragonus cuvieri*	0	4
Basking shark	*Cetorhinus maximus*	0	3
Black mackerel	*Scombrolabrax heterolepis*	0	3
Great white shark	*Carcharodon carcharias*	0	3
Pufferfish	*Sphoeroides pachygaster*	0	3
Smallscaled brown slickhead	*Alepocephalus australis*	0	3
Tuna, unspecified	Scombridae	1	3
Octopus	Cephalopoda	1	3
Salp	Salpidae	2	3
Bluntnose skate	*Notoraja* spp.	0	2
Sea perch	*Helicolenus* spp.	0	2

Appendix 3: (*continued*).

Species	Scientific Name	2015-16 to 2017-18	Total number
Trevally	*Pseudocaranx dentex*	0	2
Bigeye scabbard fish	*Benthodesmus elongatus*	0	2
Blue cod	*Parapercis colias*	0	2
Carpet shark	*Cephaloscyllium isabellum*	0	2
Crab	Crustacea	0	2
Pelagic butterfish	*Schedophilus maculatus*	0	2
Short-tailed black ray	*Dasyatis brevicaudata*	1	2
Brown stargazer	*Xenocephalus armatus*	1	2
Sharpnose seven gill shark	*Heptranchias perlo*	1	2
Ribbonfish	*Agrostichthys parkeri*	2	2
Black slickhead	*Xenodermichthys* spp.	2	2
Common warehou	*Seriolella brama*	1	1
Deepwater eel	Ophichthidae	0	1
Globefish	*Contusus richei*	0	1
Manta rays and devil rays	*Mobula* spp.	0	1
Amberjack	*Seriola rivoliana*	0	1
Blue mackerel	*Scomber australasicus*	0	1
Frigate tuna	*Auxis thazard*	0	1
Jack mackerel	*Trachurus* spp.	0	1
Kahawai	*Arripis trutta*	0	1
Louvar	*Luvaris imperialis*	0	1
Manefish	*Caristius* spp.	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
Unidentified fish		213	5 392
Total		**69 349**	**774 784**

Appendix 4: Total reported catches of each species caught in 2015–16 to 2017–18.

	Number of fish		
	2015–16	2016–17	2017–18
Albacore tuna	25 658	19 978	20 384
Bigeye tuna	3 566	1 987	2 276
Bigscale pomfret	7	18	14
Butterfly tuna	530	256	311
Blue shark	60 244	49 549	53 174
Dealfish	15	53	2
Deepwater dogfish	–	4	1
Lancetfish	3 431	3 644	5 179
Escolar	458	382	513
Mako shark	4 403	1 898	1 845
Moonfish	1 828	1 530	2 081
Oilfish	275	176	223
Porbeagle shark	4 516	2 400	1 819
Ray’s bream	9 659	4 300	1 511
Rudderfish	155	122	98
School shark	15	26	40
Striped marlin	619	261	196
Southern bluefin tuna	20 716	19 337	19 269
Swordfish	9 054	5 581	6 479
Yellowfin tuna	1 469	170	598