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Tini a Tangaroa

Catches, size, and age structure of the 2016–17 hoki fishery, and a summary of input data used for the 2018 stock assessment

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EXECUTIVE SUMMARY

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This report summarises catches by area and presents the length and age structure of hoki caught commercially during the 2016–17 fishing year. Length frequency and catch-at-age data from spawning and non-spawning fisheries are compared with those from previous years. Biomass indices from research surveys and results from other research on hoki in the last year are also briefly described. Data in this report were incorporated in the hoki stock assessment in 2018.

The total reported hoki catch in 2016–17 was 141 567 t, 8500 t lower than the TACC of 150 000 t, but almost 5000 t higher than the catch in 2015–16. Catches in 2016–17 decreased in the main spawning areas and increased in non-spawning areas. The spawning fishery catch on the west coast South Island (WCSI) decreased by 2900 t to 66 000 t, but this was the largest hoki fishery for the seventh consecutive season. The non-spawning fishery on the Chatham Rise was the second largest fishery, with 39 000 t taken in 2016–17, about 3200 t more than in 2015–16. The spawning fishery catch from Cook Strait decreased by 2300 t to 16 000 t. The non-spawning catch from the Sub-Antarctic fishery increased by 7000 t to 13 200 t in 2016–17. Catches from Puysegur, from east coast North Island (ECNI) and east coast South Island (ECSI) in 2016–17 were similar to those in 2015–16 at 1200 t, 800 t, and 4400 t respectively. Overall, about 80 300 t of the total catch in 2016–17 was taken from western stock areas, well below the industry-agreed catch limit of 90 000 t. About 61 200 t came from the eastern stock areas.

Length and age frequency distributions from the commercial fishery show that most of the catch in 2016–17 was fish of 50–90 cm. The 2014 year-class (50–65 cm) was important in all areas: at age 2+ on the Chatham Rise and Sub-Antarctic; and age 3 in Cook Strait and on the WCSI. The 2011 year-class was still strong in all main areas, and the 2010 year class was also apparent on the WCSI, in Cook Strait and in the Sub-Antarctic. Hoki from the 2015 year-class were caught in all the main fishery areas. The percentage of small fish in the catch increased in all areas, mainly due to the presence of the 2014 year-class. Most fish caught on the Chatham Rise in 2016–17 were less than 90 cm, and the largest hoki came from the Cook Strait, ECSI, and WCSI fisheries.

Two fishery independent research surveys for hoki have been carried out since the 2017 stock assessment. The relative biomass index for hoki from the core strata in the 2018 Chatham Rise trawl survey increased by 7% from 2016. The 2016 and 2015 year-classes (ages 1+ and 2+ respectively) were both above average, with the estimate from the 2015 year-class the third highest estimate in the Chatham Rise series for age 2+. The relative biomass of recruited hoki (ages 3+ years and older) declined by 26% from that in 2016 and they were also found in deep strata in 2018. The abundance index of spawning hoki from the acoustic survey in Cook Strait in winter 2017 was half that in 2015, and the lowest since 2008.

1. INTRODUCTION

This report provides biological data relevant to the 2018 hoki stock assessment. Catch statistics and data from commercial sampling carried out during the 2016–17 fishing year are presented, and results from other research programmes carried out since March 2017 are summarised, including results of the trawl survey of the Chatham Rise in January 2018, and an acoustic survey of Cook Strait in July–August 2017. Details of model structure, results, and yield estimates for the hoki stock assessment carried out in 2018 are published separately.

1.1 Project objectives

This report fulfils the final reporting requirement for objectives in research projects HOK201703 and MID201701.

HOK201703 Objective 1: To complete a descriptive analysis of the commercial catch and effort data, trawl survey data, and observer data for hoki in New Zealand.

MID201701: To determine catch-at-age for commercial catches and resource surveys of specified middle depth and deepwater fishstocks. Specific Objective 1 includes:

- Estimate the catch-at-age for the non-spawning hoki fisheries on the Chatham Rise and Sub-Antarctic (Objective 1b);
- Estimate the catch-at-age for hoki in the winter Cook Strait and WCSI spawning fisheries (Objective 1c).

1.2 Stock structure

The hoki catch is currently managed under a single TACC which can be caught in all areas of the EEZ excluding QMA 10 (Fishstock HOK 1). However, since 1990 the Hoki Working Group has assessed hoki as two stocks, “eastern” and “western” (Annala 1990) and subsequent Plenary Reports). Hoki on the west coast of the North and South Islands and in the area south of New Zealand, including Puysegur Bank, Snares Shelf, and Campbell Plateau, are assumed to be one stock unit, the “western stock”. The east coast of the South Island, Mernoo Bank, Chatham Rise, Cook Strait, and the east coast of the North Island up to North Cape are assumed to contain the “eastern stock”. Immature hoki (2–4 years old) from both “stocks” occur together on the Chatham Rise.

Livingston (1997) reviewed the two-stock hypothesis originally adopted in 1990 (Livingston 1990) with respect to data collected in 1990–97, and concluded that this hypothesis was still a valid interpretation for hoki. Morphometric and ageing studies (Horn & Sullivan 1996, Livingston & Schofield 1996) found consistent differences between adult hoki from the two main dispersed areas (Chatham Rise and Southern Plateau), and from the two main spawning grounds in Cook Strait and west coast South Island (WCSI), which suggested that there were two sub-populations of hoki. It is not known if differences between the two sub-populations are the result of genetic, environmental, or some other factor. The chemistry of otoliths from the WCSI and Cook Strait stocks was similar (Kalish et al. 1996), and no genetic differences were detected between spawning stocks (Smith et al. 1981, 1996).

The hoki stock assessment model from 2006 to 2007 (Francis 2007, 2008) and since 2012 (McKenzie 2013, 2015a, 2015b, 2016, 2017, 2018), had two variants which were associated with different stock structure hypotheses. The ‘base case’ hypothesis assumed natal fidelity: a fish that was spawned in one area will grow up to spawn in the same area (i.e., a fish is ‘eastern’ or ‘western’ from birth). The alternative hypothesis does not assume natal fidelity, so fish spawned in one area can spawn in another area (i.e., a fish chooses to be ‘eastern’ or ‘western’ when it matures). Under both hypotheses, it was assumed that once a fish has spawned it shows site fidelity – it cannot later change spawning grounds.

All model runs from 2008–11 assumed natal fidelity because of technical problems concerning the definition of unfished biomass without this assumption (Francis 2009, McKenzie 2013). These problems were resolved and model runs which do not assume natal fidelity were included as sensitivity runs from then on (McKenzie 2015a, 2015b, 2016, 2017, 2018).

Francis et al. (2011) described a pilot study, aimed at determining whether analyses of stable isotopes and trace elements in otoliths could be used to test the stock structure hypothesis and the question of natal fidelity. However, none of the six trace elements or two stable isotopes considered, unambiguously differentiated the two hoki stocks. Two earlier pilot studies appeared to provide weak support for the hypothesis of natal fidelity for the western and eastern spawning stocks. Smith et al. (2001) found significant differences in gill raker counts, and Hicks & Gilbert (2002) found significant differences in measurements of otolith zones between samples of 3 year-old hoki from the 1997 year-class caught on the WCSI and in Cook Strait. However, when additional year-classes were sampled, differences were not always detected (Hicks et al. 2003).

Horn (2011) reviewed the published literature on natal fidelity in relationship to management of hoki. He concluded that, because hoki are an off-shore species, widely dispersed in the non-spawning season, with multiple diffuse spawning areas, it is unlikely that hoki exhibit 100% natal fidelity. Even if natal fidelity is the preferred option for hoki from an evolutionary perspective, it is likely that some proportion of the population would stray routinely. An independent review of the hoki assessment model, commissioned by Ministry for Primary Industries in February 2014, noted that “the extents of natal fidelity are important to identify”, and recommended exploration of a range of model structures (Butterworth et al. 2014).

1.3 Description of the hoki fishery

Since the 1980s the main fishery for hoki has operated from late June to late August on the WCSI, where hoki aggregate to spawn. The spawning aggregations begin to concentrate at depths of 300–700 m around the Hokitika Canyon from late June, and further north off Westport later in the season. Fishing in these areas continues into September in some years. In 1988 another fishery developed on large spawning aggregations of hoki in Cook Strait. The spawning season in Cook Strait runs from late June to mid-September, peaking in July and August. Small catches of spawning hoki are taken from other grounds off the east coast of South Island (ECSI), and late in the season at Puysegur Bank. There are also anecdotal reports of spawning hoki being caught near the Snares Islands, Chatham Islands, and several other locations off the east coast of North Island (ECNI).

Outside the spawning season, when hoki disperse to their feeding grounds, substantial fisheries have developed since the early 1990s on the Chatham Rise and in the Sub-Antarctic. These fisheries usually operate at depths of 300–800 m. The Chatham Rise fishery generally has similar catches over all months except in July–September, when catches are lower due to the fishery moving to the spawning grounds. In the Sub-Antarctic, catches have typically peaked in April–June. Out-of-season catches are also taken from Cook Strait and ECNI, but these are small compared to spawning season catches.

From 1986 to 1990 surimi vessels dominated the catches and took about 60% of the annual WCSI catch. However, since 1991, the surimi component of catches has decreased and processing to head and gut or to fillet product has increased, as has “fresher” catch for shore processing. The hoki fishery now operates throughout the year, producing high quality fillet product from both spawning and non-spawning fisheries. Twin-trawl rigs were used in some hoki fisheries since 1998, and trawls made of spectra twine (a high strength twine with reduced diameter resulting in reduced drag and improved fuel efficiencies) were introduced to some vessels in 2007–08. Since 2012–13, modular harvesting system (MHS) technology has been tested in the hoki fishery. This is a prototype trawl system that aims to target specific species and fish size, as well as enabling fish to be landed in much better condition than traditional trawls. The use of MHS in the hoki fishery is moving towards becoming

“routine”, but the proportion of catch taken by this gear method is still relatively small at 4019 t or 2.8% of the total catch in 2016–17.

The Hoki Fishery Management Company introduced a Code of Practice for hoki target trawling in 2001 with the aim of protecting small fish (less than 60 cm). The Code of Practice was replaced by Operational Procedures for Hoki Fisheries, implemented by the Deepwater Group from 1 October 2009. The Operational Procedures aim to manage and monitor fishing effort within four industry management areas, where there are thought to be high abundance of juvenile hoki (Narrows Basin of Cook Strait, Canterbury Banks, Mernoo Bank, and Puysegur Bank). These areas are closed to hoki target trawling by vessels larger than 28 m, with increased monitoring when targeting species other than hoki. There is also a general recommendation that vessels move from areas where catches of juvenile hoki (defined as less than 55 cm total length) comprise more than 20% of the hoki catch by number.

1.4 Catch history

The total annual catches of hoki within the EEZ from 1969 to 2015–16 are given in Tables 1 and 2. The hoki fishery was developed by Japanese and Soviet vessels in the early 1970s (Table 1). Catches increased to 100 000 t in 1977, but dropped to less than 10 000 t in 1978 when the 200 n. mile Exclusive Economic Zone (EEZ) was declared and a quota limit of 60 000 t was introduced (Figure 1). Hoki remained a relatively small fishery of up to 50 000 t a year until 1986, when the TACC was increased. The fishery expanded to an estimated catch of about 255 000 t in 1987–88 (Table 2). Reported annual catches ranged between 175 000 and 215 000 t from 1988–89 to 1995–96, increased to 246 000 t in 1996–97, and peaked at 269 000 t in 1997–98, when the TACC was over-caught by 19 000 t. The TACC was reduced to 90 000 t by 2007–08 and catches declined accordingly (Table 2). The TACC was increased in five steps since 2009–10 and catches have increased. The TACC for 2015–16 and 2016–17 was 150 000 t, reduced from the 160 000 t TACC in 2014–15.

Catches by area since 1988–89 are given in Table 3 and Figure 2. The pattern of fishing has changed markedly since 1988–89 when over 90% of the total catch was taken in the WCSI spawning fishery. This was due to a combination of TAC changes and redistribution of fishing effort. The WCSI fishery accounted for about 47% of the total hoki catch in 2016–17, and has been the largest fishery in New Zealand for the seven most recent years (Table 3). Cook Strait catches peaked at 67 000 t in 1995–96, but have been relatively stable in the range from 15 000 to 20 000 t in the past 10 years. The Chatham Rise was the largest hoki fishery from 2006–07 to 2009–10, and contributed about 28% of the total catch in 2016–17. Catches from the Sub-Antarctic peaked at over 30 000 t from 1999–2000 to 2001–02, but have been variable since, ranging from 6000 to 20 000 t over the past 15 years. Catches from other areas remained at relatively low levels (Table 3).

From 1999–2000 to 2001–02, there was a redistribution in catch from eastern stock areas (Chatham Rise, ECSI, ECNI, and Cook Strait) to western stock areas (WCSI, Puysegur, and Sub-Antarctic) (Figure 2). This was initially due to industry initiatives to reduce the catch of small fish in the area of the Mernoo Bank, but from 1 October 2001 was part of an informal agreement with the Minister of Fisheries that 65% of the catch should be taken from the western fisheries to reduce pressure on the eastern stock. This agreement was removed in 2002–03 following the 2003 hoki assessment, which indicated that the eastern hoki stock was less depleted than the western stock, and effort was shifted back into eastern areas, particularly Cook Strait. From 2004–05 to 2006–07 there was a further agreement with the Minister that only 40% of the catch should be taken from western fisheries. From 1 October 2007 the target catch from the western fishing grounds was further reduced to 25 000 t within the overall TACC of 90 000 t. This target was exceeded in both 2007–08 and 2008–09, with about 30 000 t taken from western areas. In 2009–10, the target catch from the western fishing grounds was increased to 50 000 t within the overall TACC of 110 000 t, and catches were at about the industry-agreed catch split. Since then the target eastern catch has remained at 60 000 t, and the target western catch has further increased with changes in the overall TACC, up to a maximum of 100 000 t in 2014–15 (within the overall TACC 160 000 t). The western target catch in the

past two years was 90 000 t. The split between eastern and western catches has been within 2000 t of the management targets since 2011–12, except in 2014–15 where the eastern catch was 4600 t over the target, and in 2015–16 and 2016–17 where the western catches were lower than the target total by 13 400 t and 9600 t respectively.

1.5 Recent hoki research

McKenzie (2018) reported the stock assessment carried out in 2017, using the Bayesian model developed in 2002 (Francis et al. 2003) and implemented in the general-purpose stock-assessment program CASAL (Bull et al. 2012). The Ministry for Primary Industries Deepwater Fisheries Assessment Working Group agreed on a single base model run. In this base model, the problem of the lack of old fish in both fishery-based and survey-based observations was dealt with by allowing natural mortality to be age dependent. As for the 2016 assessment, a single catchability was used for the Sub-Antarctic summer trawl surveys, but with process error estimated. The western stock was estimated to be 40–84% B_0 and the eastern stock 44–79% B_0 (values are 95% CIs for the base case). The western stock experienced an extended period of poor recruitment from 1995 to 2001 inclusive. Western recruitment was near or just below average from 2002 to 2009; below average in 2010, 2012 and 2013; and above average in 2011 and 2014 (McKenzie 2018).

Horn & Sutton (2017) documented the age determination protocol for hoki, updating the work of Horn & Sullivan (1996). The report describes the most recent scientific methodologies used for otolith preparation and interpretation, ageing procedures, and the estimation of ageing precision, and also describes the changes in these methodologies over time. Digital image examples from an otolith reference set of 480 preparations were presented to illustrate the zone interpretation used in determining age. The reference set sample was mostly a random selection from fish stocks and seasons to account for spatio-temporal variations in otolith readability, however the selection process also ensured that a comprehensive range of fish sizes and ages were included. Agreed readings and ages determined for the reference set are stored in a reference table in the *age* database.

The selectivity of 100 mm and Modular Harvest System (MHS) codends was compared in a designed experiment on FV *Rehua* in June 2017. Results suggested similar mean 50% selection lengths of about 48–49 cm for both gears, but with the MHS gear having a narrower selection range (11.7 cm compared to 14.8 cm for 100 mm codend) (O’Driscoll & Millar 2017).

Two new fisheries-independent estimates of hoki abundance have been made since the 2018 hoki assessment, a Chatham Rise trawl survey carried out in January 2018 (Stevens et al. 2018), and an acoustic survey of Cook Strait in July–August 2017 (O’Driscoll & Escobar-Flores 2018). Results from these surveys are summarised in Section 3.1. Results from the 2016 Sub-Antarctic trawl survey were also published in the past year (O’Driscoll et al. 2018).

Overseas work on the closely related species, Patagonian hoki (*Macrourus magellanicus*) reported that juvenile hoki preying on zooplankton were associated with frontal areas, while larger hoki, which ate larger items, were not (Alemany et al. 2018). Sweetman et al. (2018) present inter-annual variability of otolith growth from 1993 to 2011 and cohort specific sex ratios from 1976 to 2011 from blue grenadier (*Macruronus novaezelandiae*) on the west coast of Tasmania. Inter-annual variation in mean otolith increment widths for the first five increment zones (juvenile zones) showed a trend of declining increment widths from 2006 to 2010. Inter-annual cohort sex ratio variation across year-of-birth was also significant displaying a similar trend to the first-year otolith increment growth profiles. The authors suggest that environmental factors may be involved with sex determination in hoki.

2. HOKI FISHERY 2016–17

2.1 Catch and effort information

2.1.1 Total Allowable Commercial Catch (TACC) and other management controls

In the 2016–17 fishing year the TACC for HOK1 was 150 000 t. This TACC applied to all areas of the EEZ except the Kermadec FMA which had a TACC of 10 t. There was an agreement with the Minister for Primary Industries that no more than 90 000 t of the TACC should be taken from western stock areas and 60 000 t from eastern stock areas. The TACC for the 2017–18 fishing year remains at 150 000 t.

Chartered vessels may not fish inside the 12-mile Territorial Sea and there are various vessel size restrictions around some parts of the coast. On the WCSI, a 25-mile line closes much of the hoki spawning area in the Hokitika Canyon and most of the area south to the Cook Canyon to vessels over 46 m overall length. In Cook Strait, the whole spawning area is closed to vessels over 46 m overall length.

2.1.2 Catch

The overall catch of 141 567 t was almost 5000 t higher than the catch in 2015–16, but about 8500 t lower than the TACC (see Table 2). The total estimated catch from catch-effort-and-landing-return (CELR), lining-catch-effort-return (LCER), net-catch-effort-and-landing-return (NCELR), trawl-catch-effort-return (TCER), lining-trip-catch-effort-return (LTCER), tuna-longlining-catch-effort-return (TLCER), and trawl-catch-effort-and-processing-return (TCEPR) data was 138 553 t. A small amount of data may not have been entered into the database as the data extraction was done in mid-December 2017. Estimated catches were scaled up to the total monthly harvest return MHR catch of 141 567 t because estimated catches did not match the (MHR) catch.

Relative to 2015–16, catches in 2016–17 decreased in the main spawning areas and increased in non-spawning areas (Figure 2a, Table 3). The WCSI was the largest fishery for the seventh consecutive year, but catches there decreased by 2900 t from 2015–16 to be 66 000 t in 2016–17. Catches inside the 25 n. mile line were 16 300 t, and made up 25% of the total WCSI catch in 2016–17, an increase from 2015–16, but down from a peak of 41% of the catch taken inside-the-line in 2003–04 (Table A1a). The Chatham Rise was the second largest hoki fishery, with 39 900 t taken from this area in 2016–17, an increase of 3200 t from 2015–16. The catch from Cook Strait of 16 100 t was down by about 2300 t from that in 2015–16, and at a level similar to that in 2011–12. The catch from the Sub-Antarctic of 13 200 t in 2016–17 was double that in 2015–16 (see Table 3). Catches from Puysegur, ECNI and ECSI in 2016–17 were similar to those in 2015–16 at 1200 t, 800 t, and 4400 t respectively. Overall, about 80 300 t of the total catch in 2016–17 was taken from western stock areas, with 61 200 t from the eastern stock areas (Figure 2a). The western catch was well below the industry-agreed western catch limit of 90 000 t.

Catch recording

Nearly 93% of the hoki catch was recorded on the TCEPR form (131 500 t), with the WCSI and Cook Strait the only areas where a substantial amount of catch was recorded on the TCER form (Table A1, Figure 2b). Most hoki catch on the WCSI and in Cook Strait was taken by midwater trawling, whereas most catch on the Chatham Rise and Sub-Antarctic was taken by bottom trawling (Figure 2b).

Target fishing

Up until 2003–04 almost all of the hoki catch was from target hoki tows. Hoki targeting then decreased on the Sub-Antarctic, WCSI and Chatham Rise until 2008–09, when only 86% of the overall hoki catch was from tows targeting hoki (Figure 3). With the increases in TACC from 2009–10, hoki targeting has again increased, and in 2016–17, 93% of the overall catch was taken from hoki target tows (98% of the hoki catch on the WCSI, 86% on the Sub-Antarctic, and 95% on the Chatham Rise). Cook Strait has remained almost

exclusively a hoki target fishery.

Season

A high proportion of the hoki catch in 2016–17 was taken during the spawning season from June to September (Figure 4). Peak catches on the WCSI spawning grounds were in July and August, as in previous years (Figure 5). In the 2017 season there was some fishing on the WCSI in May (with most pre-June catch inside the 25 n. mile line), with high catches through to mid-August, and the season ending in early September, as it did in 2015 and 2016 (Figure 4b, Figure 5). In Cook Strait, peak catches were from mid-July to mid-September, with about 3400 t caught outside the spawning season and MHS trawls accounting for 2900 t (Figure 5). The seasonal pattern of fishing in Cook Strait was similar to that in previous years, but catches were lower from mid-July and August 2017 compared to those in the 2016 season (Figure 4b, Figure 5). Fishing during the spawning season on the ECSI occurred mainly in September. Fishing at Puysegur was mainly in May–June, and August–September (Figure 5).

Outside the spawning fisheries most of the catch was taken from October 2016 to June 2017 on the Chatham Rise and in the Sub-Antarctic, with small amounts of catch taken over the rest of the year in these areas (see Figures 4 and 5). Small catches were taken year-round from the ECNI, with very little catch taken from the WCNI (Figures 4 and 5).

2.1.3 CPUE analysis

Unstandardised catch and effort from TCEPR data for the six largest hoki fisheries (WCSI, Cook Strait, Chatham Rise, ECSI, Sub-Antarctic, and Puysegur) are summarised in Appendix 1. Standardised CPUE analyses on tow-by-tow target hoki catches reported on TCEPR for the WCSI, Cook Strait, Chatham Rise, and Sub-Antarctic were also carried out (Appendix 1 and Figure 6). Catch rate analysis did not include data from CELR forms (which account for up to a third of the catch in some years in Cook Strait and some catch from the WCSI), as they do not provide tow-by-tow effort data. The analyses also excluded data from TCER forms (which have been in use for only seven years) and from the LCER, LTCER, TLCER or NCELR forms. Standardised CPUE analyses using observer tow-by-tow target hoki catches for the WCSI, Cook Strait, Chatham Rise, and Sub-Antarctic were also carried out.

Standardised analyses were carried out only to explore trends in catch rate. CPUE indices are not believed to provide reliable estimates of hoki abundance and were not used in the 2018 hoki stock assessment. Changes in fishing methods (e.g., use of twin trawls), fishing practices (e.g., target fishing, use of escapement panels on smaller boats, incorrect recording of tow duration as some vessels leave the catch in the water until ready to process, changes in target bag size to reflect the processing capacity of the vessel and improve the quality of fish product), and the reliability of gear parameters recorded on the fishing returns are problems for CPUE analyses. There are also other effects on catching ability that cannot be quantified, such as improvements or changes in net and bottom rig design, and electronic equipment. Modular seafood harvesting (MHS) trawls were identified in TCEPR and observer data based on information from the Ministry for Primary Industries and were excluded from unstandardised and standardised analyses.

Model

A lognormal linear model was used for all standardised analysis models, following Dunn (2002). A forward stepwise Generalised Linear Model (Chambers & Hastie 1991) implemented in R code (R Development Core Team 2017) was used to select variables in the model. *Fishing year* was forced into the model as the first term, and the algorithm added variables based on changes in residual deviance. The explanatory power of a particular model is described by the reduction in residual deviance relative to the null deviance defined by a simple intercept model. Variables were added to the model until an improvement of less than 1% of residual deviance explained was seen following inclusion of an additional variable. Variables were either categorical or continuous. Categorical variables offered to the model included *vessel key*, *primary method*, *month*, *vessel experience* (number of years vessel

participated in the fishery), *twin vessel* (true/false variable for a vessel that has used a twin trawl), and *statistical area*. Continuous variables included *fishing duration*, *fishing distance* (calculated from positions at start and end of tow), *distance 2* (calculated as *fishing duration* × *speed*), *start latitude*, *start longitude*, *start time*, *mid time* (mid time of tow), *depth of bottom*, *effort depth* (depth of net), *depth above bottom* (*depth of bottom* minus *effort depth*), *effort width* (wing spread), *day of season*, and *effort height* (headline height). Model fits to most continuous variables were made as third-order polynomials, but a fourth-order polynomial was also offered to the models for duration. As the WCSI dataset included both midwater and bottom tows, nested effects between *method* and *effort duration*, *effort depth*, *effort height*, *effort speed*, *depth above bottom* and *effort width* were investigated. The dependent variable was the log-transformed estimated catch per tow, with positive catches retained and zero hoki catches excluded. *Grid number*, defined as the 0.5° latitude/longitude square where the catch was taken (V. McGregor, NIWA, pers. comm.) was included in all runs to allow for differences in fishing area. Model runs with *grid number* included all cells (all cells), top cell (cell with the highest overall catch), the top 4–6 cells (cells with the highest catches), and the complement of the top cells (all cells not included in the top cells model run).

A vessel variable was incorporated into the CPUE standardisation to allow for differences in fishing power between vessels. A subset of “core” vessels was chosen for each analysis, with vessels not involved in the fishery for a minimum number of years (varied by analysis) and with a minimum level of annual effort excluded because they provided little information for the standardisations. Inclusion of these vessels could result in model over-fitting (Francis 2001b). Data were investigated for level of catch and effort for different years of vessel participation in the fishery, and “core” vessels were defined as those which reported approximately 80% of hoki catches in the defined fishery.

The standardised indices were calculated using GLM, with associated standard errors. Indices were presented using the canonical form (Francis 1999) so that the year effects for an area were standardised to have a geometric mean of 1. The CVs represent the ratio of the standard error to the index. The 95% confidence intervals were also calculated for each index.

The influence of each variable accepted into the lognormal models was described by influence plots (Bentley et al. 2012). They show the combined effect of (a) the expected log catch for each level of the variable (model coefficients) and (b) the distribution of the levels of the variable in each year, and therefore describe the influence that the variable has on the unstandardised CPUE and which is accounted for by the standardisation.

Fits to the model were investigated using standard residual diagnostics. For each model, a plot of residuals against fitted values and a plot of residuals against quantiles of the standard normal distribution were produced to check for departures from the regression assumptions of homoscedasticity and normality of errors in log-space (i.e., log-normal errors).

The data used for each CPUE analysis consisted of all records from core vessels that targeted hoki. Selected explanatory variables for target hoki runs are listed in Table 4.

WCSI

Unstandardised catch rates are presented for both midwater and bottom trawls (Table A2). Midwater trawl catches accounted for 65% of the total spawning season catch in 2017, with almost all bottom trawl tows from outside the 25 n.mile line. Unstandardised catch rates on the WCSI in 2017 increased from 2016, with a median catch rate in all midwater tows targeting hoki of 5.5 t per hour, and a median tow duration of 2.2 hours. As most of the midwater catch and tows were from target hoki tows, catch rates and median tow duration were the same as those for target hoki tows. Catch rates in bottom trawls were lower than those in midwater trawls, with median catch rates of 1.3 t per hour for all non-zero hoki bottom trawl catches. Catch rates were marginally higher for target hoki bottom tows at 1.8 t per hour. Median tow duration of bottom trawls decreased slightly in 2017, to 4.8 hours for all target species, and 4.4 hours for target hoki tows. Standardised CPUE indices show a similar pattern to unstandardised catch rates with a decline from 2000 to 2003, an increase to 2013, then a recent decline (Table A3–A4, Figure 6a). TCEPR and observer data tow-by-tow showed similar overall trends.

Cook Strait

Midwater trawl catches accounted for 76% of the spawning season catch of 12 700 t reported on TCEPR forms in 2017, with 2800 t (23%) coming from MHS tows. A further 3380 t of catch was reported on TCER forms (see Figure 2b). Non-standardised catch rates continued to be high. Median catch rates in non-zero mid-water tows decreased from 26.2 in 2016 to 17.0 t per hour in 2017, with a slight increase in median tow duration from 0.7 to 0.9 hours. Overall, the non-standardised catch rates showed a slight increase from 1990 to 2002 and have been flat since, and standardised catch rates showed no trend (Table A3–A4, Figure 6). Catch rates appear to reflect a fishing strategy where vessels limit the size of catches to maintain fish quality. TCEPR and observer data tow-by-tow showed similar overall trends.

Chatham Rise

Over 97% of the catch in 2016–17 was taken in bottom trawls, with most of the catch reported on TCEPR forms (see Figure 2b), and MHS tows accounted for nearly 1% of the catch. There was a general increase in tow duration since the 1990s, with a median tow duration of 4.8 hour in 2016–17. The median non-standardised catch rate in bottom trawls in 2016–17 of 1.4 t per hour was similar to that in the previous eight years. The catch rate in hoki target trawls increased from 0.6 t per hour in 2002–03 to 1.7 t per hour in 2008–09, and has levelled off to 1.4–1.6 t per hour from 2009–10 to 2016–17. Standardised CPUE indices show a similar pattern to unstandardized catch rates (Table A3–A4, Figure 6a).

Sub-Antarctic

Bottom trawl catches reported on TCEPR forms accounted for 98% of the catch taken in 2016–17, with midwater trawling accounting for the balance (see Figure 2b). Median tow duration in 2016–17 increased slightly to 5.3 hours, and non-standardised catch rates in bottom trawls increased to 0.5 t per hour. Catch rates for hoki target bottom trawls (1.3 t per hour in 2016–17) were higher than those for all target trawls, and only slightly lower than those on the Chatham Rise. Standardised CPUE generally decreased from 1996–97 to 2003–04, increased to much higher levels, but decreased again in 2015–16 and 2016–17 (Figure 6a). Observed vessels had lower CPUE indices from 2011–12 to 2013–14 (Figure 6a).

Other fisheries

Spawning season catches from the ECSI were mainly reported on TCEPR forms (see Figure 2b). Midwater tow target hoki catch rates in 2016–17 increased to 6.4 t per hour, and bottom tow catch rates increased to 2.9 t per hour. Spawning season catches from Puysegur were also mainly reported on TCEPR (see Figure 2b), and midwater and bottom tow target hoki catch rates in 2016–17 were 3.1 t and 3.3 t per hour respectively.

CPUE trends

Standardised CPUE indices for WCSI, Chatham Rise, and Sub-Antarctic all decreased from 1991–92 to 2003–04 and have since increased. However, indices from western areas (WCSI and Sub-Antarctic) have declined since 2014–15, while those in eastern areas (Chatham Rise and Cook Strait) were flatter (Figure 6b). Observer CPUE indices for WCSI, Chatham Rise, and Sub-Antarctic showed overall similar trends, but were spiky due to fewer data.

2.1.4 Bycatch

Estimates of bycatch in the hoki fishery were determined from data collected by Ministry for Primary Industries observers. For target hoki trawls, the observer data in 2016–17 represented about 53% of vessels, 8% of tows, and 11% of the total catch (Table 5). The bycatch rate (defined as the percentage of the hoki catch) was estimated for the main bycatch species by fishery in Table 6. Other bycatch species were also taken, particularly in the non-spawning fisheries, but bycatch rates for these species were usually less than 1%. Some of the apparent changes in bycatch rates may have been related to changes in observer coverage

between years (e.g., Livingston et al. 2002), so the data should be treated with caution. There were changes in the proportion of hoki target catches (see Figure 3, Section 2.1.2), so caution also needs to be exercised when interpreting the definition of the hoki target fishery. A more comprehensive analysis of catch and discards in the hoki, hake, and ling fishery from 1990–91 to 2012–13 was provided by Ballara & O’Driscoll (2015b).

Overall bycatch rates in the spawning areas in 2016–17 were generally low (less than 2%) for most species. On the WCSI, bottom trawl fishery bycatch rates in 2016–17 were higher than those in 2015–16 for hake (9.1%) and ling (4.5%), but lower for silver warehou (0.7%). WCSI midwater trawl bycatch rates decreased for hake (1.7%), ling (1.6%), and silver warehou (0.1%) (Figure 7). As in the past, there was very little bycatch in the midwater Cook Strait fishery (Figure 7), and spiny dogfish and ling had the largest observed bycatch rates (0.4% and 0.2% respectively).

In the non-spawning fisheries, bycatch rates were generally higher than those for spawning fisheries (Figure 7). In the Chatham Rise bottom trawl fishery, bycatch rates for hake (1.0%), ling (3.6%), and silver warehou (0.6%) decreased from 2015–16, whereas javelinfish (9.7%), rattails (8.4%), and spiny dogfish (2.4%) increased. Of the main Sub-Antarctic bottom trawl bycatch species, bycatch rates increased for rattails (3.1%), spiny dogfish (10.5%), silver warehou (4.0%), and white warehou (6.8%), and decreased for hake (2.1%), ling (17.1%), and javelinfish (4.2%).

2.2 Size and age composition of commercial catches

Data to estimate length frequency distributions in 2016–17 were available from the at-sea Ministry for Primary Industries Observer Programme (OP). Land-based (‘market’) sampling of landed hoki from Cook Strait and WCSI (inside the 25 n.mile line) was also carried out in 2016–17 for Ministry for Primary Industries research project HOK201702. The fishing industry observer programme formerly run by the Hoki Fishery Management Company (HMC) was discontinued and no data have been provided since 2004–05.

Density plots of all commercial TCEPR and TCER trawls in which hoki was caught in 2016–17 are shown in Figure 8. Observed positions of all tows sampled for hoki length frequency by the OP are provided in the TCEPR plot. Hoki were measured by OP observers from 1335 tows (more than in 2015–16), of which 689 came from the WCSI, 73 from Cook Strait, 313 from the Chatham Rise, 208 from the Sub-Antarctic, 16 from the ECSI (June–September), 28 from Puysegur (June–September), and 14 from ECNI. In Cook Strait and WCSI, 32 and 12 land-based samples were collected respectively by NIWA scientists. Tables 7 and 8 describe timing of sampling in the main areas.

Length frequency distributions were estimated for each of the major fisheries as the weighted (by catch weight) average of individual length samples. Length frequency data from each area were post-stratified. Data from the WCSI were stratified by area (inside or outside 25 n. miles) and time. Length frequency data from outside and inside the line from May to September were split into weekly or fortnightly time periods and scaled, respectively, to the outside or inside the line catch in each period (Table 8a). Adjacent strata were combined if there were few length samples available, e.g., strata 1, 9, 10 and 22 (Table 8a). Length frequency data from Cook Strait are normally stratified by month and vessel size. However, because of patchy OP coverage in 2017, Cook Strait samples from June and July were combined for both vessels less than and greater than 40 m (Table 8b). A regression tree method (described below) was used to stratify the two non-spawning fisheries.

Catch-at-age from spawning fisheries was estimated using age-length keys derived from otolith ageing. Otoliths were available from the OP and land-based samples. A subsample of 753 otoliths from WCSI (617 from OP samples, and 136 from land-based samples), and 751 otoliths from Cook Strait (134 from OP samples, and 617 from land-based samples) were selected, prepared, and read using the validated technique of Horn & Sullivan (1996) as modified by Cordue et al. (2000), and described by Horn & Sutton (2017).

The sub-sample was derived by randomly selecting a set number of otoliths from each of a series of 1 cm length bins covering the bulk of the catch and then systematically selecting additional otoliths to ensure that the tails of the length distribution were represented. The chosen sample sizes approximated those necessary to produce mean weighted CVs of less than 20% across all age classes, in each of the spawning fisheries.

Age-length keys were constructed for each spawning fishery and applied to the total length frequency distribution to produce an age frequency distribution for the catch of each sex separately. Catch-at-age estimates were determined using the 'catch.at.age' software (Bull & Dunn 2002). This software also incorporates data from otolith zone measurements using the consistency scoring method of Francis (2001a) in the age-length key.

Catch-at-age in both the Chatham Rise and Sub-Antarctic fisheries was estimated by sampling directly for age. This continued the approach used since 1998–99 for the Chatham Rise (Francis 2002) and since 2000–01 for the Sub-Antarctic (Ballara et al. 2003). Sampling directly for age is necessary because a single age-length key is not appropriate in non-spawning fisheries. The fisheries are spread over much of the year and there will be substantial fish growth. This means that for any given length the proportions-at-age will change through the fishery. To sample directly for age, observer coverage must be sufficient to provide a random sample of otoliths from the fishery. Francis (2002) suggested that even a sample size of 1200 otoliths may not be sufficient to achieve a target CV of 0.20 in some years.

On the Chatham Rise in 2016–17, 1231 otoliths out of the available 3090 collected from 301 tows (12 with catches less than 150 kg) that caught over 150 kg of hoki were selected at random for age estimation as follows:

1. Rejected all otoliths from tows that caught less than 1 t of hoki.
2. For tows that caught 1–4 t of hoki, 1 otolith from each tow.
3. For tows that caught 4–6 t of hoki, 3 otoliths from each tow.
4. For tows that caught 6–9 t of hoki, 5 otoliths from each tow.
5. For tows that caught more than 9 t of hoki, 6 otoliths from each tow.

On the Sub-Antarctic in 2016–17, 1093 otoliths were collected from 208 tows, and as the number of otoliths were less than the required sample size of 1200 otoliths, all otoliths were selected and 1085 read.

Observers also collected 170 Chatham Rise identified as 'non-random' otoliths, but these were not considered for the selected otolith samples. However, 517 otoliths classified as 'non-random' were considered for the selection of otolith samples from the Sub-Antarctic, otherwise there would have been even fewer otoliths for age estimation.

The method to estimate catch-at-age for the Chatham Rise and Sub-Antarctic followed that of Francis (2002) as modified by Smith (2005). First, the regression tree method (Breiman et al. 1984) was used to stratify the two fishing areas by minimising the weighted least squares of the mean lengths (as a proxy for age) of fish in the observed tows (see Smith (2005) for details). Next, the estimated age frequencies by sex for the observed tows within each stratum were obtained by scaling the otolith ages and sexes up by the estimated numbers of hoki of each sex caught in the tow and averaging over all tows in the stratum. Finally, the number of fish caught in each stratum was estimated from the TCEPR data, and catch-at-age frequencies were calculated as the weighted average, over the strata, of the estimated age frequencies by sex. Numbers of fish were estimated from catch weights using the length-weight relationship of Francis (2003).

Estimates of catch-at-age before 1999–2000 in the Sub-Antarctic and up to 1997–98 on the Chatham Rise were based on an optimised length frequency model (OLF) described in detail by Hicks et al. (2002).

2.2.1 Size and age composition in spawning fisheries

West coast South Island

The WCSI catch in 2017 was dominated by fish from 55 to 110 cm from the 2007–14 year-classes (ages 3–10) (Figures 9 and 10). The length distribution of hoki had two modes, the smaller mode made up mainly of fish from the 2014 year class (age 3), with fish from the larger mode corresponding to older fish from the 2007–11 year classes (ages 6–10) (Figures 9 and 10). There was a relatively high proportion of males from the 2014 year class (age 3), and 13% of hoki caught on the WCSI were less than 65 cm (Figures 9 and 10).

From 2000 to 2004, the sex ratio of the sampled catch was highly skewed (Figure 11a), with many more females caught than males. In 2005 to 2011, as the catch of younger fish increased, the sex ratio reversed with more males than females caught. In 2014 and 2015 the percentage of males decreased slightly to 47%, and in 2016 and 2017 further decreased to 43%. The percentage of hoki aged 7 and older in the catch declined steeply from 68% in 2003–04 to 16% in 2005–06, increased again to 47–49% in 2013 and 2014, but decreased to 43% in 2015 owing to the abundance of the 2011 year-class (Figure 11a). In 2016 the percentage of fish aged 7 and older increased substantially to 62%, but dropped to 57% in 2017. Conversely, the percentage of small fish (less than 65 cm, which is approximately equivalent to ages 3 years and younger) by number in the catch increased from 20% in 2006–07 to 31% in 2008–09, then decreased to 7–14% in 2013–17 (Figure 11b). Some of these small fish were spawning: 20% of the female fish less than 55 cm (i.e., mostly 2 year-olds) were in spawning condition (ripe and running ripe) in 2017, compared to 44% of all fish (Table 9). The spawning state of male hoki is not recorded by observers, but observations from research tows in other areas suggest that a higher proportion of small males than females would be mature.

Previous comparisons showed that in most years there were differences in the length frequency distributions from land-based samples of hoki caught inside the 25 n. mile line and at-sea samples of fish outside this area, with a higher proportion of larger fish (greater than 70 cm) from samples taken inside the line (Ballara & O’Driscoll 2014, 2015a, 2016, 2017). In 2017, the observer and land-based sampling data from inside the line in May–September had very few fish less than 70 cm (Figure 12).

The overall mean length of both female and male hoki decreased as the 2017 spawning season progressed (Figure 13). This pattern of declining mean length over the spawning season used to be a common feature of the fishery, but was not observed between 1999 and 2006. The mean length-at-age for hoki aged from 3–10 increased from the start of the fishery to the mid-2000s, but has since decreased. (Figure 14).

The OP data used to estimate catch-at-age was representative of the overall spatial, depth, and temporal distribution of the catch in 2016–17, although small vessels and vessels from 65–70 m were not well sampled (Figure 15).

Cook Strait

Fish from a broad range of ages contributed to the fishery, with the main mode at ages 6–9 (2008 to 2011 year-classes) for females and ages 3–8 (2009 to 2014 year classes) for males (Figure 16 and 17). Only 12% of the catch was fish less than 65 cm (see Figure 11b).

In 2017, the OP data used to estimate catch-at-age was poorly representative of the overall spatial and depth and temporal distribution of the catch (Figures 18 and 19, see Table 8). However, land-based samples were well spread throughout the spawning season (Table 8, Figure 19).

Length frequency distributions by strata showed that the size distribution of the catch was broadly similar in each month, by each sampling method, and by vessel size category (Figure 20). More females were caught especially in August by both smaller and larger vessels. The sex ratio of the catch fluctuated over time, but was dominated by females from 2001–05, and was mostly male-dominated since then

(see Figure 11a). The apparent change in sex ratio may be related to a sampling bias, as there is some evidence that larger vessels catch a higher proportion of female hoki in Cook Strait (O’Driscoll et al. 2015). The sex ratio of the Cook Strait catch has fluctuated over time, with 49% males in the catch in 2017 (see Figure 11a).

There was a slight decreasing trend in the mean length of hoki during the season (Figure 21). As on the WCSI, the mean length-at-age in the Cook Strait fishery increased to the mid-2000s, but has subsequently declined (Figure 22).

The catch-at-age data for 2011–13 were not used in the 2015 hoki stock assessment model as they were not considered representative of the commercial catch due to poor observer coverage and the rapidly changing sex ratio. The catch-at-age data for 2014–17 were included in the 2018 assessment model because of improved coverage due to reinstatement of the land-based sampling programme for Cook Strait hoki.

Puysegur

In 2016–17, 7 OP samples were collected during the spawning season, and these were mainly fish of 45–90 cm (Figure 23).

East coast South Island

Sixteen samples were collected during the 2017 spawning season (Figure 24). Fish from this area were larger than those observed in the non-spawning fishery on the Chatham Rise, especially the females.

2.2.2 Size and age composition in non-spawning fisheries

Chatham Rise

About 95% of the commercial catch, 80% of length frequency data, and 89% of the available otoliths came from the hoki target fishery in 2016–17 (Figure 25). The tree-based regression split the OP data into four strata based on depth of net, and longitude (Table 10). The mean length of hoki was smaller in shallower water, and to the west. The length distribution of hoki in 2016–17 was dominated by hoki of 45–90 cm, and was similar for males and females (Figure 26). The length frequencies had modes at 40–50 cm from the 2015 year-class (age 1+), and at 50–65 cm from the 2014 year-class (ages 2+), with fewer larger, older fish (Figure 26 and 27). About 60% of the catch by number was less than 65 cm in 2016–17, an increase from 2015–16 (27%), due to the high numbers of 2+ hoki caught (see Figure 11b). Females comprised 56% of the catch (see Figure 11a). There was a lower proportion of large old fish (males and females) than in other areas, with only 20% of the catch aged 7 years or older, and only 30% of these were male (see Figure 11a).

The OP data used to estimate catch-at-age was representative of the overall spatial and temporal distribution of the catch in 2016–17, although coverage was lower than ideal in October, and June (Figure 28).

Sub-Antarctic

About 86% of the commercial catch, but only 33% of length frequency data and 28% of the available otoliths came from the hoki target fishery in 2016–17 (Figure 29). The remainder of the otoliths were from tows that targeted southern blue whiting, hake, ling, squid, smooth oreos, silver warehou, or white warehou. The tree-based regression on hoki target tows only split the OP data based into three strata based on depth and latitude (Table 10). Smaller fish tended to occur on the Snares Shelf, especially in shallower water.

The length distribution of hoki in 2016–17 was broad and similar for males and females (Figure 30). The observed catch included hoki of 35–45 cm from the 2015 year-class (age 1+), fish from 50–65 cm from the 2014 year-class (age 2+), and fish from 65–90 cm primarily from ages 3–10 (Figure 31). There was a higher proportion of old fish caught than on the Chatham Rise (see Figure 11a), but the proportion

of the catch of fish less than 65 cm was less than on the Chatham Rise at 44% (see Figure 11b). About 60% of the fish caught in 2016–17 were females (see Figure 11a).

The OP sampling in the Sub-Antarctic in 2016–17 was not representative of the overall spatial and temporal distribution of the catch: deeper tows were under-sampled; and there was little coverage in Statistical Area 603 (Figure 32). Because of the poor level of coverage of the target fishery, the Deepwater Fishery Assessment Working Group decided at its meeting on 23 February 2018 not to include catch-at-age data from the 2016–17 Sub-Antarctic fishery (Figure 31) in the 2018 stock assessment.

Problems with estimation of catch-at-age in non-spawning fisheries

In addition to the problems associated with whether OP coverage was representative of the catch, there was an ongoing problem with selection of otoliths. Observers collected otoliths from 10 fish out of the 50–150 sampled per tow for length measurement (and three otoliths per tow in the spawning fisheries). As in previous years, a rank sums test showed that the observers tended to select larger fish for extraction of otoliths from the Sub-Antarctic in 2016–17, although the Chatham Rise otolith selection appeared unbiased in 2016–17 (Figure 33). This introduces a bias into the age estimates which is difficult to correct. Electronic aids introduced to help observers take random samples for otoliths should have solved this problem, but this does not seem to have worked.

2.2.3 Comparison of size and age composition between the main fisheries

Length distributions from the main fisheries in 2016–17 are compared in Figure 34. The catch in all areas was mainly fish 50–90 cm. The 2014 year-class (50–65 cm) was important in all areas at age 2+ on the Chatham Rise and Sub-Antarctic, and at age 3 in Cook Strait and on the WCSI. The 2011 year-class was also important in all areas at age 5+ on the Chatham Rise and Sub-Antarctic, and at age 6 in Cook Strait and on the WCSI. The 2010 year-class was also apparent on the WCSI, in Cook Strait and in the Sub-Antarctic. Small hoki from the 2015-year class appeared in all the main fishery areas. Most fish on the Chatham Rise were less than 90 cm. Large female fish (over 90 cm) were proportionately more abundant in Cook Strait, ECSI, and WCSI.

3. HOKI RESEARCH

3.1 Resource surveys

3.1.1 Trawl surveys

Chatham Rise

The twenty-fifth *Tangaroa* trawl survey of the Chatham Rise was conducted from 4 January to 3 February 2018, with 83 core (200–800 m) phase 1 biomass tows, 4 core phase 2 tows, and 40 deep (800–1300 m) tows. Estimated relative biomass of all hoki in core strata was 122 097 t (CV 16.2%), an increase of 7% from January 2016 (Table 11). This increase was largely driven by the biomass estimates for 1+ year old hoki (2016 year-class) of 30 499 t and 2+ hoki (2015 year-class) of 51 346 t. The biomass estimate for 2+ hoki was the third highest estimate in the time series. The relative biomass of recruited hoki (ages 3+ years and older) of 40 252 t declined by 26% from that in 2016, but 3++ hoki were also observed in deep (800–1300 m) strata in 2018 (Table 11).

Hoki size and age frequency distributions from the 2018 Chatham Rise survey showed a large mode of 1+ hoki (34–48 cm), with a slightly smaller mode of 2+ hoki (48–58 cm) hoki, and a right-hand tail of larger, older fish (Figures 35 and 36).

In 2018 the survey again covered 800–1300 m depths around the entire Rise. The deep strata provide

relative biomass indices for a range of deepwater sharks and other species associated with orange roughy and oreo fisheries. Some large hoki (typically longer than 80 cm) were caught deeper than 800 m, with the deepwater strata contributing 23% of the 3++ hoki biomass, and 9% of the total biomass for all strata.

Sub-Antarctic

No Sub-Antarctic trawl survey was carried out in November–December 2017.

WCSI

No WCSI trawl survey was carried out in winter 2017.

3.1.2 Acoustic surveys

Cook Strait

An acoustic survey of spawning hoki abundance in Cook Strait was carried out from the research vessel *Ikatere* from 25 July to 27 August 2017 (O’Driscoll & Escobar-Flores 2018). Six acoustic snapshots of the main Cook Strait spawning grounds were carried out: five snapshots were completed; but snapshot 2 only covered three of the six strata (Table 12). *Ikatere* is not capable of mark identification trawling, so the only biological data available were from at-sea observers and land-based sampling of the commercial catch. Acoustic estimates of hoki abundance ranged from 51 000 t in snapshot 6 on 26–27 August to 167 000 t in the incomplete snapshot 2 on 30 July (where abundance in the three strata that were not surveyed was assumed to be the average estimate from these strata from the other five snapshots). The average estimate over the six snapshots was 102 000 t. This was half the equivalent estimate from 2015 (204 000 t) and the lowest since 2008 (Table 13). The survey weighting (expressed as a coefficient of variation, CV) for the 2017 survey – which includes uncertainty associated with survey timing, sampling precision, acoustic detectability, mark identification, calibration, target strength – was 36%.

4. CONCLUSIONS

The total reported hoki catch in 2016–17 was 141 567 t, 8500 t lower than the TACC of 150 000 t, but almost 5000 t higher than the catch in 2015–16. Catches in 2016–17 decreased in the main spawning areas and increased in non-spawning areas. The WCSI was the largest hoki fishery for the seventh consecutive season, followed by the non-spawning fishery on the Chatham Rise.

Length and age frequency distributions from the commercial fishery show that most of the catch in 2016–17 was fish of 50–90 cm. The 2014 year-class (50–65 cm) was important in all areas and comprised fish aged 2+ on the Chatham Rise and Sub-Antarctic, and aged 3 in Cook Strait and on the WCSI. The 2011 year-class was also important in all areas as age 5+ on the Chatham Rise and Sub-Antarctic, and as age 6 in Cook Strait and on the WCSI. The 2010 year-class (age 6+) was also apparent on the WCSI, in Cook Strait and in the Sub-Antarctic. The 2015 year-class appeared in all the main fishery areas. The percentage of small fish in the catch increased in all areas, mainly due to the presence of the 2014 year-class. Most fish caught on the Chatham Rise in 2016–17 were less than 90 cm, and the largest hoki came from the Cook Strait, ECSI, and WCSI fisheries.

The relative biomass index for hoki from the core strata in the 2018 Chatham Rise trawl survey increased by 7% from 2016. The 2016 and 2015 year-classes (age 1+ and 2+ respectively) were above average, with the estimates from the 2015 year-class the third highest estimates in the Chatham Rise series for age 2+. The relative biomass of recruited hoki (ages 3+ years and older) declined by 26% from that in 2016, but recruited hoki were also observed in deep strata in 2018. The abundance index from the acoustic index from Cook Strait in 2017 was less than half that in 2015, and the lowest since 2008.

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TABLES

Table 1: Reported trawl catches (t) from 1969 to 1987–88; 1969–83 by calendar year, 1983–84 to 1987–88 by fishing year (1 October to 30 September). Source, FSU data.

Year	U.S.S.R.	Japan	South Korea	New Zealand		Total
				Domestic	Chartered	
1969		95				95
1970		414				414
1971		411				411
1972	7 300	1 636				8 936
1973	3 900	4 758				8 658
1974	13 700	2 160		125		15 985
1975	36 300	4 748		62		41 110
1976	41 800	24 830		142		66 772
1977	33 500	54 168	9 865	217		97 750
1978*	2 028 +	1 296	4 580	678		8 581
1979	4 007	8 550	1 178	2 395	7 970	24 100
1980	2 516	6 554		2 658	16 042	27 770
1981	2 718	9 141	2	5 284	15 657	32 802
1982	2 251	7 591		6 982	15 192	32 018
1983	3 853	7 748	137	7 706	20 697	40 141
1983–84	4 520	7 897	93	9 229	28 668	50 407
1984–85	1 547	6 807	35	7 213	28 068	43 670
1985–86	4 056	6 413	499	8 280	80 375	99 623
1986–87	1 845	4 107	6	8 091	153 222	167 271
1987–88	2 412	4 159	10	7 078	216 680	230 339

* Catches for foreign licensed and New Zealand chartered vessels from 1978 to 1984 were based on estimated catches from vessel logbooks. Few data were available for the first 3 months of 1978 because these vessels did not begin completing these logbooks until 1 April 1978.

+ Soviet hoki catches were taken from the estimated catch records and differ from official Fisheries New Zealand statistics. Estimated catches were used because of the large amount of hoki converted to meal and not recorded as processed fish.

Table 2: Reported catch (t) from QMS¹, estimated catch (t) from Monthly Harvest Return (MHR) data, and TACC (t) for HOK 1 from 1986–87 to 2016–17. Estimated catches included TCEPR and CELR data (from 1989–90), LCER data (from 2003–04), NCELR data (from 2006–07), and TCER and LTCER data (from 2007–08).

Year	Reported catch	Estimated catch (MHR)		TACC
		Exclude HOK ET	Include HOK ET	
1986–87	158 171		175 000	250 000
1987–88	216 206		255 000	250 000
1988–89	208 500		210 000	250 000
1989–90	210 000		210 000	251 884
1990–91	215 000		210 000	201 897
1991–92	215 000		215 000	201 897
1992–93	195 000		215 000	202 155
1993–94	191 000		195 000	202 155
1994–95	174 000		190 000	220 350
1995–96	210 000		168 000	240 000
1996–97	246 000		194 000	250 000
1997–98	269 000		230 000	250 000
1998–99	244 500		234 000	250 000
1999–00	242 000		237 000	250 000
2000–01	230 625	229 858	229 862	250 000
2001–02	200 054	195 492	195 506	200 000
2002–03	182 560	184 659	184 668	200 000
2003–04	133 764	135 784	135 787	180 000
2004–05	102 885	104 364	106 189	100 000
2005–06	101 984	104 385	105 965	100 000
2006–07	97 790	101 009	102 861	100 000
2007–08	87 815	89 318	91 045	90 000
2008–09	87 598	88 805	89 475	90 000
2009–10	105 105	107 209	107 209	110 000
2010–11	115 782	118 805	118 805	120 000
2011–12	126 184	130 108	130 108	130 000
2012–13	127 962	131 575	132 618	130 000
2013–14	143 705	146 344	146 344	150 000
2014–15	156 471	161 528	161 528	160 000
2015–16	136 087	136 719	136 722	150 000
2016–17	138 553	141 567	141 571	150 000

1. Discrepancies between QMS data and estimated catches from 1986 to 1990 arose from incorrect surimi conversion factors. The estimated catch in those years was corrected from conversion factors measured each year by Ministry observers on the WCSI fishery. Since 1990 the current conversion factor of 5.8 was used, and the total catch reported to the QMS is considered to be more representative of the true level of catch. From 2000–01 MHR catches were shown including and excluding HOK ET catches (catches outside the EEZ).

Table 3: Estimated total catch (t) of hoki by area¹, 1988–89 to 2016–17. Estimated (TCEPR and CELR) catches were scaled to reported (QMR or MHR) catch totals. Data also included LCER (from 2003–04), and NCELR estimated data (from 2006–07), and TCER and LTCER data (from 2007–08).

Fishing Year	Spawning fisheries				Non-spawning fisheries					Total catch
	WCSI	Puysegur	Cook Strait	ECSI	Sub- Antarctic	Chatham Rise	ECNI	WCNI	Other ²	
1988–89	188 000	3 500	7 000	-	5 000	5 000	-	-	-	208 500
1989–90	165 000	8 000	14 000	-	10 000	13 000	-	-	-	210 000
1990–91	154 000	4 000	26 500	1 000	18 000	11 500	-	-	-	215 000
1991–92	105 000	5 000	25 000	500	34 000	45 500	-	-	-	215 000
1992–93	98 000	2 000	21 000	-	26 000	43 000	2 000	-	3 000	195 000
1993–94	113 000	2 000	37 000	-	12 000	24 000	2 000	-	1 000	191 000
1994–95	80 000	1 000	40 000	-	13 000	39 000	1 000	-	-	174 000
1995–96	73 000	3 000	67 000	1 000	12 000	49 000	3 000	-	2 000	210 000
1996–97	91 000	5 000	61 000	1 500	25 000	56 500	5 000	-	1 000	246 000
1997–98	107 000	2 000	53 000	1 000	24 000	75 000	4 000	-	3 000	269 000
1998–99	94 562	2 883	45 252	1 977	23 753	73 594	2 315	94	97	244 527
1999–00	102 721	2 880	43 192	2 351	33 772	56 014	1 387	98	4	242 419
2000–01	102 235	6 798	36 298	2 411	30 076	49 847	2 035	147	-	229 847
2001–02	92 719	5 322	23 976	2 971	30 175	39 151	1 147	39	-	195 500
2002–03	73 856	5 948	36 713	7 382	20 199	39 092	929	532	8	184 659
2003–04	45 112	1 158	41 034	2 140	11 635	33 650	880	126	-	135 735
2004–05	32 647	5 501	24 485	4 259	6 337	30 434	516	36	-	104 215
2005–06	38 281	1 457	21 405	653	6 961	34 944	673	8	-	104 382
2006–07	33 328	408	20 113	1 006	7 661	37 813	667	8	-	101 004
2007–08	20 928	308	18 470	2 323	8 708	37 920	640	19	-	89 316
2008–09	20 548	233	17 535	1 054	9 807	39 011	588	25	-	88 801
2009–10	36 349	272	17 880	669	12 275	39 138	618	7	-	107 208
2010–11	48 373	1 176	14 937	1 625	12 655	38 447	1 588	2	-	118 803
2011–12	54 532	1 308	15 859	2 531	15 743	39 246	858	31	-	130 108
2012–13	56 208	955	19 415	3 311	14 095	36 530	1 051	9	-	131 574
2013–14	69 400	778	18 400	2 750	19 927	33 752	1 326	9	-	146 342
2014–15	78 700	1 875	20 125	3 598	16 378	40 071	766	11	5	161 529
2015–16	68 869	1 056	18 378	4 126	6 639	36 714	888	20	-	136 690
2016–17	65 953	1 209	16 084	4 405	13 157	39 919	826	6	-	141 559

¹ Estimated catches by area from TCEPR, CELR, LCER, NCELR, and TCER adjusted pro rata to the total reported (QMS or MHR) catches (excluding HOK ET catches) in Table 2.

² Area undefined because of missing positions or statistical areas.

- No catches

Table 4: Variables retained in order of decreasing explanatory value by each lognormal CPUE model for each fishery area and the corresponding total R² value.

WCSI: TCEPR tow-by-tow, target hoki

Variable	R-squared
Year	6.71
Day of year	16.16
Vessel	22.79
Mid time of tow	26.10

WCSI: Observer catch, target hoki

Variable	R-squared
Year	7.17
Vessel	14.50
Day of year	22.77
Mid time of tow	25.88

Cook Strait: TCEPR tow-by-tow, target hoki

Variable	R-squared
Year	2.52
Day of year	15.45
Vessel	22.14

Cook Strait: Observer catch, target hoki

Variable	R-squared
Year	5.11
Vessel	11.15
Grid number	14.80
Day of year	18.45

Chatham Rise: TCEPR tow-by-tow, target hoki

Variable	R-squared
Year	11
Vessel	17.13
Start time of tow	19.77
Duration	22.68
Month	24.29
Grid number	25.44

Chatham Rise: Observer catch, target hoki

Variable	R-squared
Year	11.19
Vessel	13.83
Start time of tow	16.11
Duration	18.87
Month	20.85
Grid number	22.63

Sub-Antarctic: TCEPR tow-by-tow, target hoki

Variable	R-squared
Year	5.62
Month	10.88
Grid number	15.95
Start time of tow	21.30
Vessel	23.94
Duration	25.51

Sub-Antarctic: Observer catch, target hoki

Variable	R-squared
Year	5.86
Gridnumber	12.01
Start time of tow	17.59
Vessel	20.54
Duration	22.57
Month	24.27

Table 5: Observer coverage in 2016–17 by area, for combined trawl methods. WCSI, Cook Strait and ECSI are for June to September only.

(a) All target species tows

Area	Number of vessels			Number of tows			Catch (t)		
	All	Observed	Percent	All	Observed	Percent	All	Observed	Percent
Chatham Rise	50	21	42.0	5 699	313	5.5	39 879	2 700	6.8
Cook Strait	20	5	25.0	916	73	8.0	12 718	1 402	11.0
ECNI	44	3	6.8	1 948	14	0.7	818	19	2.3
ECSI	16	1	6.2	297	16	5.4	4 430	363	8.2
Puysegur	24	6	25.0	200	28	14.0	1 209	106	8.7
Sub–Antarctic	35	18	51.4	2 477	208	8.4	13 157	1 364	10.4
WCNI	18	1	5.6	70	1	1.4	6	-	-
WCSI	41	20	48.8	5 323	683	12.8	65 358	9 900	15.1
All areas combined	103	40	38.8	16 930	1 335	7.9	137 573	15 853	11.5

(b) Target hoki tows

Area	Number of vessels			Number of tows			Catch (t)		
	All	Observed	Percent	All	Observed	Percent	All	Observed	Percent
Chatham Rise	19	11	57.9	4 319	250	5.8	37 969	2 325	6.1
Cook Strait	17	5	29.4	876	72	8.2	12 706	1 393	11.0
ECNI	13	2	15.4	289	6	2.1	457	9	1.9
ECSI	14	1	7.1	287	16	5.6	4 331	363	8.4
Puysegur	8	1	12.5	83	1	1.2	1 002	-	-
Sub–Antarctic	18	9	50.0	1 279	69	5.4	11 278	781	6.9
WCNI	1	1	100.0	1	1	100.0	-	-	-
WCSI	35	20	57.1	4 825	548	11.4	64 020	9 265	14.5
All areas combined	61	32	52.5	11 959	962	8.0	131 764	14 136	10.7

Table 6: Bycatch rates (in parentheses) on vessels with Observer Programme observers in the hoki fishery for tows that targeted hoki from 1990–91 to 2016–17. The WCSI (bottom and midwater trawls), Cook Strait, and ECSI data covered the spawning season (June–September) only. -, less than 0.1 t (except for Cook Strait 1994–95 and 1996–97, Puysegur 1997–98 to 2008–09, and ECSI 2006–07, for which there were no observer data). Bycatch rates were not calculated where observed hoki catch was less than 100 t. Species chosen were the top eight by observed catch in an area. Species include: BAR, barracouta; CSQ, leafscale gulper shark; FRO, frostfish; GSP, pale ghost shark; HAK, hake; HOK, hoki; JAV, javelinfish; JMA, jack mackerels; LIN, ling; RAT, rattails; RCO, red cod; SND, shovelnose dogfish; SPD, spiny dogfish; SPO, rig; SQU, arrow squid; SWA, silver warehou; and WWA, white warehou.

(a) WCSI (bottom trawl)

Year	Catch in t (% of hoki catch)										
	HOK	HAK	JAV	LIN	RAT	SPD	SQU	SWA	Other		
1990–91	1 046	25 (2.4)	1 (0.1)	56 (5.3)	2 (0.2)	8 (0.8)	11 (1.1)	67 (6.4)	39 (3.7)		
1991–92	516	7 (1.4)	1 (0.2)	44 (8.5)	2 (0.4)	5 (1)	13 (2.5)	9 (1.7)	44 (8.5)		
1992–93	3 375	82 (2.4)	1 (0)	79 (2.3)	6 (0.2)	30 (0.9)	4 (0.1)	78 (2.3)	60 (1.8)		
1993–94	1 503	52 (3.5)	4 (0.3)	56 (3.7)	4 (0.3)	28 (1.9)	17 (1.1)	23 (1.5)	59 (3.9)		
1994–95	179	24 (13.4)	1 (0.6)	30 (16.8)	3 (1.7)	7 (3.9)	8 (4.5)	9 (5)	25 (14)		
1995–96	360	48 (13.3)	- (-)	31 (8.6)	2 (0.6)	43 (11.9)	1 (0.3)	26 (7.2)	28 (7.8)		
1996–97	1	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)		
1997–98	673	69 (10.2)	3 (0.4)	45 (6.7)	5 (0.7)	15 (2.2)	1 (0.2)	19 (2.8)	30 (4.5)		
1998–99	2 660	244 (9.2)	19 (0.7)	159 (6)	24 (0.9)	67 (2.5)	3 (0.1)	85 (3.2)	108 (4.1)		
1999–00	3 033	438 (14.4)	17 (0.6)	122 (4)	26 (0.9)	35 (1.1)	4 (0.1)	84 (2.8)	175 (5.8)		
2000–01	1 462	54 (3.7)	4 (0.3)	66 (4.5)	6 (0.4)	13 (0.9)	6 (0.4)	57 (3.9)	37 (2.5)		
2001–02	7 493	592 (7.9)	33 (0.4)	306 (4.1)	51 (0.7)	80 (1.1)	39 (0.5)	60 (0.8)	277 (3.7)		
2002–03	2 609	213 (8.2)	17 (0.6)	139 (5.3)	19 (0.7)	28 (1.1)	21 (0.8)	49 (1.9)	141 (5.4)		
2003–04	2 034	335 (16.5)	32 (1.6)	270 (13.3)	20 (1)	28 (1.4)	37 (1.8)	182 (8.9)	291 (14.3)		
2004–05	1 507	74 (4.9)	5 (0.3)	126 (8.4)	5 (0.3)	23 (1.5)	13 (0.9)	74 (4.9)	116 (7.7)		
2005–06	2 242	102 (4.5)	26 (1.2)	141 (6.3)	17 (0.8)	50 (2.2)	18 (0.8)	70 (3.1)	144 (6.4)		
2006–07	1 375	71 (5.2)	12 (0.9)	38 (2.8)	11 (0.8)	7 (0.5)	11 (0.8)	42 (3)	62 (4.5)		
2007–08	1 297	23 (1.8)	8 (0.6)	43 (3.3)	6 (0.5)	28 (2.2)	5 (0.4)	36 (2.8)	32 (2.5)		
2008–09	61	31 (50.8)	2 (3.3)	4 (6.6)	- (-)	4 (6.6)	- (-)	1 (1.6)	10 (16.4)		
2009–10	3 888	67 (1.7)	14 (0.4)	132 (3.4)	9 (0.2)	73 (1.9)	6 (0.2)	41 (1.1)	61 (1.6)		
2010–11	2 961	194 (6.5)	18 (0.6)	154 (5.2)	21 (0.7)	49 (1.6)	6 (0.2)	75 (2.5)	126 (4.3)		
2011–12	5 284	169 (3.2)	21 (0.4)	217 (4.1)	16 (0.3)	136 (2.6)	14 (0.3)	61 (1.1)	84 (1.6)		
2012–13	6 874	865 (12.6)	98 (1.4)	449 (6.5)	82 (1.2)	158 (2.3)	43 (0.6)	102 (1.5)	365 (5.3)		
2013–14	4 996	554 (11.1)	67 (1.3)	278 (5.6)	50 (1.0)	55 (1.1)	34 (0.7)	96 (1.9)	323 (6.5)		
2014–15	4 761	389 (8.2)	72 (1.5)	281 (5.9)	65 (1.4)	48 (1)	25 (0.5)	58 (1.2)	283 (5.9)		
2015–16	6 751	184 (2.7)	58 (0.9)	266 (3.9)	64 (1)	56 (0.8)	19 (0.3)	198 (2.9)	262 (3.9)		
2016–17	8 340	760 (9.1)	51 (0.6)	376 (4.5)	85 (1)	80 (1)	28 (0.3)	60 (0.7)	423 (5.1)		

(b) WCSI (midwater trawls)

Year	Catch in t (% of hoki catch)									
	HOK	BAR	FRO	HAK	JMA	LIN	SPD	SWA	Other	
1990–91	27 606	36 (0.1)	285 (1)	1 548 (5.6)	197 (0.7)	187 (0.7)	35 (0.1)	397 (1.4)	397 (0.6)	
1991–92	18 157	57 (0.3)	174 (1)	145 (0.8)	83 (0.5)	97 (0.5)	94 (0.5)	147 (0.8)	147 (0.8)	
1992–93	15 720	67 (0.4)	82 (0.5)	289 (1.8)	16 (0.1)	104 (0.7)	27 (0.2)	61 (0.4)	61 (0.4)	
1993–94	31 065	29 (0.1)	253 (0.8)	166 (0.5)	128 (0.4)	111 (0.4)	187 (0.6)	591 (1.9)	591 (0.8)	
1994–95	25 541	30 (0.1)	188 (0.7)	817 (3.2)	261 (1)	191 (0.8)	186 (0.7)	152 (0.6)	152 (0.7)	
1995–96	17 346	85 (0.5)	111 (0.6)	1 361 (7.8)	157 (0.9)	247 (1.4)	272 (1.6)	446 (2.6)	446 (1.8)	
1996–97	14 270	10 (0.1)	192 (1.4)	647 (4.5)	89 (0.6)	131 (0.9)	59 (0.4)	422 (3)	422 (0.6)	
1997–98	17 981	15 (0.1)	84 (0.5)	1 008 (5.6)	20 (0.1)	281 (1.6)	230 (1.3)	427 (2.4)	427 (1.4)	
1998–99	14 768	12 (0.1)	203 (1.4)	781 (5.3)	21 (0.1)	130 (0.9)	151 (1)	136 (0.9)	136 (0.9)	
1999–00	15 729	2 (0)	155 (1)	643 (4.1)	6 (0)	169 (1.1)	76 (0.5)	299 (1.9)	299 (1)	
2000–01	14 971	90 (0.6)	270 (1.8)	460 (3.1)	3 (0)	196 (1.3)	69 (0.5)	238 (1.6)	238 (1.1)	
2001–02	9 175	38 (0.4)	215 (2.3)	868 (9.5)	1 (0)	206 (2.2)	39 (0.4)	65 (0.7)	65 (2.8)	
2002–03	7 582	73 (1)	166 (2.2)	315 (4.2)	2 (0)	52 (0.7)	13 (0.2)	47 (0.6)	47 (1.1)	
2003–04	6 396	63 (1)	213 (3.3)	482 (7.5)	63 (1)	237 (3.7)	22 (0.3)	87 (1.4)	87 (2.9)	
2004–05	5 671	221 (3.9)	262 (4.6)	271 (4.8)	8 (0.1)	155 (2.7)	15 (0.3)	25 (0.4)	25 (3.2)	
2005–06	7 283	35 (0.5)	152 (2.1)	302 (4.2)	3 (0)	91 (1.2)	12 (0.2)	26 (0.4)	26 (0.9)	
2006–07	8 410	26 (0.3)	175 (2.1)	41 (0.5)	1 (0)	41 (0.5)	23 (0.3)	38 (0.4)	38 (0.8)	
2007–08	6 478	6 (0.1)	158 (2.4)	24 (0.4)	1 (0)	29 (0.4)	20 (0.3)	17 (0.3)	17 (1.2)	
2008–09	8 733	3 (0)	106 (1.2)	37 (0.4)	24 (0.3)	64 (0.7)	21 (0.2)	58 (0.7)	58 (1.8)	
2009–10	7 731	- (-)	17 (0.2)	18 (0.2)	- (-)	30 (0.4)	6 (0.1)	24 (0.3)	24 (0.6)	
2010–11	6 595	25 (0.4)	15 (0.2)	37 (0.6)	- (-)	35 (0.5)	13 (0.2)	23 (0.4)	23 (0.7)	
2011–12	13 150	2 (0)	43 (0.3)	132 (1.0)	1 (0)	117 (0.9)	108 (0.8)	29 (0.2)	29 (0.6)	
2012–13	24 970	3 (0)	162 (0.6)	647 (2.6)	18 (0.1)	372 (1.5)	91 (0.4)	44 (0.2)	44 (0.9)	
2013–14	26 989	7 (0)	295 (1.1)	476 (1.8)	1 (-)	331 (1.2)	89 (0.3)	50 (0.2)	50 (1)	
2014–15	33 042	164 (0.5)	312 (0.9)	435 (1.3)	62 (0.2)	388 (1.2)	98 (0.3)	75 (0.2)	75 (0.9)	
2015–16	21 974	10 (0)	292 (1.3)	486 (2.2)	20 (0.1)	435 (2)	58 (0.3)	51 (0.2)	51 (1.1)	
2016–17	13 230	95 (0.7)	94 (0.7)	224 (1.7)	4 (0)	211 (1.6)	51 (0.4)	15 (0.1)	15 (1.2)	

Table 6: continued.

(c) Cook Strait (midwater trawls)

Year	Catch in t (% of hoki catch)									
	HOK	CSQ	LIN	RAT	RCO	SPD	SPO	SWA	Other	
1992-93	107	- (-)	- (-)	- (-)	- (-)	1 (0.9)	- (-)	- (-)	- (-)	- (-)
1993-94	495	- (-)	6 (1.2)	- (-)	- (-)	1 (0.2)	- (-)	- (-)	- (-)	- (0.2)
1995-96	734	- (-)	2 (0.3)	- (-)	- (-)	13 (1.8)	- (-)	- (-)	- (-)	- (-)
1997-98	3 435	- (-)	7 (0.2)	- (-)	- (-)	55 (1.6)	7 (0.2)	- (-)	- (-)	- (0.2)
1998-99	3 513	- (-)	16 (0.5)	- (-)	- (-)	76 (2.2)	- (-)	- (-)	- (-)	- (0.2)
1999-00	3 017	- (-)	9 (0.3)	- (-)	- (-)	103 (3.4)	- (-)	- (-)	- (-)	- (0.1)
2000-01	4 089	- (-)	15 (0.4)	- (-)	- (-)	84 (2)	- (-)	1 (0)	1 (0.2)	1 (0.2)
2001-02	1 991	- (-)	6 (0.3)	- (-)	- (-)	44 (2.2)	- (-)	- (-)	- (-)	- (0.1)
2002-03	2 416	- (-)	5 (0.2)	- (-)	- (-)	104 (4.3)	- (-)	- (-)	- (-)	- (0.1)
2003-04	2 482	- (-)	4 (0.2)	- (-)	- (-)	39 (1.6)	- (-)	- (-)	- (-)	- (0.2)
2004-05	2 176	- (-)	4 (0.2)	- (-)	- (-)	38 (1.8)	- (-)	2 (0.1)	2 (0.4)	2 (0.4)
2005-06	1 080	- (-)	2 (0.2)	- (-)	- (-)	15 (1.4)	- (-)	- (-)	- (-)	- (0.2)
2006-07	2 102	- (-)	10 (0.5)	- (-)	2 (0.1)	84 (4.0)	- (-)	2 (0.1)	2 (0.2)	2 (0.2)
2007-08	3 437	3 (0.1)	8 (0.2)	2 (0.1)	1 (0)	63 (1.8)	- (-)	1 (0)	1 (0.1)	1 (0.1)
2008-09	2 290	- (-)	3 (0.1)	1 (0)	- (-)	27 (1.2)	- (-)	- (-)	- (-)	- (0.1)
2009-10	3 353	- (-)	4 (0.1)	3 (0.1)	- (-)	27 (0.8)	- (-)	- (-)	- (-)	- (0.2)
2010-11	1 590	1 (0.1)	- (-)	- (-)	- (-)	13 (0.8)	- (-)	2 (0.1)	2 (0.1)	2 (0.1)
2011-12	1 551	1 (0.1)	4 (0.3)	3 (0.2)	1 (0.1)	27 (1.7)	- (-)	7 (0.4)	7 (0.4)	7 (0.4)
2012-13	956	- (-)	3 (0.3)	- (-)	- (-)	6 (0.6)	- (-)	- (-)	- (-)	- (0.2)
2013-14	2 537	6 (0.2)	7 (0.3)	3 (0.1)	1 (0)	24 (1)	- (-)	6 (0.2)	6 (0.6)	6 (0.6)
2014-15	320	- (-)	1 (0.3)	- (-)	- (-)	2 (0.6)	- (-)	- (-)	- (-)	- (-)
2015-16	2 139	- (-)	9 (0.4)	1 (0)	- (-)	9 (0.4)	- (-)	- (-)	- (-)	- (0.1)
2016-17	2 054	- (-)	3 (0.2)	- (-)	- (-)	9 (0.4)	- (-)	- (-)	- (-)	- (0)

(d) Puysegur (bottom and midwater trawls)

Year	Catch in t (% of hoki catch)									
	HOK	CSQ	HAK	LIN	RCO	SND	SPD	SWA	Other	
1990-91	986	- (-)	3 (0.3)	25 (2.5)	2 (0.2)	2 (0.2)	1 (0.1)	1 (0.1)	1 (1.4)	1 (1.4)
1991-92	1 028	1 (0.1)	27 (2.6)	431 (41.9)	16 (1.6)	4 (0.4)	4 (0.4)	2 (0.2)	2 (5.3)	2 (5.3)
1992-93	530	3 (0.6)	3 (0.6)	80 (15.1)	2 (0.4)	1 (0.2)	- (-)	1 (0.2)	1 (3)	1 (3)
1993-94	959	- (-)	- (-)	8 (0.8)	5 (0.5)	- (-)	6 (0.6)	7 (0.7)	7 (1)	7 (1)
1994-95	226	- (-)	- (-)	8 (3.5)	- (-)	- (-)	- (-)	- (-)	- (0.4)	- (0.4)
1995-96	719	- (-)	2 (0.3)	33 (4.6)	3 (0.4)	- (-)	2 (0.3)	3 (0.4)	3 (0.7)	3 (0.7)
1996-97	455	1 (0.2)	- (-)	6 (1.3)	- (-)	- (-)	3 (0.7)	3 (0.7)	3 (2)	3 (2)
1998-99	226	- (-)	4 (1.8)	25 (11.1)	6 (2.6)	1 (0.4)	9 (4)	6 (2.6)	6 (6.2)	6 (6.2)
1999-00	370	- (-)	- (-)	25 (6.8)	- (-)	2 (0.5)	7 (1.9)	17 (4.6)	17 (4)	17 (4)
2000-01	823	- (-)	6 (0.7)	30 (3.6)	4 (0.5)	5 (0.6)	16 (1.9)	221 (26.9)	221 (6.3)	221 (6.3)
2001-02	561	- (-)	- (-)	20 (3.6)	1 (0.2)	- (-)	1 (0.2)	34 (6.1)	34 (1.2)	34 (1.2)
2002-03	678	2 (0.3)	2 (0.3)	52 (7.7)	- (-)	1 (0.2)	2 (0.3)	25 (3.7)	25 (3.8)	25 (3.8)
2003-04	549	- (-)	- (-)	32 (5.8)	1 (0.2)	2 (0.4)	2 (0.4)	14 (2.5)	14 (3.1)	14 (3.1)
2004-05	1 237	- (-)	1 (0.1)	20 (1.6)	1 (0.1)	- (-)	11 (0.9)	1 (0.1)	1 (1.4)	1 (1.4)
2005-06	478	5 (1.1)	3 (0.6)	105 (22)	1 (0.2)	10 (2.1)	1 (0.2)	26 (5.4)	26 (7.7)	26 (7.7)
2006-07	10	- (-)	- (-)	4 (40.0)	- (-)	- (-)	- (-)	- (-)	- (20.0)	- (20.0)
2009-10	31	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	1 (3.2)	1 (-)	1 (-)
2010-11	1	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
2011-12	381	6 (1.6)	6 (1.6)	19 (5)	- (-)	2 (0.5)	- (-)	5 (1.3)	5 (2.6)	5 (2.6)
2012-13	444	13 (2.9)	12 (2.7)	22 (5)	- (-)	12 (2.7)	1 (0.2)	30 (6.8)	30 (7.7)	30 (7.7)
2013-14	69	3 (4.3)	1 (1.4)	6 (8.7)	- (-)	1 (1.4)	- (-)	- (-)	- (5.8)	- (5.8)
2014-15	8	- (-)	- (-)	5 (62.5)	- (-)	- (-)	- (-)	1 (12.5)	1 (-)	1 (-)
2015-16	163	7 (4.3)	1 (0.6)	7 (4.3)	- (-)	15 (9.2)	- (-)	1 (0.6)	1 (4.9)	1 (4.9)
2016-17	5	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)

Table 6: continued.

(e) Sub-Antarctic (bottom trawls)

Year	Catch in t (% of hoki catch)									
	HOK	HAK	JAV	LIN	RAT	SPD	SWA	WWA	Other	
1990-91	1 974	204 (10.3)	17 (0.9)	91 (4.6)	14 (0.7)	3 (0.2)	- (-)	3 (0.2)	3 (10.9)	3 (10.9)
1991-92	3 452	332 (9.6)	47 (1.4)	248 (7.2)	39 (1.1)	15 (0.4)	9 (0.3)	35 (1)	35 (5.9)	35 (5.9)
1992-93	2 566	509 (19.8)	30 (1.2)	224 (8.7)	21 (0.8)	8 (0.3)	5 (0.2)	22 (0.9)	22 (4.4)	22 (4.4)
1993-94	1 118	31 (2.8)	11 (1)	98 (8.8)	10 (0.9)	12 (1.1)	11 (1)	5 (0.4)	5 (5.5)	5 (5.5)
1994-95	877	22 (2.5)	14 (1.6)	57 (6.5)	12 (1.4)	15 (1.7)	- (-)	8 (0.9)	8 (6.2)	8 (6.2)
1995-96	742	27 (3.6)	9 (1.2)	95 (12.8)	15 (2)	5 (0.7)	8 (1.1)	22 (3)	22 (6.7)	22 (6.7)
1996-97	66	8 (12.1)	4 (6.1)	3 (4.5)	3 (4.5)	- (-)	- (-)	- (-)	- (30.3)	- (30.3)
1997-98	1 893	127 (6.7)	66 (3.5)	190 (10)	59 (3.1)	20 (1.1)	3 (0.2)	28 (1.5)	28 (6)	28 (6)
1998-99	4 727	133 (2.8)	74 (1.6)	256 (5.4)	77 (1.6)	20 (0.4)	26 (0.6)	18 (0.4)	18 (4.8)	18 (4.8)
1999-00	5 020	212 (4.2)	186 (3.7)	336 (6.7)	65 (1.3)	47 (0.9)	158 (3.1)	25 (0.5)	25 (6.7)	25 (6.7)
2000-01	2 739	87 (3.2)	76 (2.8)	369 (13.5)	50 (1.8)	58 (2.1)	159 (5.8)	26 (1)	26 (7.7)	26 (7.7)
2001-02	3 889	154 (4)	308 (7.9)	193 (5)	94 (2.4)	97 (2.5)	35 (0.9)	27 (0.7)	27 (7.7)	27 (7.7)
2002-03	2 003	81 (4)	99 (4.9)	363 (18.1)	47 (2.4)	80 (4)	21 (1.1)	20 (1.0)	20 (10.3)	20 (10.3)
2003-04	548	37 (6.8)	36 (6.6)	309 (56.4)	16 (2.9)	171 (31.2)	54 (9.8)	13 (2.4)	13 (15.7)	13 (15.7)
2004-05	391	24 (6.1)	71 (18.2)	189 (48.3)	15 (3.8)	6 (1.5)	5 (1.3)	10 (2.6)	10 (11.5)	10 (11.5)
2005-06	1 170	14 (1.2)	29 (2.5)	118 (10.1)	14 (1.2)	63 (5.4)	68 (5.8)	70 (6)	70 (4)	70 (4)
2006-07	1 225	16 (1.3)	50 (4.1)	225 (18.4)	18 (1.5)	85 (6.9)	82 (6.7)	85 (6.9)	85 (7.3)	85 (7.3)
2007-08	2 670	100 (3.8)	176 (6.6)	1 002 (37.5)	28 (1.1)	30 (1.1)	9 (0.3)	76 (2.8)	76 (10.8)	76 (10.8)
2008-09	2 890	93 (3.2)	127 (4.4)	359 (12.4)	40 (1.4)	83 (2.9)	52 (1.8)	39 (1.4)	39 (6.6)	39 (6.6)
2009-10	2 905	64 (2.2)	147 (5.1)	232 (8)	85 (2.9)	68 (2.3)	26 (0.9)	30 (1)	30 (7.2)	30 (7.2)
2010-11	2 014	34 (1.7)	61 (3)	208 (10.3)	58 (2.9)	105 (5.2)	58 (2.9)	56 (2.8)	56 (8.3)	56 (8.3)
2011-12	2 141	46 (2.1)	64 (3)	404 (18.9)	48 (2.2)	46 (2.1)	1 (0)	30 (1.4)	30 (5.4)	30 (5.4)
2012-13	6 059	58 (1)	197 (3.2)	647 (10.7)	129 (2.1)	132 (2.2)	226 (3.7)	39 (0.6)	39 (4.7)	39 (4.7)
2013-14	5 327	81 (1.5)	225 (4.2)	593 (11.1)	149 (2.8)	240 (4.5)	58 (1.1)	74 (1.4)	74 (7.3)	74 (7.3)
2014-15	2 463	27 (1.1)	131 (5.3)	299 (12.1)	120 (4.9)	185 (7.5)	115 (4.7)	6 (0.2)	6 (9.5)	6 (9.5)
2015-16	1 739	87 (5.0)	105 (6)	470 (27)	41 (2.4)	53 (3)	16 (0.9)	16 (0.9)	16 (13.3)	16 (13.3)
2016-17	1 236	26 (2.1)	52 (4.2)	211 (17.1)	38 (3.1)	130 (10.5)	49 (4)	84 (6.8)	84 (13.4)	84 (13.4)

(f) Chatham Rise and ECSI (excluded ECSI from June-September) (bottom trawl).

Year	Catch in t (% of hoki catch)									
	HOK	GSP	HAK	JAV	LIN	RAT	SPD	SWA	Other	
1990-91	3 323	33 (1)	132 (4)	142 (4.3)	157 (4.7)	100 (3)	24 (0.7)	210 (6.3)	210 (15.9)	210 (15.9)
1991-92	4 853	24 (0.5)	59 (1.2)	70 (1.4)	144 (3)	129 (2.7)	5 (0.1)	28 (0.6)	28 (7.1)	28 (7.1)
1992-93	455	- (-)	46 (10.1)	13 (2.9)	8 (1.8)	7 (1.5)	- (-)	9 (2)	9 (11)	9 (11)
1993-94	3 526	6 (0.2)	50 (1.4)	76 (2.2)	112 (3.2)	108 (3.1)	16 (0.4)	15 (0.4)	15 (7.5)	15 (7.5)
1994-95	1 463	- (-)	23 (1.6)	58 (4)	51 (3.5)	38 (2.6)	7 (0.5)	6 (0.4)	6 (6)	6 (6)
1995-96	3 477	- (-)	112 (3.2)	103 (3)	131 (3.8)	190 (5.5)	47 (1.4)	128 (3.7)	128 (5.6)	128 (5.6)
1996-97	1 027	- (-)	86 (8.4)	38 (3.7)	49 (4.8)	90 (8.8)	6 (0.6)	116 (11.3)	116 (10.4)	116 (10.4)
1997-98	5 388	- (-)	107 (2)	291 (5.4)	184 (3.4)	297 (5.5)	67 (1.2)	90 (1.7)	90 (10.5)	90 (10.5)
1998-99	7 745	61 (0.8)	90 (1.2)	339 (4.4)	267 (3.5)	313 (4)	131 (1.7)	84 (1.1)	84 (7)	84 (7)
1999-00	3 457	68 (2)	62 (1.8)	217 (6.3)	103 (3)	156 (4.5)	135 (3.9)	126 (3.6)	126 (11.7)	126 (11.7)
2000-01	4 262	117 (2.8)	125 (2.9)	344 (8.1)	214 (5)	291 (6.8)	91 (2.1)	214 (5)	214 (14.2)	214 (14.2)
2001-02	4 643	117 (2.5)	95 (2)	385 (8.3)	223 (4.8)	385 (8.3)	121 (2.6)	50 (1.1)	50 (13.1)	50 (13.1)
2002-03	2 260	104 (4.6)	67 (3)	429 (19)	199 (8.8)	330 (14.6)	48 (2.1)	139 (6.2)	139 (21.1)	139 (21.1)
2003-04	2 384	69 (2.9)	52 (2.2)	250 (10.5)	157 (6.6)	265 (11.1)	58 (2.4)	245 (10.3)	245 (16.4)	245 (16.4)
2004-05	4 768	104 (2.2)	52 (1.1)	528 (11.1)	177 (3.7)	338 (7.1)	106 (2.2)	134 (2.8)	134 (11.6)	134 (11.6)
2005-06	5 182	99 (1.9)	49 (1)	396 (7.6)	132 (2.5)	316 (6.1)	93 (1.8)	260 (5)	260 (9.3)	260 (9.3)
2006-07	5 533	69 (1.2)	80 (1.4)	500 (9)	155 (2.8)	165 (3)	39 (0.7)	195 (3.5)	195 (7)	195 (7)
2007-08	5 695	62 (1.1)	77 (1.4)	408 (7.2)	121 (2.1)	323 (5.7)	73 (1.3)	153 (2.7)	153 (9.1)	153 (9.1)
2008-09	4 427	28 (0.6)	50 (1.1)	355 (8)	96 (2.2)	289 (6.5)	45 (1)	71 (1.6)	71 (4.9)	71 (4.9)
2009-10	5 743	39 (0.7)	73 (1.3)	546 (9.5)	136 (2.4)	437 (7.6)	48 (0.8)	244 (4.2)	244 (6.3)	244 (6.3)
2010-11	6 012	51 (0.8)	52 (0.9)	385 (6.4)	143 (2.4)	317 (5.3)	46 (0.8)	222 (3.7)	222 (6)	222 (6)
2011-12	7 868	69 (0.9)	42 (0.5)	329 (4.2)	185 (2.4)	350 (4.5)	107 (1.4)	237 (3)	237 (5.8)	237 (5.8)
2012-13	10 254	116 (1.1)	106 (1)	754 (7.3)	390 (3.8)	822 (8)	96 (0.9)	321 (3.1)	321 (9.8)	321 (9.8)
2013-14	8 808	83 (0.9)	88 (1.0)	444 (5)	350 (4)	462 (5.2)	229 (2.6)	389 (4.4)	389 (9.8)	389 (9.8)
2014-15	5 025	75 (1.5)	116 (2.3)	581 (11.6)	262 (5.2)	415 (8.3)	94 (1.9)	242 (4.8)	242 (11.2)	242 (11.2)
2015-16	7 303	74 (1)	85 (1.2)	650 (8.9)	290 (4)	550 (7.5)	129 (1.8)	217 (3)	217 (8.1)	217 (8.1)
2016-17	8 100	81 (1.0)	82 (1)	787 (9.7)	295 (3.6)	679 (8.4)	198 (2.4)	50 (0.6)	50 (8.8)	50 (8.8)

Table 6: continued.

(g) ECSI, June–September (bottom and midwater trawls).

Year	Catch in t (% of hoki catch)									
	HOK	HAK	JAV	LIN	RAT	SPD	SWA	WWA	Other	
2000–01	5	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
2001–02	97	- (-)	- (-)	1 (1)	1 (1)	- (-)	- (-)	- (-)	- (-)	- (1)
2002–03	914	22 (2.4)	6 (0.7)	8 (0.9)	18 (2)	5 (0.6)	20 (2.2)	2 (0.2)	2 (2.7)	2 (2.7)
2003–04	939	2 (0.2)	4 (0.4)	4 (0.4)	6 (0.6)	1 (0.1)	1 (0.1)	2 (0.2)	2 (0.8)	2 (0.8)
2004–05	280	- (-)	1 (0.4)	1 (0.4)	2 (0.7)	- (-)	- (-)	- (-)	- (0.4)	- (0.4)
2005–06	505	5 (1)	1 (0.2)	- (-)	3 (0.6)	1 (0.2)	35 (6.9)	- (-)	- (0.6)	- (0.6)
2007–08	72	2 (2.8)	2 (2.8)	1 (1.4)	9 (12.5)	- (-)	2 (2.8)	2 (2.8)	2 (4.2)	2 (4.2)
2008–09	311	- (-)	- (-)	- (-)	1 (0.3)	- (-)	- (-)	- (-)	- (-)	- (-)
2009–10	41	- (-)	1 (2.4)	1 (2.4)	18 (43.9)	- (-)	- (-)	2 (4.9)	2 (4.9)	2 (4.9)
2010–11	413	2 (0.5)	- (-)	1 (0.2)	4 (1)	- (-)	- (-)	2 (0.5)	2 (0.2)	2 (0.2)
2011–12	355	1 (0.3)	2 (0.6)	1 (0.3)	15 (4.2)	- (-)	10 (2.8)	3 (0.8)	3 (0.6)	3 (0.6)
2012–13	1 451	7 (0.5)	3 (0.2)	4 (0.3)	17 (1.2)	4 (0.3)	99 (6.8)	- (-)	- (0.2)	- (0.2)
2013–14	43	3 (7)	1 (2.3)	1 (2.3)	2 (4.7)	- (-)	- (-)	- (-)	- (4.7)	- (4.7)
2014–15	627	7 (1.1)	1 (0.2)	2 (0.3)	- (-)	2 (0.3)	5 (0.8)	- (-)	- (0.5)	- (0.5)
2015–16	249	2 (0.8)	8 (3.2)	5 (2)	17 (6.8)	7 (2.8)	6 (2.4)	5 (2)	5 (6.8)	5 (6.8)
2016–17	582	3 (0.5)	1 (0.2)	3 (0.5)	4 (0.7)	1 (0.2)	30 (5.2)	1 (0.2)	1 (0.9)	1 (0.9)

Table 7: Number of 2016–17 hoki length frequency samples and otoliths by observer trips and land-based sampling programme, target species, and monthly timing. Length frequency samples with errors, missing data or outside the sample period (e.g. non-spawning season in a spawning area) were removed. Four observer programme length frequency samples were excluded as these were from large vessels inside the 25 n. mile line, which may have position errors. – no data.

(a) WCSI observer samples

Trip	Month	Target species	Number of	
			Length frequencies	Otoliths
1	May/Jun	HOK	26	49
2	Jul/Aug	HOK	30	31
3	Jun	HAK/HOK	17	12
4	Jul	HOK	15	21
5	Jul	HAK/HOK	19	17
6	Jul	HOK	13	16
7	Jun/Jul	HAK/HOK	17	14
8	Jun/Jul/Aug	HOK	31	27
9	Jun/Jul	HOK	21	22
10	Jun/Jul/Aug	HAK/HOK	58	49
11	Jun/Jul/Aug	HAK/HOK	79	38
12	Jun	HOK	2	4
13	Jun/Jul	HOK	15	15
14	Jun/Jul	HOK	29	36
15	Jul/Aug	HAK/HOK	40	23
16	Jul/Aug	HOK	33	40
17	Jul/Aug/Sep	HAK/HOK	49	38
18	Jul/Aug	HOK	19	16
19	Jul/Aug	HOK	18	21
20	Jul/Aug	HOK	33	40
21	Jul/Aug	HOK	16	15
22	Jul/Aug	HOK	17	14
23	Aug	HOK	8	4
24	Aug	HOK	14	18
25	Aug	HOK	20	19
26	Aug/Sep	HAK/HOK	15	11
27	Aug/Sep	HAK/HOK	7	-
28	Aug	HOK	5	7
29	Aug/Sep	HOK	8	-
30	Sep	HAK/HOK	8	-
31	Sep	BAR/HAK/HOK	7	-
Total	-	-	689	617
		BAR (1), HAK (134), HOK (554)	(595 outside, 94 inside)	
Land based Jun	Jun	HOK	4	49
Land based Jul	Jul	HOK	4	31
Land based Aug	Aug	HOK	4	56
Land based Sep			0	0
Total land based	-	-	12	136
Total	-	-	701	753

Table 7: continued.

(b) Cook Strait observer and land-based samples.

Trip	Month	Target species	Number of	
			Length frequencies	Otoliths
1	Jul	HOK	1	4
2	Jul/Aug	HOK	15	39
3	Jul	HOK	4	8
4	Jul/Aug	HOK	35	51
5	Aug	HOK	17	32
6	Aug	BYX	1	-
Observer total	-	-	73	134
Land-based	Jun	HOK	2	32
Land-based	Jul	HOK	11	221
Land-based	Aug	HOK	11	217
Land-based	Sep	HOK	8	147
Land-based total	-	-	32	617
Total	-	-	105	751

(c) Chatham Rise and ECSI observer data; Chatham Rise includes ECSI non-spawning data. – no data.

Trip	Month	Target species	Number of samples		Number of otoliths
			Chatham Rise	ECSI spawning	
1	Oct	RBT	1	-	-
2	Nov	BAR/HOK/SWA	8	-	8
3	Nov	SWA	11	-	53
4	Nov/Dec	HOK	23	-	91
5	Nov/Dec	ORH	2	-	-
6	Dec	BAR	2	-	-
7	Dec	HOK/SWA	9	-	38
8	Dec/Jan	HOK/SWA	13	-	61
9	Dec	HOK/SWA	16	-	82
10	Jan	BYS	1	-	-
11	Dec/Jan	ORH	4	-	-
12	Dec/Jan/Feb	HOK/SWA	40	-	205
13	Dec/Jan	SWA	3	-	1
14	Jan	BAR	1	-	1
15	Feb	HOK/SWA	19	-	68
16	Feb	BAR	1	-	-
17	Feb/Mar	HOK/SWA	50	-	191
18	Feb/Mar	BAR/JMA	4	-	-
19	Feb	BAR	2	-	-
20	Mar	SCI	2	-	-
21	Mar/Apr	HOK/SWA	21	-	115
22	Apr/May	BAR/HOK	37	-	150
23	Mar	ORH	1	-	-
24	Apr	HOK	1	-	-
25	Apr	BAR	1	-	-
26	Apr	SQU	1	-	-
27	Apr/May	HOK	23	-	123
28	Sep	HOK	-	16	-
29	Sep	HOK	1	-	5
30	Sep	LIN	6	-	9
31	Sep	HOK	9	-	30
Total	-	-	313	16	1231

Table 7: continued.

(d) Sub-Antarctic observer data

Trip	Month	Target species	Number of	
			samples	Otoliths
1	Oct	SBW	1	5
2	Oct	HOK	2	20
3	Oct	HOK	1	10
4	Oct	BAR	1	-
5	Oct	HOK/SWA	2	20
6	Oct/Nov	SCI	2	10
7	Oct	WWA	1	5
8	Oct	HOK/LIN	2	19
9	Nov/Dec	HOK/SWA	11	101
10	Nov/Dec	HAK/LIN/WWA	16	77
11	Dec/Jan	HOK/SQU	2	20
12	Dec/Jan/Feb	HAK/SQU/SWA/WWA	17	60
13	Dec/Jan	SWA	3	30
14	Dec	SWA	1	10
15	Jan	SWA	3	31
16	Jan/Feb	SQU/SWA	5	25
17	Jan	HOK/SWA	5	30
18	Jan/Feb	SQU/SWA	2	21
19	Jan/Feb	SQU/SWA	6	35
20	Mar	HOK/SQU	2	15
21	Feb	SQU	2	15
22	Feb/Mar	HOK	38	36
23	Feb/Mar	SQU	5	15
24	Mar	HOK/SQU	3	14
25	Mar	SQU	4	20
26	Mar	SQU	1	5
27	Mar	SQU	2	12
28	Apr	HOK	1	3
29	Mar	SQU	3	14
30	Apr	SQU	3	15
31	Apr	SQU	1	-
32	Apr	HOK	1	9
33	Apr	SQU	2	9
34	Mar/Apr	LIN	4	-
35	Apr	SQU	2	11
36	Apr	SWA	6	29
37	Apr/May/Jun	HOK/SQU	10	60
38	May	SQU/SWA	2	10
39	Jun	HOK	1	10
40	May/Jun	SCI	6	20
41	Jun	SQU	1	10
42	Jun	SCI	1	12
43	Jul	SSO	1	5
44	Jul	LIN	2	10
45	Sep	HOK	5	46
46	Sep	LIN	1	5
47	Sep	HOK	9	85
48	Sep	LIN	5	51
49	Sep	HOK	1	10
Total	-	-	208	1085

Table 8: Stratification for the 2017 WCSI and Cook Strait length samples.

(a) WCSI.

Stratum	25 n. mile line	Number of length samples			Date	Catch Tonnes
		Date	Observer	Land-based		
1	Inside	22 May–1 Jun	9	-	1 May–4 Jun	429.8
2	Inside	5–17 Jun	10	-	5–17 Jun	884.3
3	Inside	18–24 Jun	9	2	18–24 Jun	869.5
4	Inside	25 Jun–1 Jul	11	2	25 Jun–1 Jul	1 305.0
5	Inside	2–8 Jul	13	-	2–8 Jul	1 522.7
6	Inside	9–22 Jul	13	2	9–22 Jul	3 006.7
7	Inside	23–29 Jul	11	1	23–29 Jul	1 461.5
8	Inside	30 Jul–5 Aug	10	1	30 Jul–5 Aug	1 547.3
9	Inside	6 Aug–20 Sep	8	4	6-Aug–30 Sep	5 703.8
10	Outside	22 May–17 Jun	12	-	1 May–17 Jun	2 523.7
11	Outside	18–24 Jun	23	-	18–24 Jun	1 968.8
12	Outside	25 Jun–1 Jul	33	-	25 Jun–1 Jul	1 978.9
13	Outside	2–8 Jul	68	-	2–8 Jul	4 072.8
14	Outside	9–15 Jul	51	-	9–15 Jul	5 390.7
15	Outside	16–22 Jul	49	-	16–22 Jul	7 308.4
16	Outside	23–29 Jul	64	-	23–29 Jul	5 889.0
17	Outside	30 Jul–5 Aug	65	-	30 Jul–5 Aug	7 319.2
18	Outside	6–12 Aug	75	-	6–12 Aug	5 444.1
19	Outside	13–19 Aug	53	-	13–19 Aug	2 566.9
20	Outside	20–26 Aug	55	-	20–26 Aug	3 591.8
21	Outside	27 Aug –2 Sep	28	-	27 Aug–2 Sep	897.4
22	Outside	3–20 Sep	19	-	3–30 Sep	263.6

(b) Cook Strait

Stratum	Vessel size	Date range	Stratum	Number of samples	
			Catch (t)	Land-based	Observer
1	< 40 m	Jun–Jul	2603.0	9	8
2	< 40 m	Aug	2512.7	7	30
3	< 40 m	Sep	763.1	4	-
4	≥ 40m	Jun–Jul	2201.1	4	2
5	≥ 40m	Aug	2014.7	4	33
6	≥ 40m	Sep	2623.2	4	-

Table 9: Percentage of female hoki by observer gonad stages on the WCSI for female fish less than or equal to 55 cm (n = 1097) and female fish greater than 55 cm (n = 31 297) for the 2017 spawning season.

Stage		Females \leq 55 cm		Females $>$ 55 cm	
		Number	Percent	Number	Percent
1	Immature and resting	508	46	1 384	4
2	Maturing	347	32	13 646	44
3	Mature/Ripe	163	15	9 895	32
4	Running ripe	52	5	3 896	12
5	Spent	27	3	2 476	8

Table 10: Strata for the 2016–17 non spawning fisheries based on the tree regression of all data (Observer Programme only), with comparison of the TCEPR, Observer Programme (OP), tows and otolith data sampled by stratum. The catch for OP is the total catch for the observed tows.

(a) Chatham Rise all target species

Stratum	Splitting variables		Mean length (cm)	Hoki catch (t)		No. of tows		No. of otoliths	No. of fish measured
	Depth of net (m)	Longitude		TCEPR	OP	TCEPR	OP		
1	< 479.25	-	57.7	5931.8	527.4	1258	69	116	5475
2	479.25-607.75	< 179.1592	64.3	27274.8	1691.8	2975	180	607	18798
3	479.25-607.75	\geq 179.1592	73.7	2601.8	213.3	322	30	119	3115
4	\geq 607.75	-	77.1	4100.7	267.1	1110	34	102	3022

(b) Sub-Antarctic all target species

Stratum	Splitting variables		Mean length (cm)	Hoki catch (t)		No. of tows		No. of otoliths	No. of fish measured	
	Latitude	Date		Depth of net (m)	TCEPR	OP	TCEPR			OP
1	\leq 48.9° S	-	< 422.3 m	58.0	1010.2	410.0	348	68	250	3395
2	\leq 48.9° S	-	\geq 422.3 m	68.8	3912.8	240.4	653	44	209	2801
3	$>$ 48.9° S	Oct 2016 – Jan 2017	-	67.2	891.5	26.9	417	18	62	332
4	$>$ 48.9° S	Feb – Sep 2017	-	82.8	7342.1	686.8	1082	78	307	6511

Table 11: Relative biomass estimates of hoki on the Chatham Rise from *Tangaroa* trawl surveys, January 1992–2014, 2016, and 2018. The CV is the coefficient of variation as % (in parentheses).

Survey	1+ year class	1+ hoki		2+ year class	2+ hoki		3 ++ hoki		Total hoki	
		t	% CV		t	% CV	t	% CV	t	% CV
1992	1990	3.0	(27.8)	1989	23.9	(13.1)	94.7	(7.8)	121.6	(7.7)
1993	1991	33.0	(33.4)	1990	8.8	(18.2)	144.5	(9.0)	186.2	(10.2)
1994	1992	14.7	(20.2)	1991	44.8	(18.4)	87.2	(9.4)	146.7	(9.8)
1995	1993	6.6	(12.9)	1992	42.7	(11.4)	71.8	(8.3)	121.2	(7.4)
1996	1994	27.6	(24.4)	1993	15.0	(13.3)	110.3	(10.3)	152.8	(9.7)
1997	1995	3.2	(40.3)	1994	61.4	(12.0)	93.4	(8.2)	158.0	(8.4)
1998	1996	4.4	(33.0)	1995	15.6	(19.1)	66.7	(10.7)	86.7	(10.9)
1999	1997	25.5	(30.6)	1996	13.8	(19.0)	70.1	(10.2)	109.3	(11.6)
2000	1998	14.4	(32.4)	1997	28.2	(20.7)	29.1	(9.2)	71.7	(12.4)
2001	1999	0.4	(72.9)	1998	26.3	(17.1)	33.7	(8.8)	60.3	(9.7)
2002	2000	22.5	(26.1)	1999	1.2	(21.2)	50.6	(12.7)	74.4	(11.4)
2003	2001	4.9	(46.0)	2000	27.2	(15.1)	20.4	(9.3)	52.5	(11.6)
2004	2002	14.4	(32.5)	2001	5.5	(20.4)	32.8	(12.9)	52.7	(12.6)
2005	2003	17.5	(23.4)	2002	45.8	(16.3)	21.2	(11.4)	84.6	(11.5)
2006	2004	25.9	(21.5)	2003	33.6	(18.8)	39.7	(10.3)	99.2	(10.6)
2007	2005	9.1	(27.5)	2004	32.8	(13.1)	28.8	(8.9)	70.7	(8.5)
2008	2006	15.6	(31.6)	2005	23.8	(15.6)	37.5	(7.8)	76.9	(11.4)
2009	2007	25.2	(28.8)	2006	65.2	(17.2)	53.7	(7.8)	144.1	(10.6)
2010	2008	19.3	(30.7)	2007	28.6	(15.4)	49.6	(16.3)	97.5	(14.6)
2011	2009	26.9	(36.9)	2008	26.3	(14.1)	40.7	(7.8)	93.9	(14.0)
2012	2010	2.6	(30.1)	2009	29.1	(16.6)	55.9	(8.0)	87.5	(9.8)
2013	2011	50.9	(24.5)	2010	1.0	(43.6)	72.1	(12.8)	124.1	(15.3)
2014	2012	5.7	(36.6)	2011	43.3	(14.2)	53.0	(10.9)	101.9	(9.8)
2016	2014	47.6	(27.6)	2013	12.9	(18.6)	54.0	(12.8)	114.5	(14.2)
2018	2016	30.5	(38.8)	2015	51.3	(19.1)	40.3	(14.8)	122.1	(16.0)

Table 12: Hoki acoustic abundance estimates from the 2017 Cook Strait survey by snapshot and stratum. Mean is the average biomass per stratum over all snapshots. NA indicates strata that were not surveyed. *Total biomass in snapshot 2 was estimated by assuming that abundance in the three strata which were not surveyed was the average estimate from these strata from the other five snapshots.

Snapshot	Stratum biomass ('000 t)						Total (‘000 t)	Snapshot CV
	1	2	3	5A	5B	6		
1	6	97	4	7	5	2	121	23
2	NA	125	NA	11	NA	1	167*	51
3	22	25	3	7	14	2	74	14
4	25	40	3	3	9	1	81	16
5	13	67	4	15	11	5	116	18
6	8	21	2	6	14	1	51	13
Mean	15	63	3	8	11	2	102	15

Table 13: Acoustic abundance indices for Cook Strait hoki 1988–2017. * Surveys from industry vessels.

Year	No of accepted snapshots	Biomass (‘000 t)	CV
1991	4	88	0.41
1993	4	283	0.52
1994	3	278	0.91
1995	4	194	0.61
1996	5	92	0.57
1997	6	141	0.40
1998	5	80	0.44
1999	6	114	0.36
2001	11	102	0.30
2002	9	145	0.35
2003	9	104	0.34
2005	9	59	0.32
2006	7	60	0.34
2007*	4	104	0.46
2008	7	82	0.30
2009*	5	166	0.39
2011*	6	141	0.35
2013*	7	168	0.30
2015*	5	204	0.33
2017	6	102	0.36

FIGURES

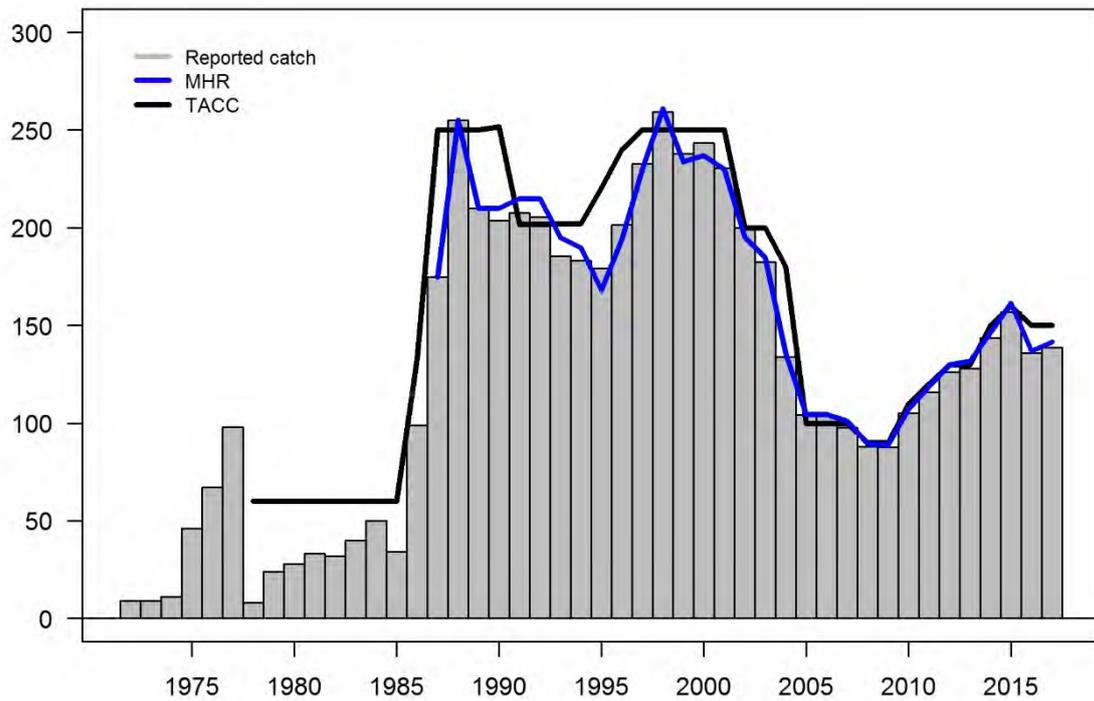


Figure 1: Total New Zealand hoki catch (tonnes, × 1000) estimated from reported landings for calendar years 1972 to 1983 and fishing years 1983–84 (1984) to 2016–17.

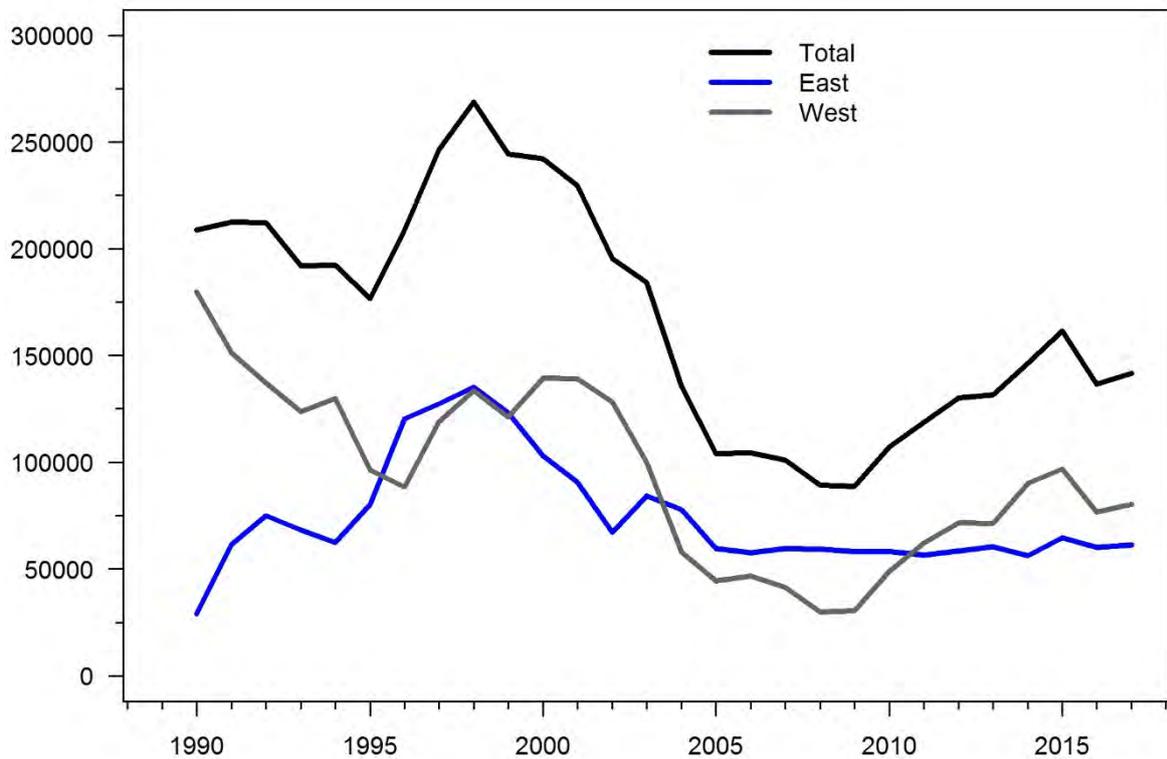
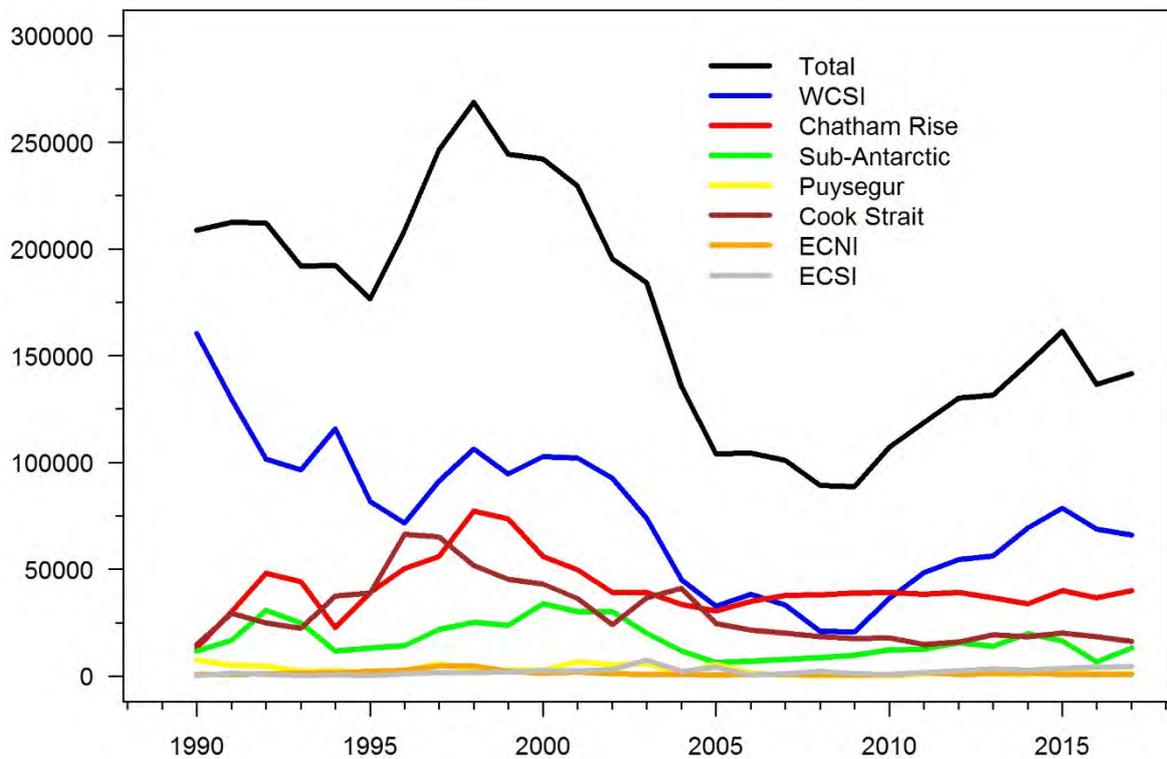


Figure 2a: Estimated total catch (t) of hoki by ‘stock’ area (upper panel) and fishing area (lower panel) from 1988–89 (1989) to 2016–17 (2017). “Eastern” areas include Chatham Rise, east coast South Island (ECSI), Cook Strait, and east coast North Island (ECNI). “Western” areas include west coast South Island (WCSI), Sub-Antarctic, and Puysegur.

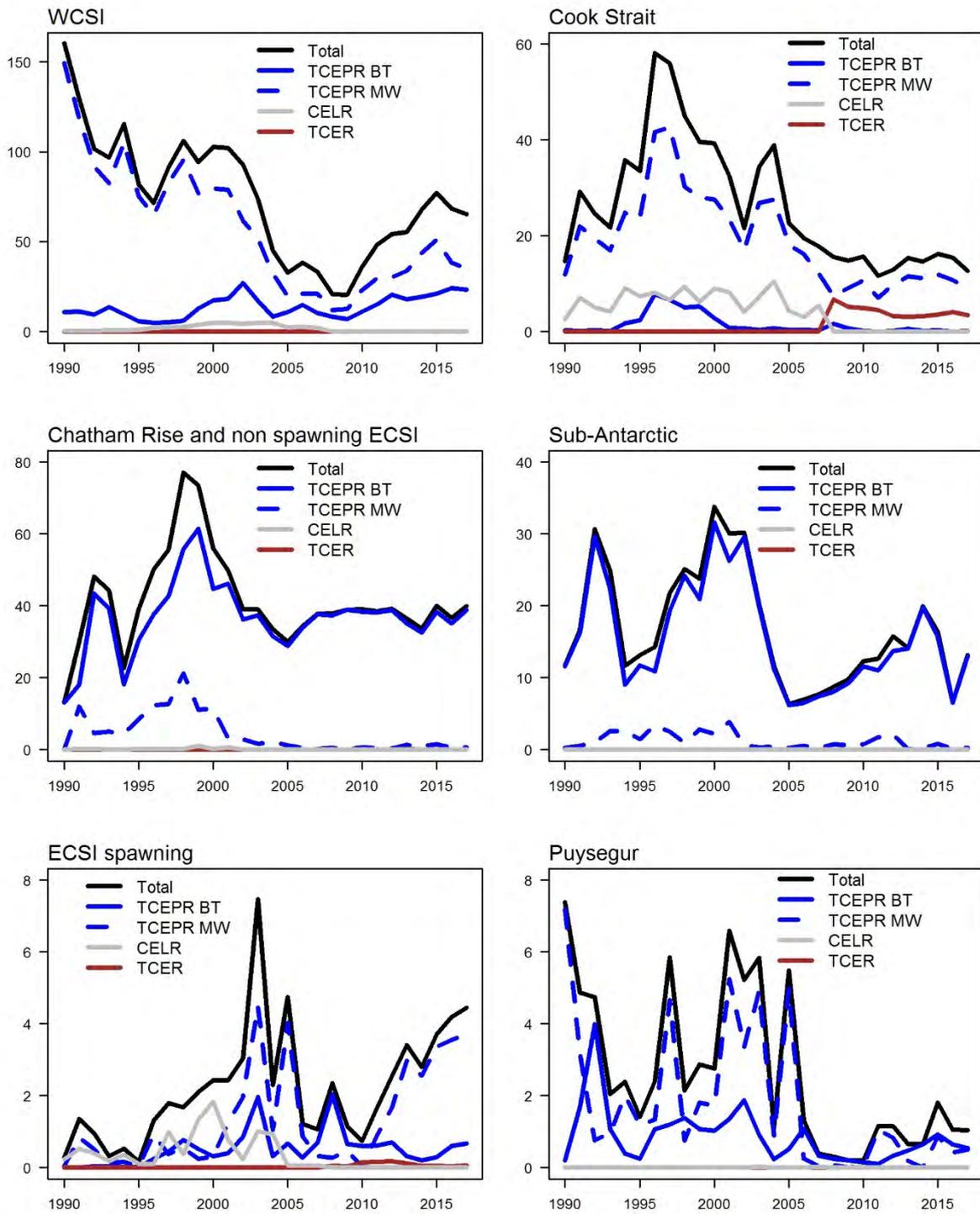


Figure 2b: Total catches and catches by form type by hoki fishing area and fishing year. All areas (except Cook Strait) also show TCEPR data split by MW (midwater trawl) and BT (Bottom trawl). Sub-Antarctic and Puysegur had very little CELR or TCER data.

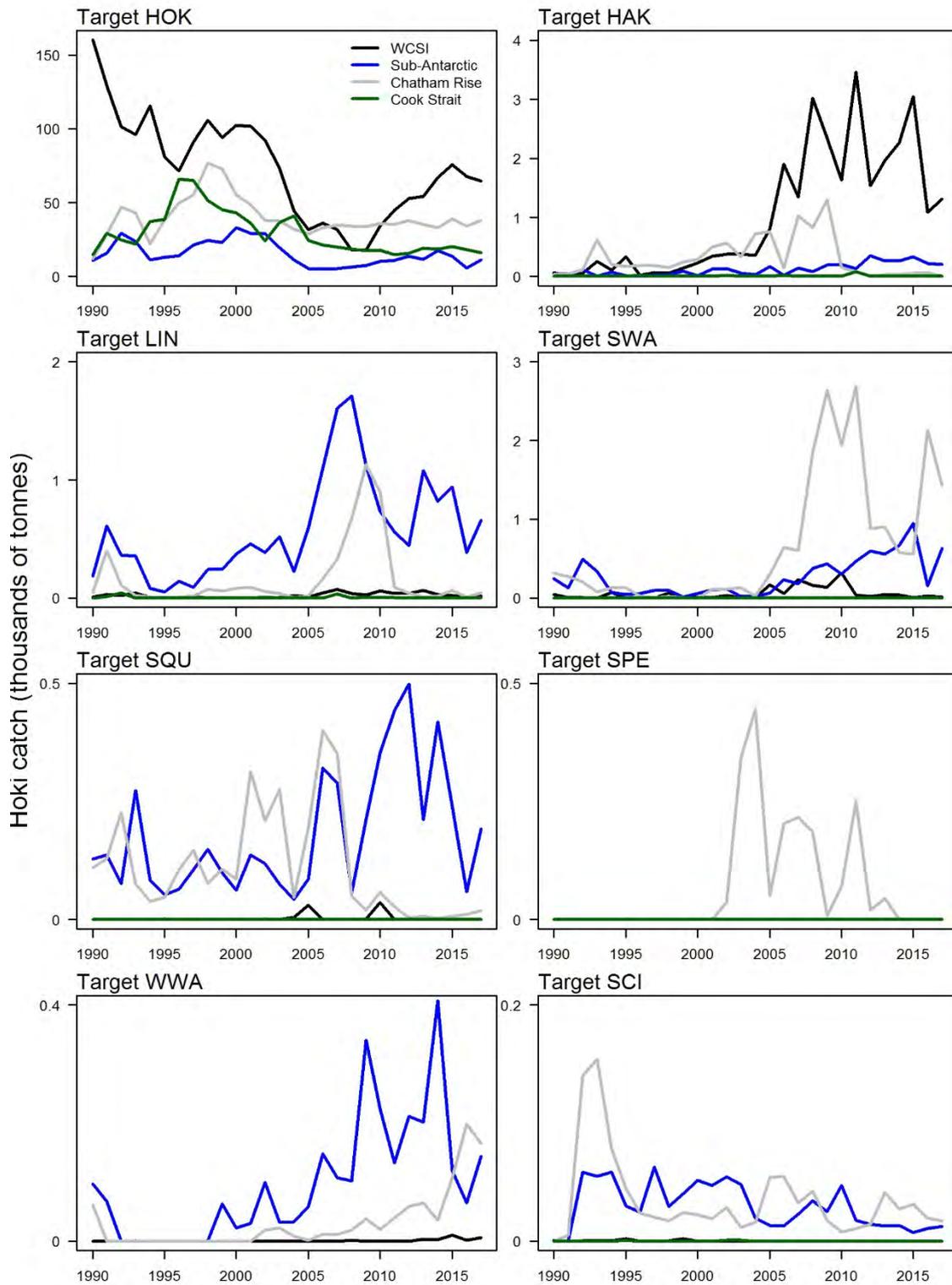


Figure 3: Hoki catch by target species and area for the 1989–90 to 2016–17 fishing years. Hoki catches by target species include HOK, hoki; HAK, hake; LIN, ling; SWA, silver warehou; SQU, arrow squid; SPE, sea perch; WWA, white warehou; and SCI, scampi.

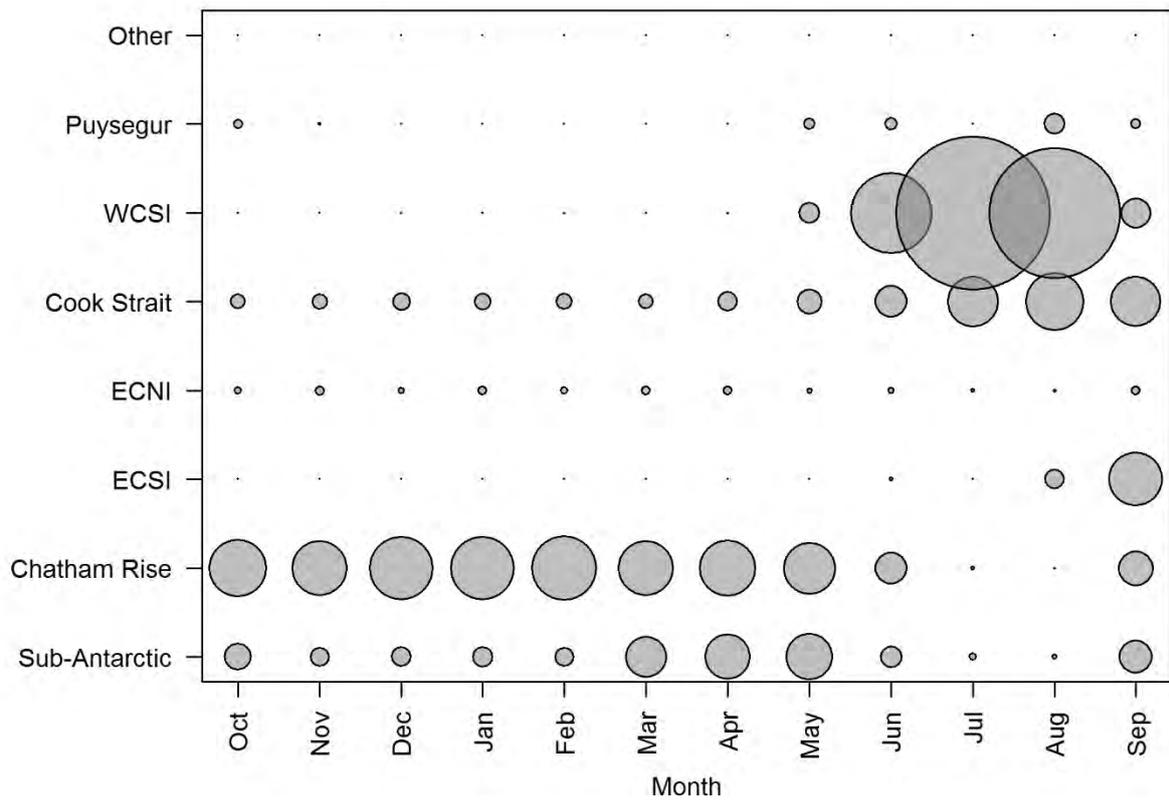


Figure 4a: Hoki catch by month and area for the 2016–17 fishing year (maximum circle size is 35 000 t).

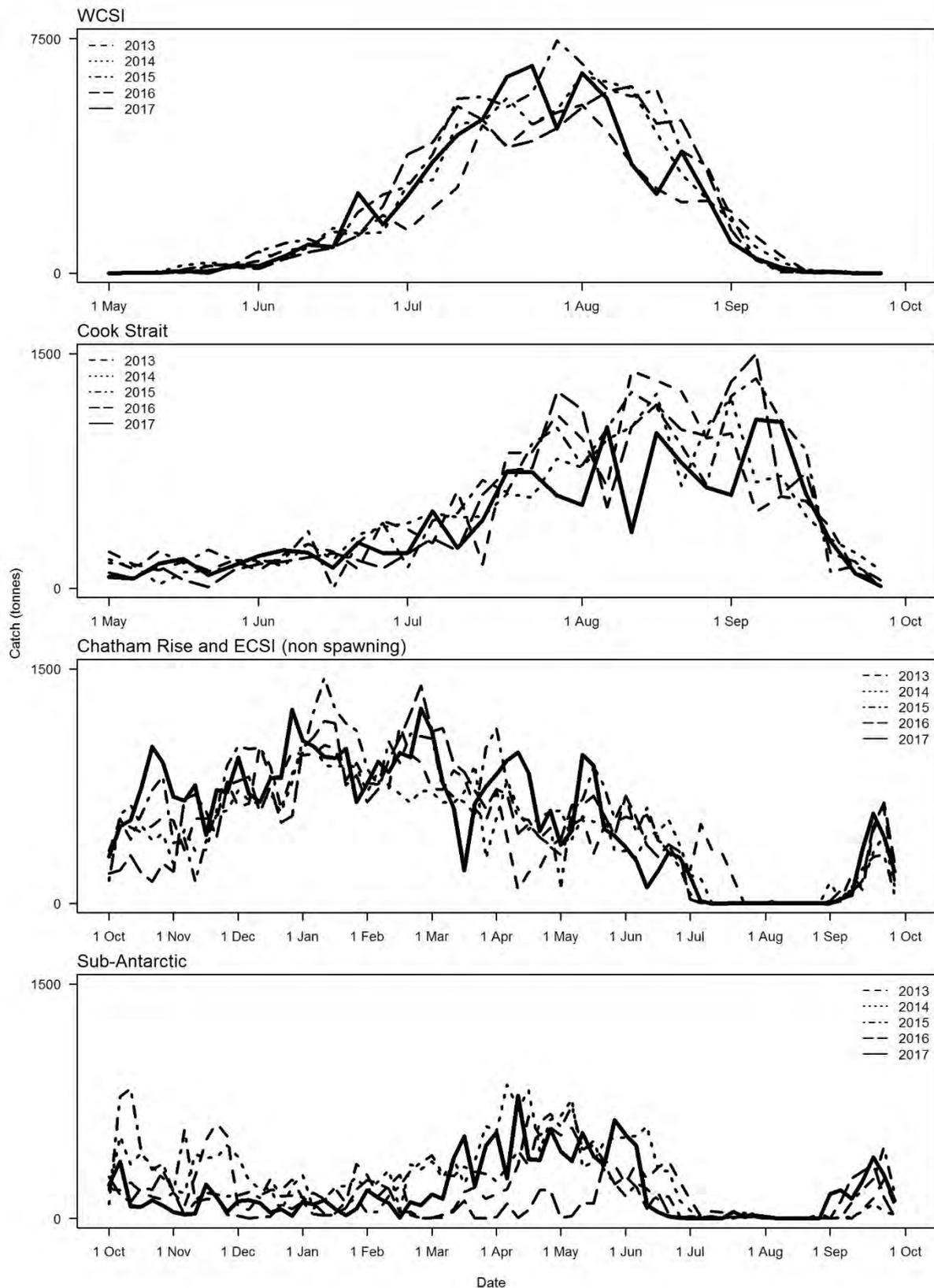


Figure 4b: Daily distribution of hoki catch by area (in 5-day bins) by main area for 2012–13 to 2016–17 fishing years.

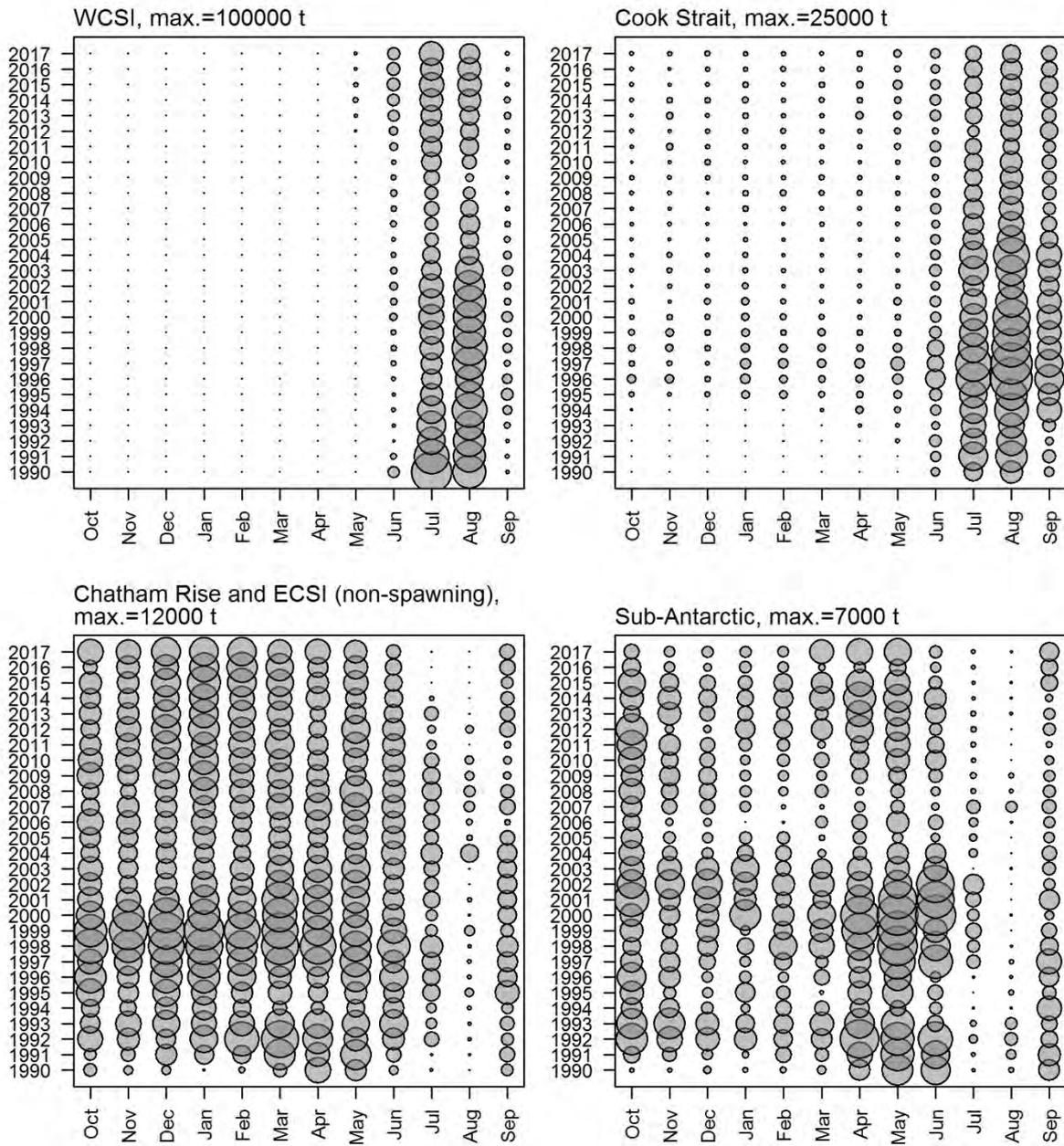


Figure 5: Distribution of hoki catch by month and area for the 1989–90 to 2016–17 fishing years.

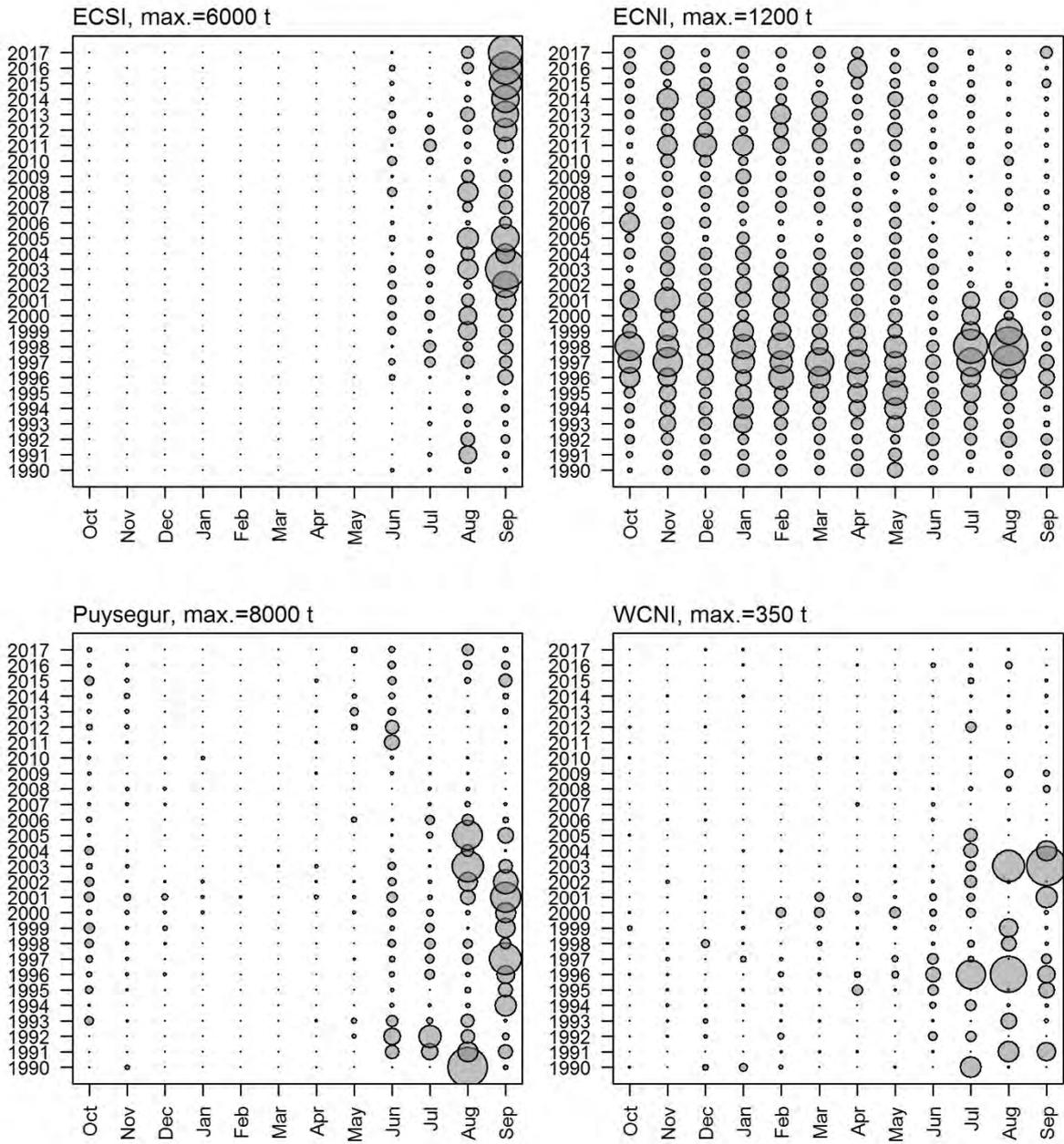


Figure 5 continued.

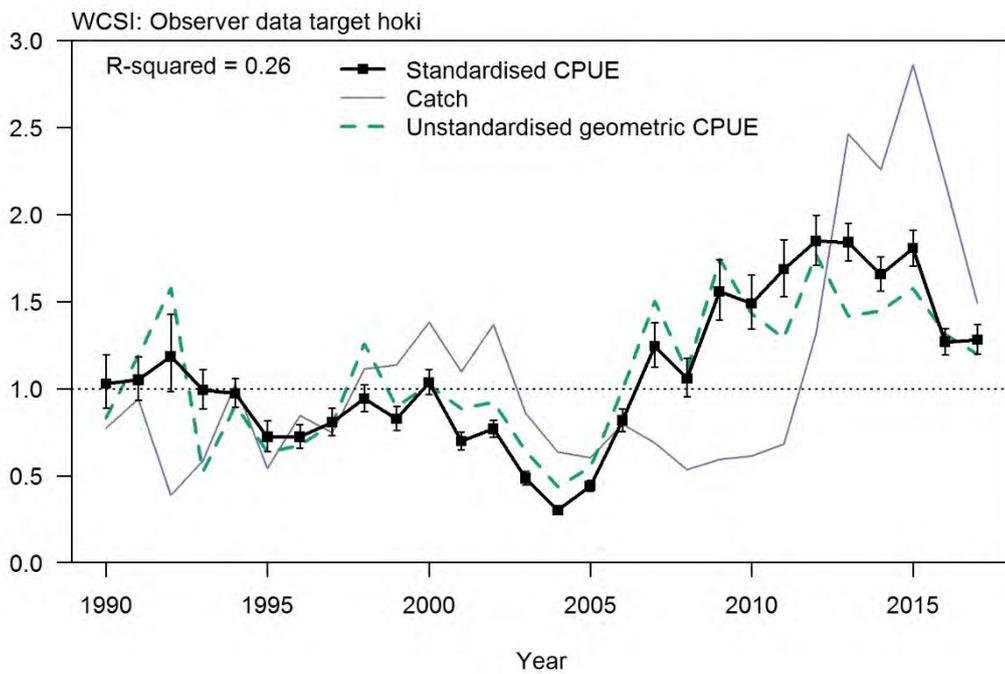
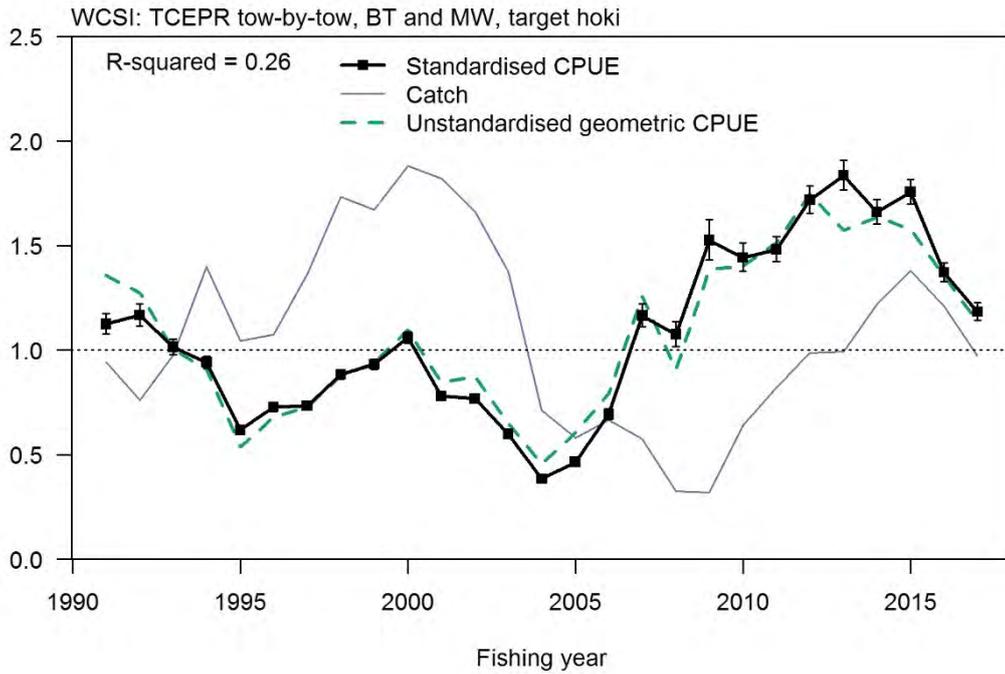


Figure 6a: Model catch, unstandardised geometric, and standardised CPUE indices for core data TCEPR and observed (OP) hoki tows from the WCSI for 1990–2017.

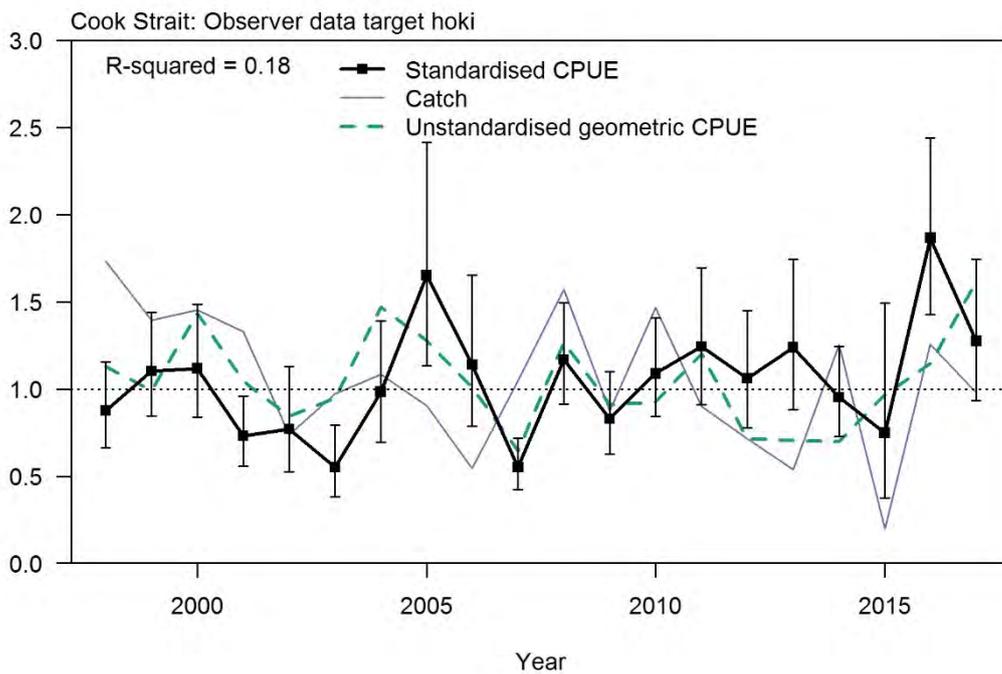
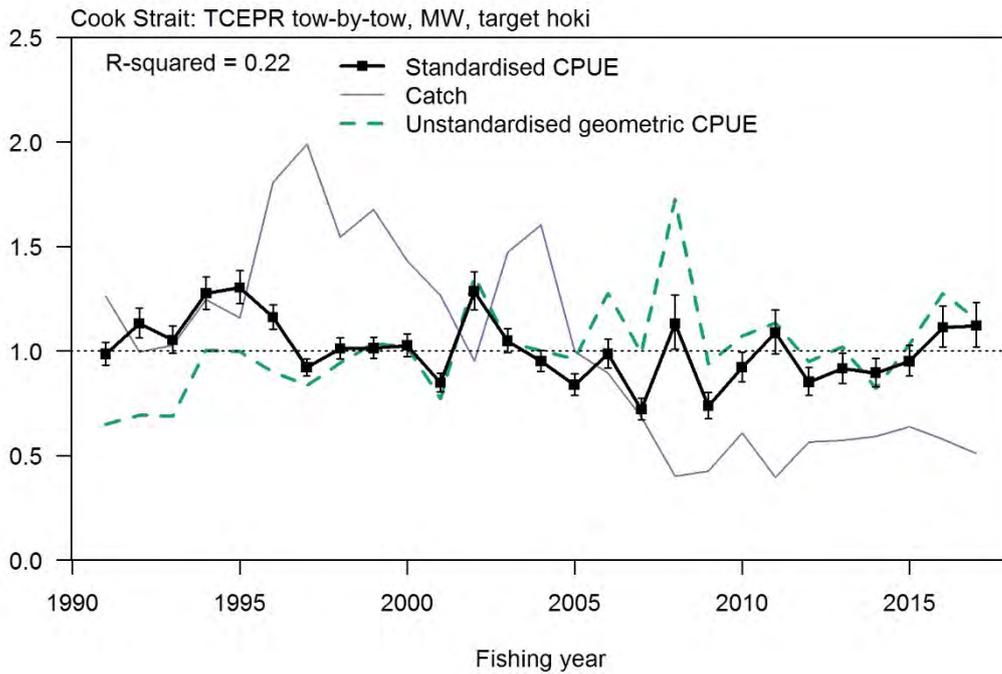


Figure 6a continued. Model catch, and unstandardised geometric and standardised CPUE indices for core data TCEPR and observed hoki tows from Cook Strait for 1991–2017. Cook Strait included only midwater tows.

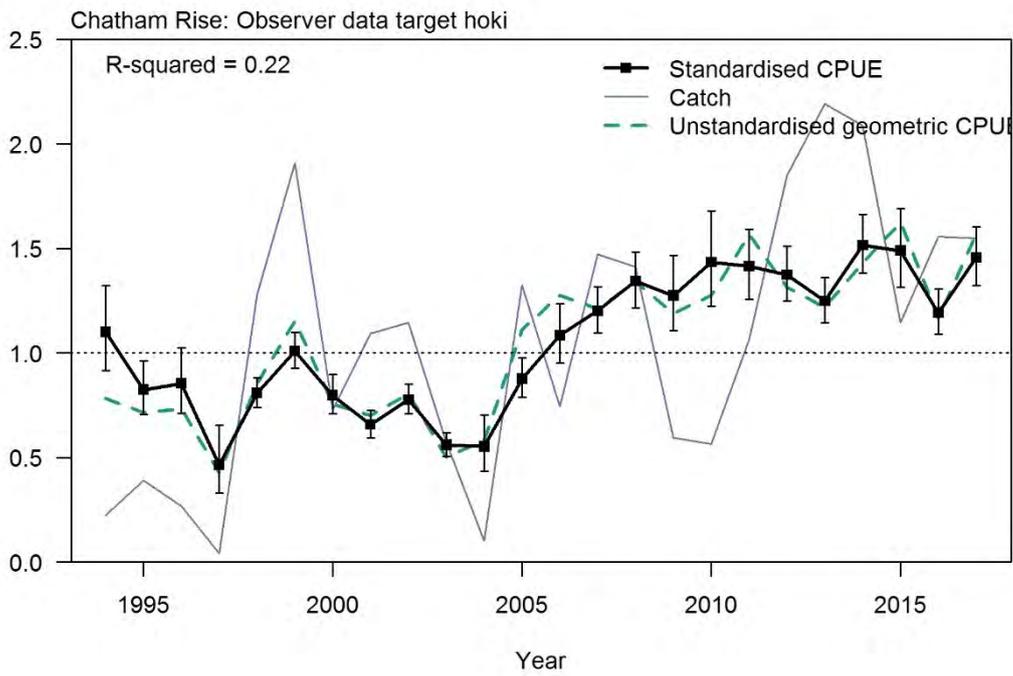
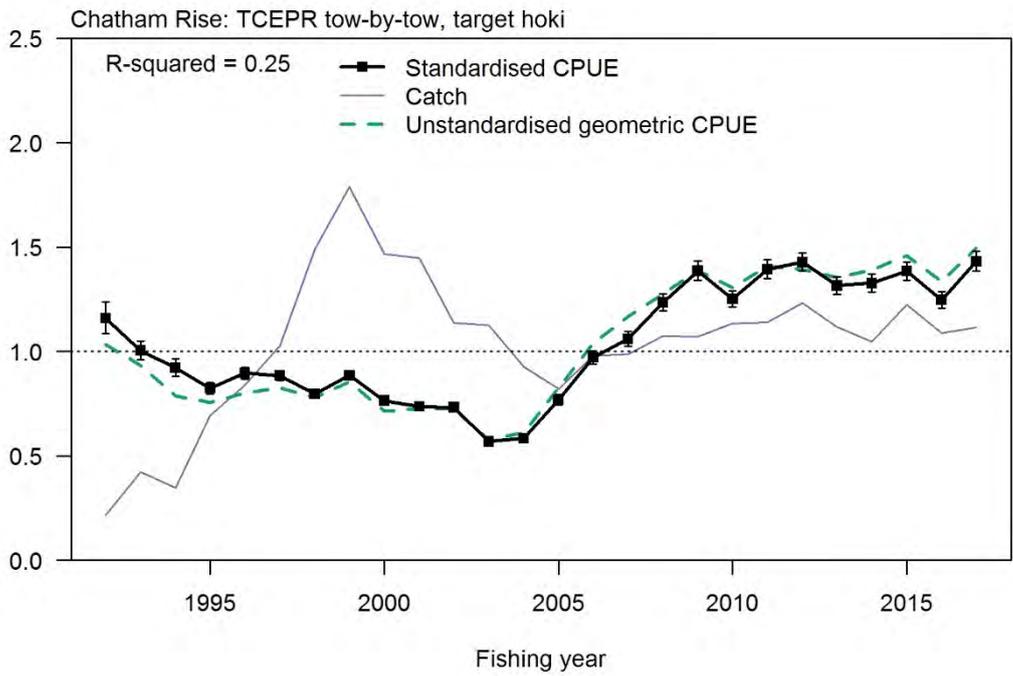


Figure 6a continued. Model catch, and unstandardised geometric and standardised CPUE indices for core data hoki tows from the Chatham Rise for 1992–2017. Dataset for Chatham Rise included only bottom trawl tows.

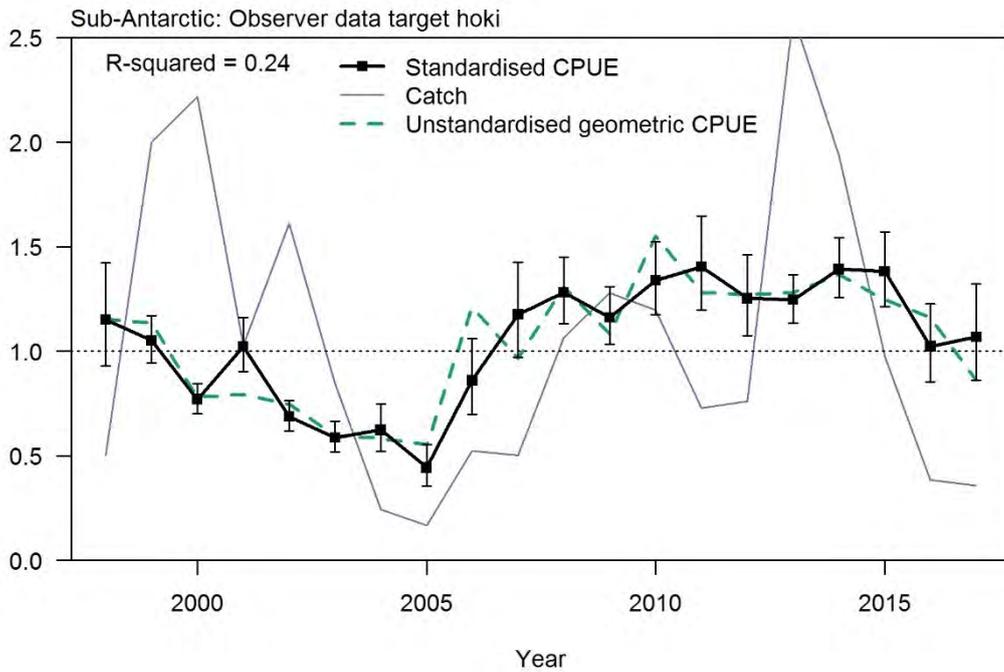
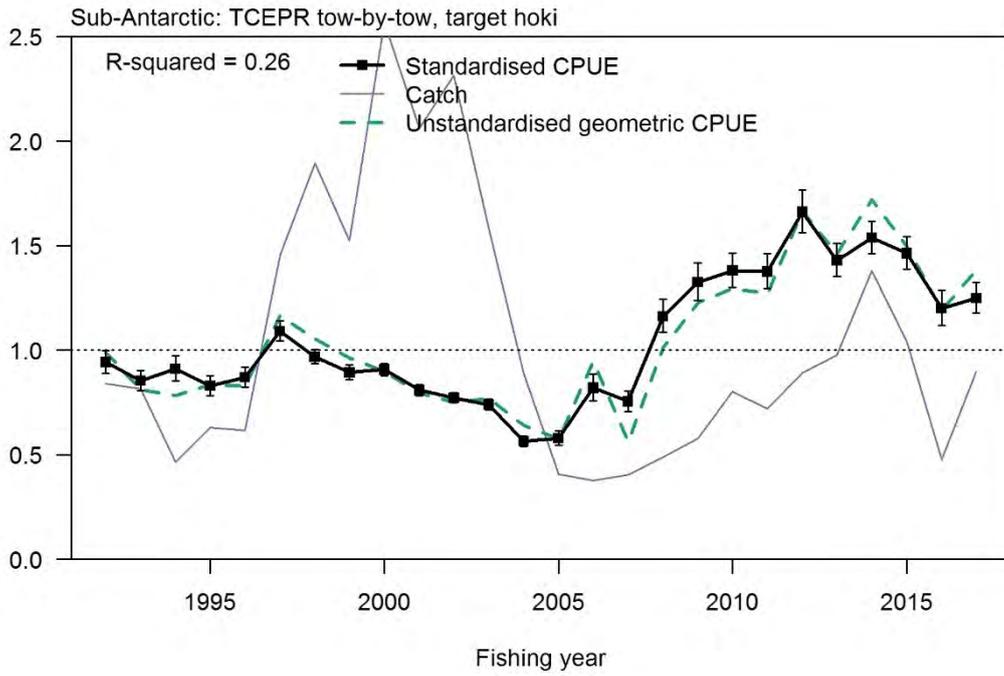


Figure 6a continued. Model catch, and unstandardised geometric and standardised CPUE indices for core data hoki tows from the Sub-Antarctic for 1992–2017. Datasets for Sub-Antarctic included only bottom trawl tows.

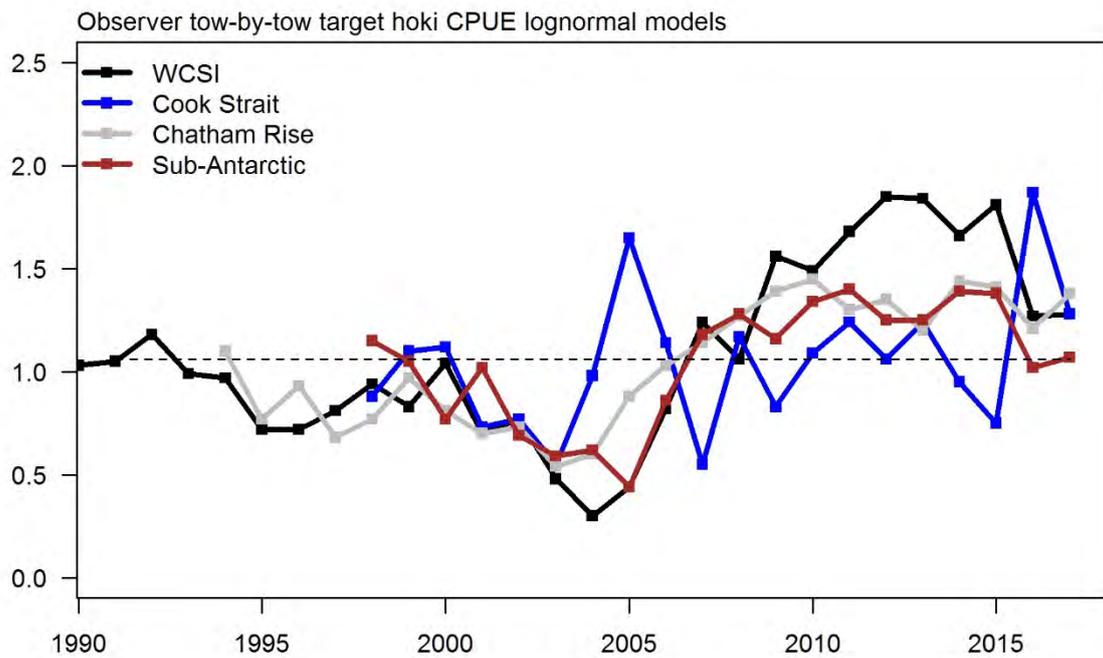
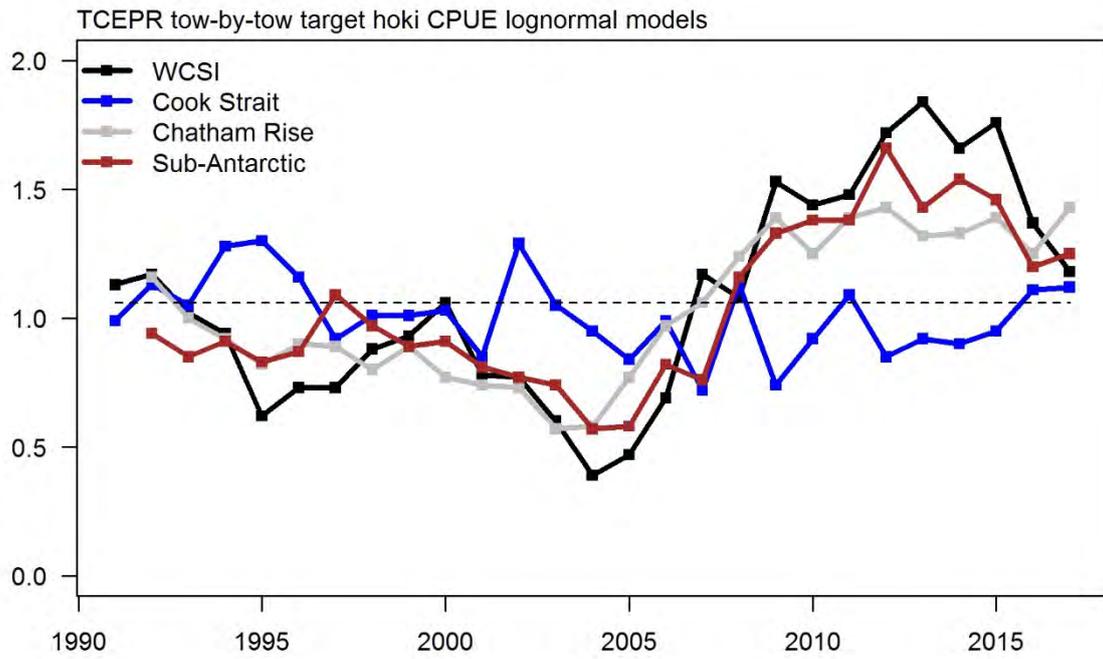


Figure 6b: Comparison of relative standardised CPUE indices from model runs for each area.

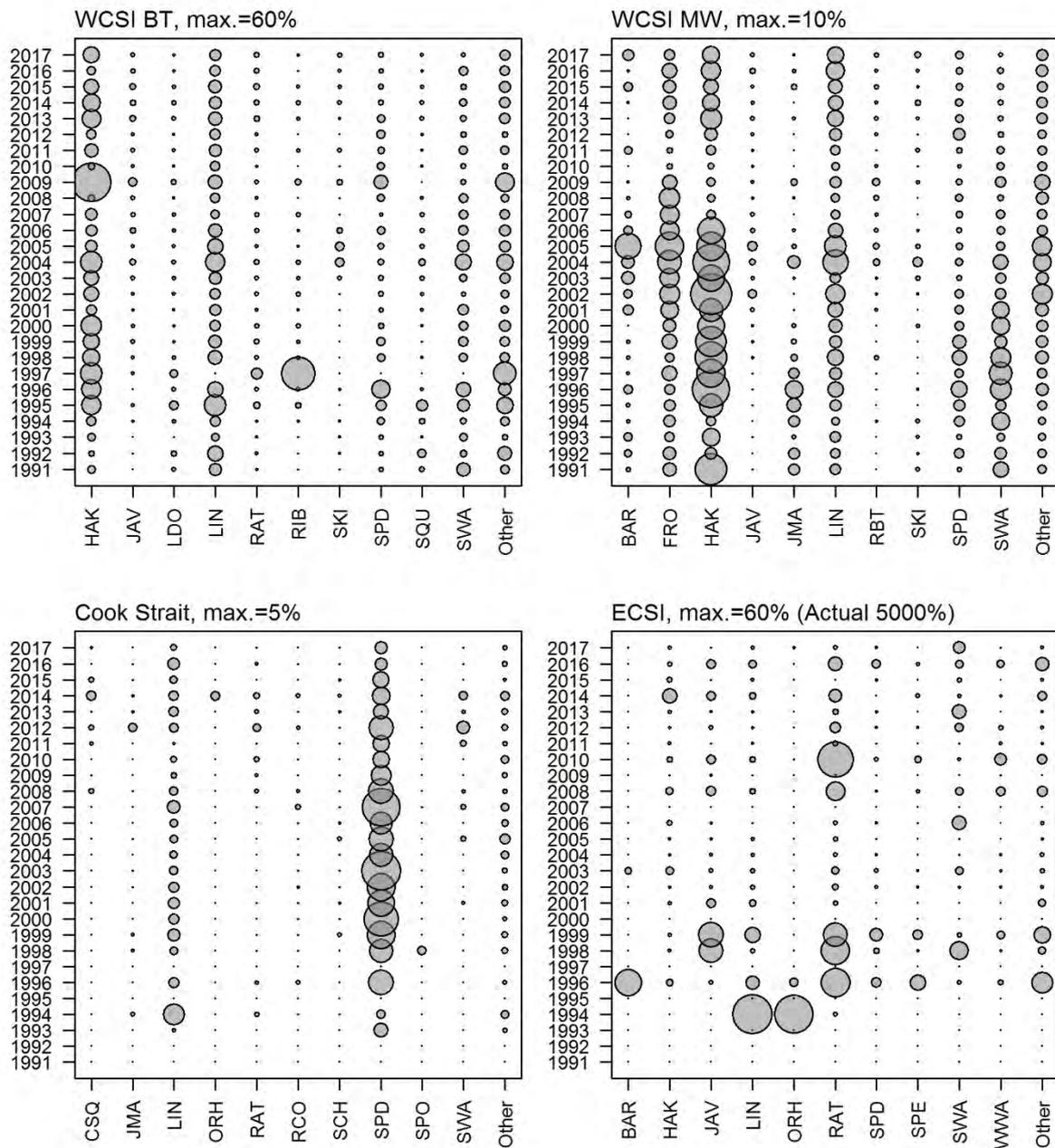


Figure 7: Bycatch rates on vessels with Observer Programme observers in the hoki fishery for tows targeting hoki from 1990–91 to 2016–17. WCSI (bottom and midwater trawls), Cook Strait, and ECSI data cover the spawning season (June–September) only. No observer data for Cook Strait 1994–95 and 1996–97, Puysegur 1997–98 to 2008–09, and ECSI 2006–07. Bycatch rates not calculated where observed hoki catch was less than 100 t. Species chosen are the top eight by observed catch in an area. Species include: BAR, barracouta; BOE, black oreo; BNS, bluenose; BYS, alfonsino; CSQ, leafscale gulper shark; FRO, frostfish; GSP, pale ghost shark; HAK, hake; HOK, hoki; JAV, javelinfish; JMA, jack mackerels; LDO, lookdown dory; LIN, ling; MDO, mirror dory; ORH, orange roughy; RAT, rattails; RBM, rays bream; RCO, red cod; RIB, ribaldo; RBT, redbait; SBW, southern blue whiting; SCH, school shark; SKI, gemfish; SND, shovelnose dogfish; SPD, spiny dogfish; SPE, sea perch; SPO, rig; SQU, arrow squid; SWA, silver warehou; and WWA, white warehou.

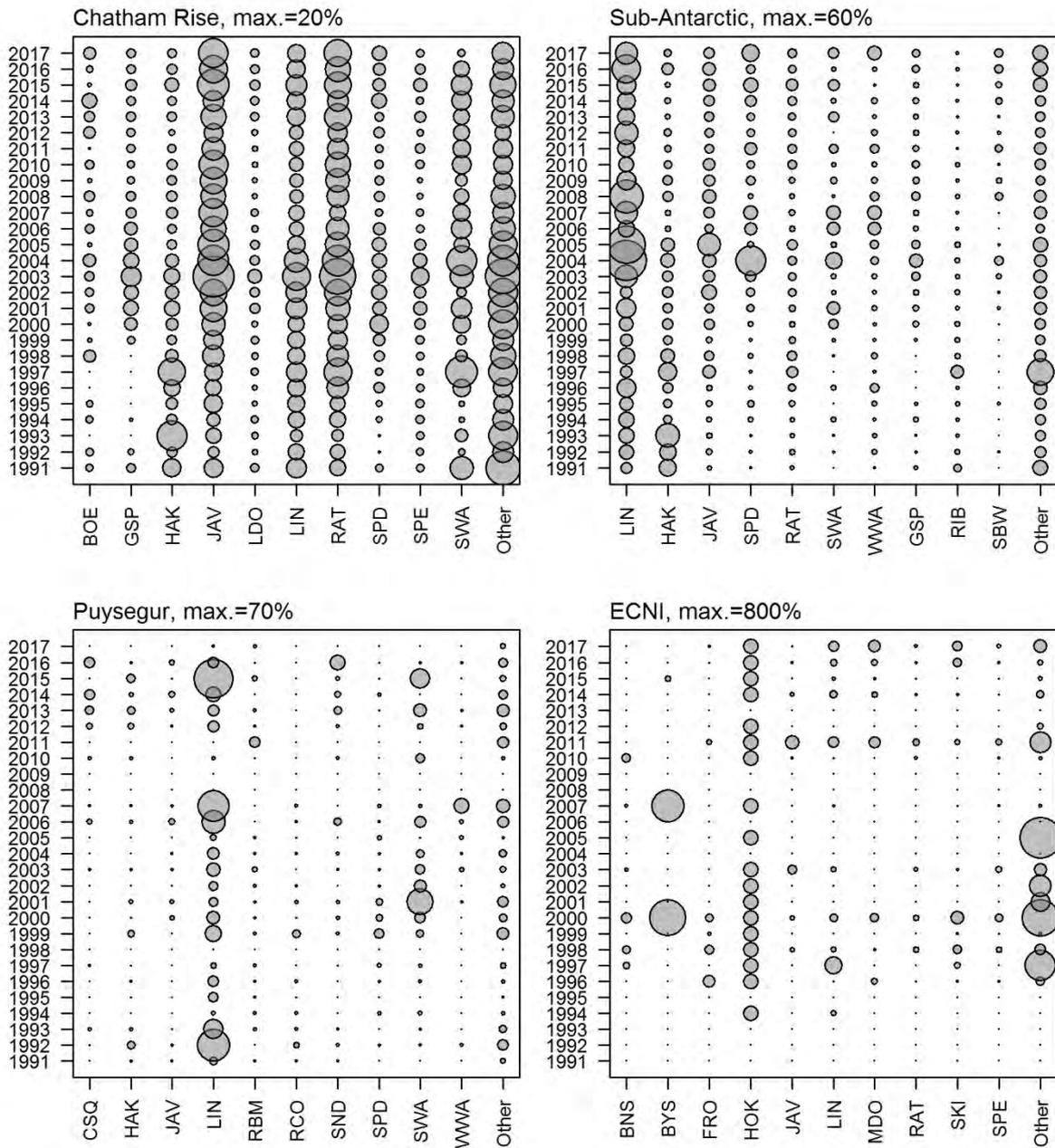


Figure 7: continued.

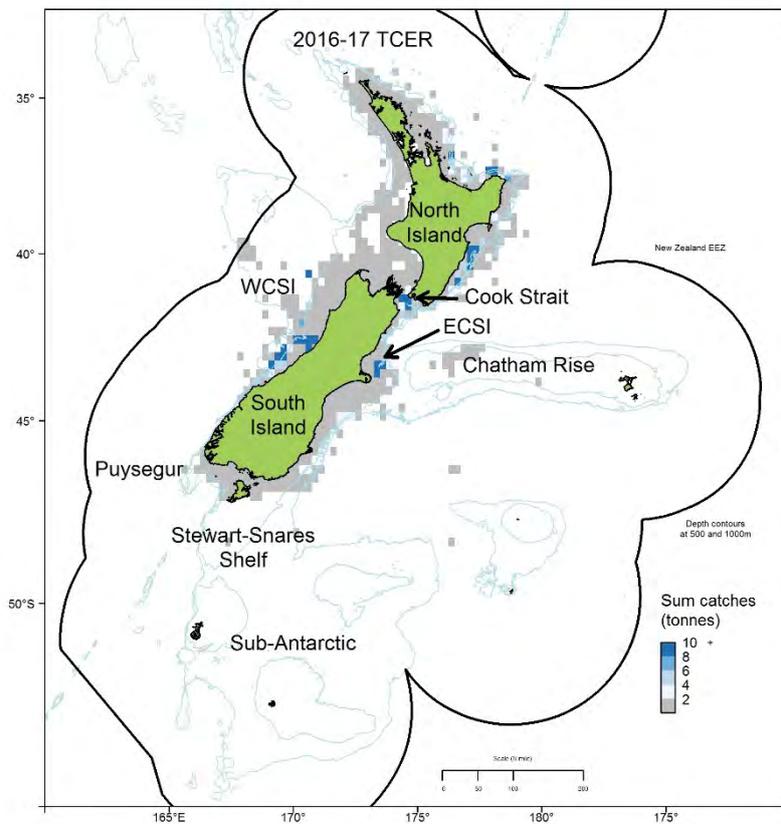
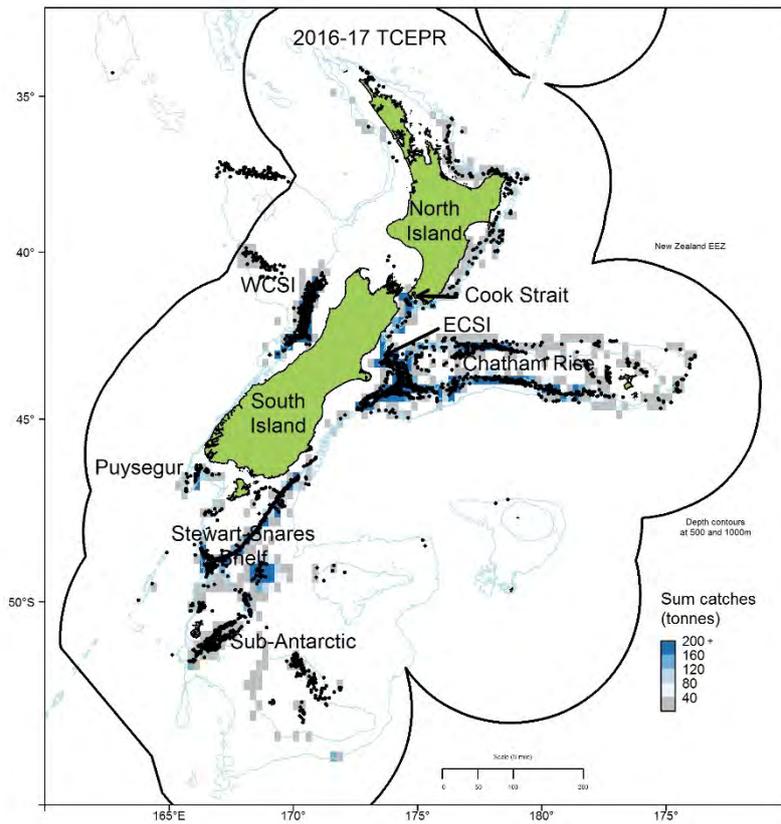


Figure 8: Density plots of all commercial TCEPR and TCER trawls where hoki was caught in the 2016–17 fishing year. TCEPR plot also shows observed positions as black dots.

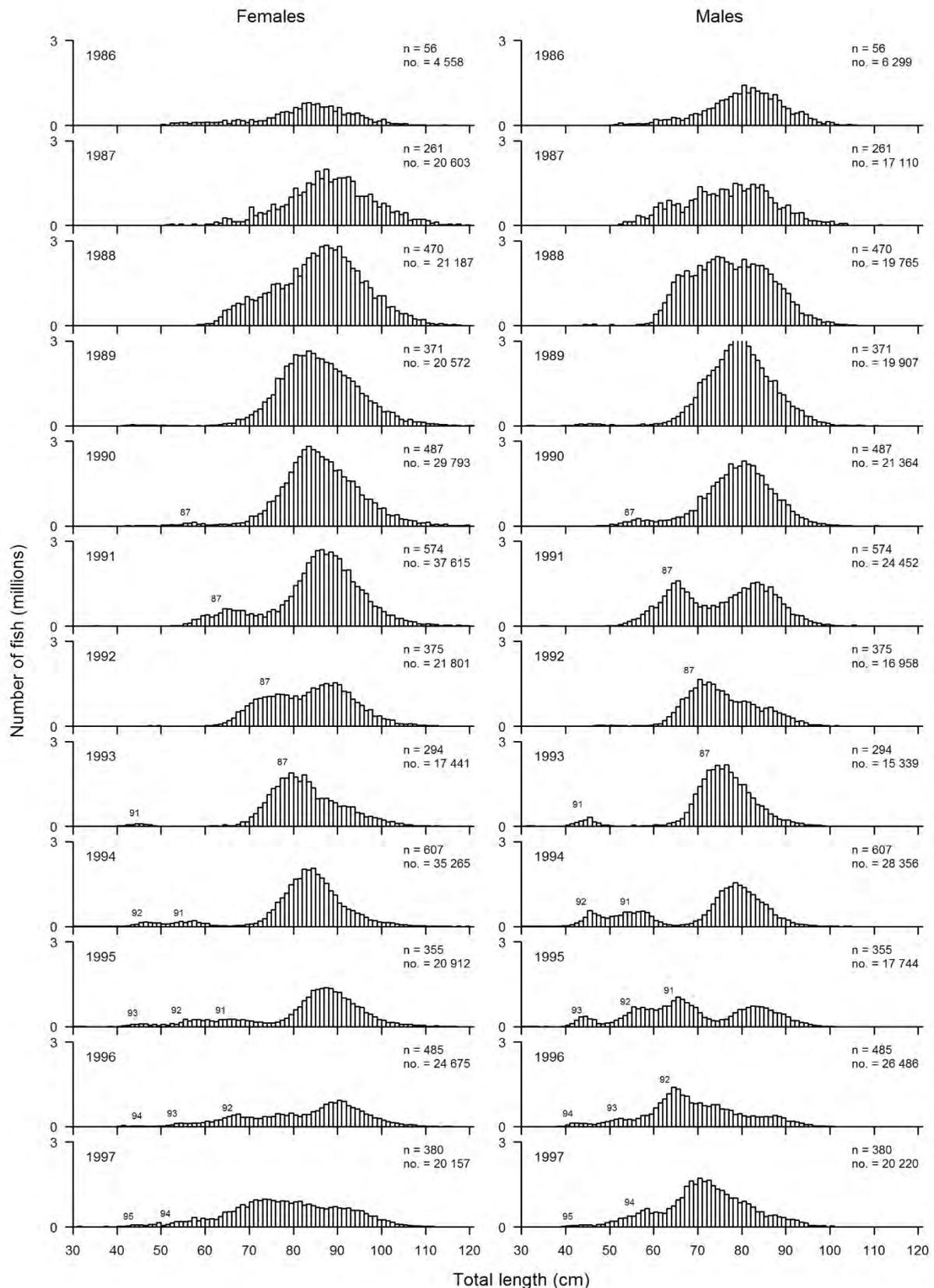


Figure 9: Length frequency distributions of hoki in commercial catches from the west coast South Island spawning fishery from 1989 to 1997 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled. Numbers above the histograms mark estimated year-class modes, e.g., 91 = 1991 year-class.

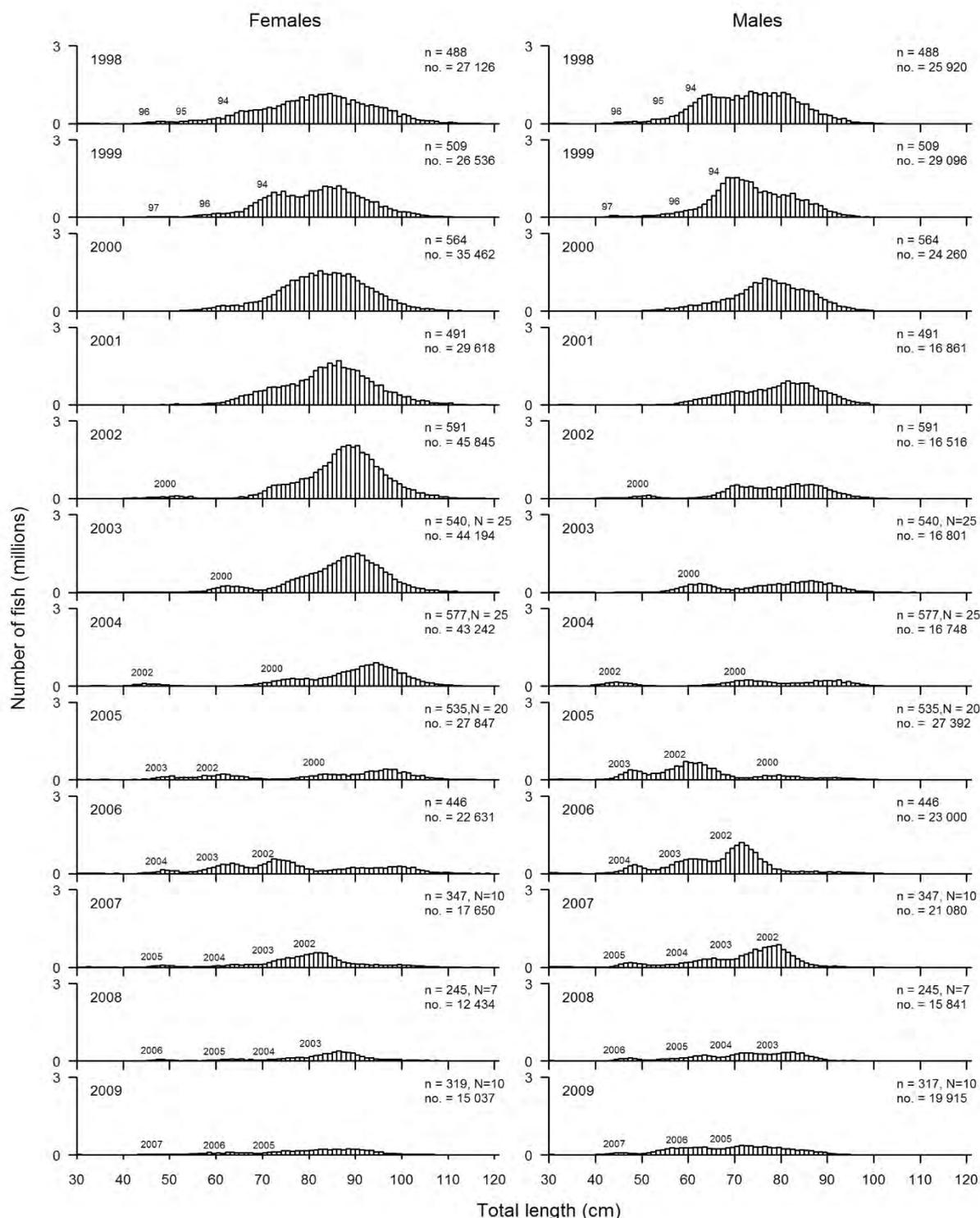


Figure 9 continued. Length frequency distributions of hoki in commercial catches from the west coast South Island spawning fishery from 1998 to 2009 sampled at sea by the Observer Programme. In 2003–05 and 2007–09, Observer Programme data were combined with samples of landings from inside the 25 n. mile line sampled by NIWA. n, number of tows sampled; N, number of landings sampled by NIWA; no., number of fish sampled. Numbers above the histograms mark estimated year-class modes, e.g., 2004 = 2004 year-class.

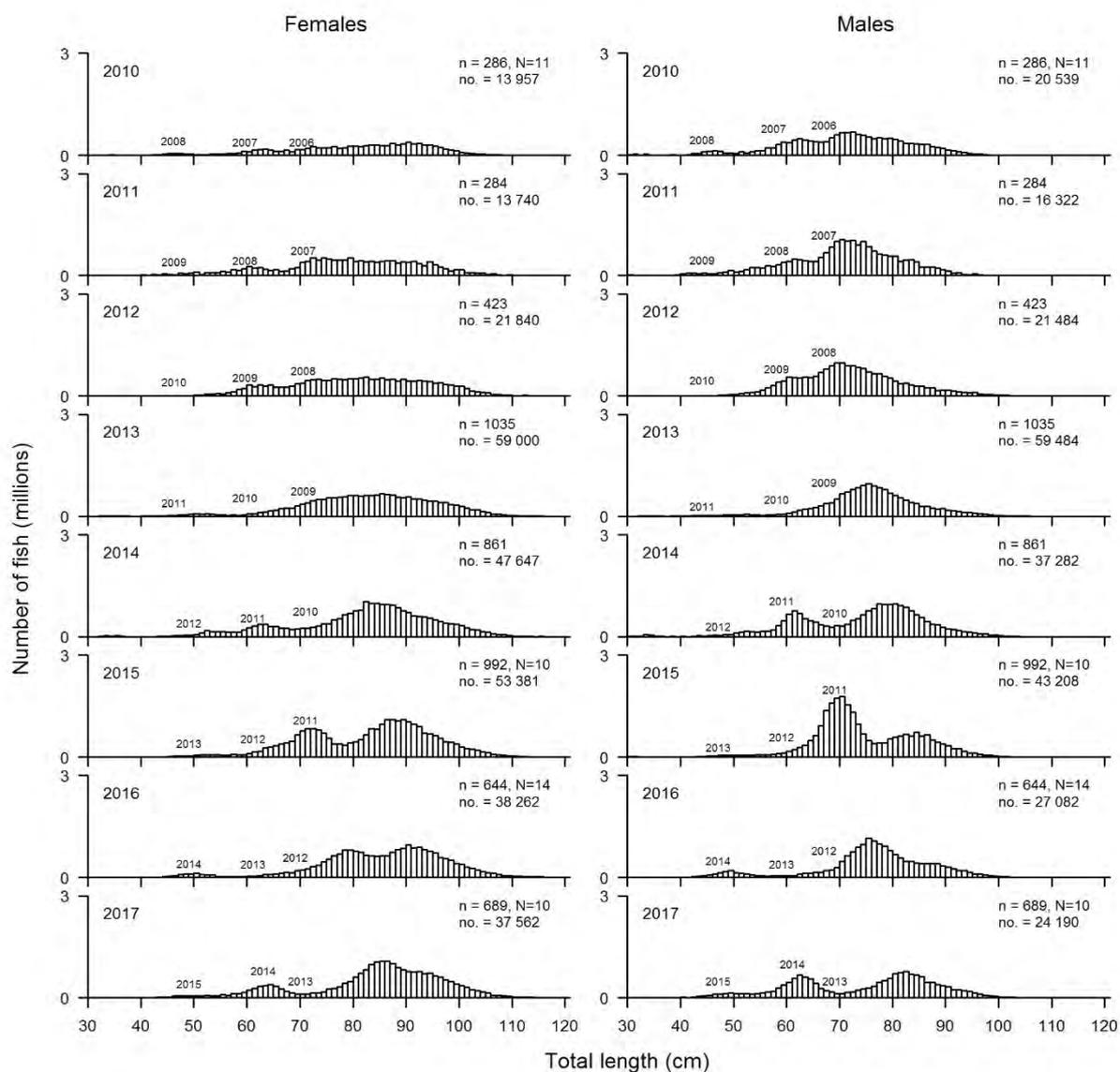


Figure 9 continued. Length frequency distributions of hoki in commercial catches from the west coast South Island spawning fishery from 2010 to 2017. In 2010, and 2015–2017, Observer Programme data were combined with land-based samples from inside the 25 n. mile line sampled by NIWA. n, number of tows sampled; no., number of fish sampled; N, number of landings sampled by NIWA. Numbers above the histograms mark estimated year-class modes, e.g., 2007 = 2007 year-class.

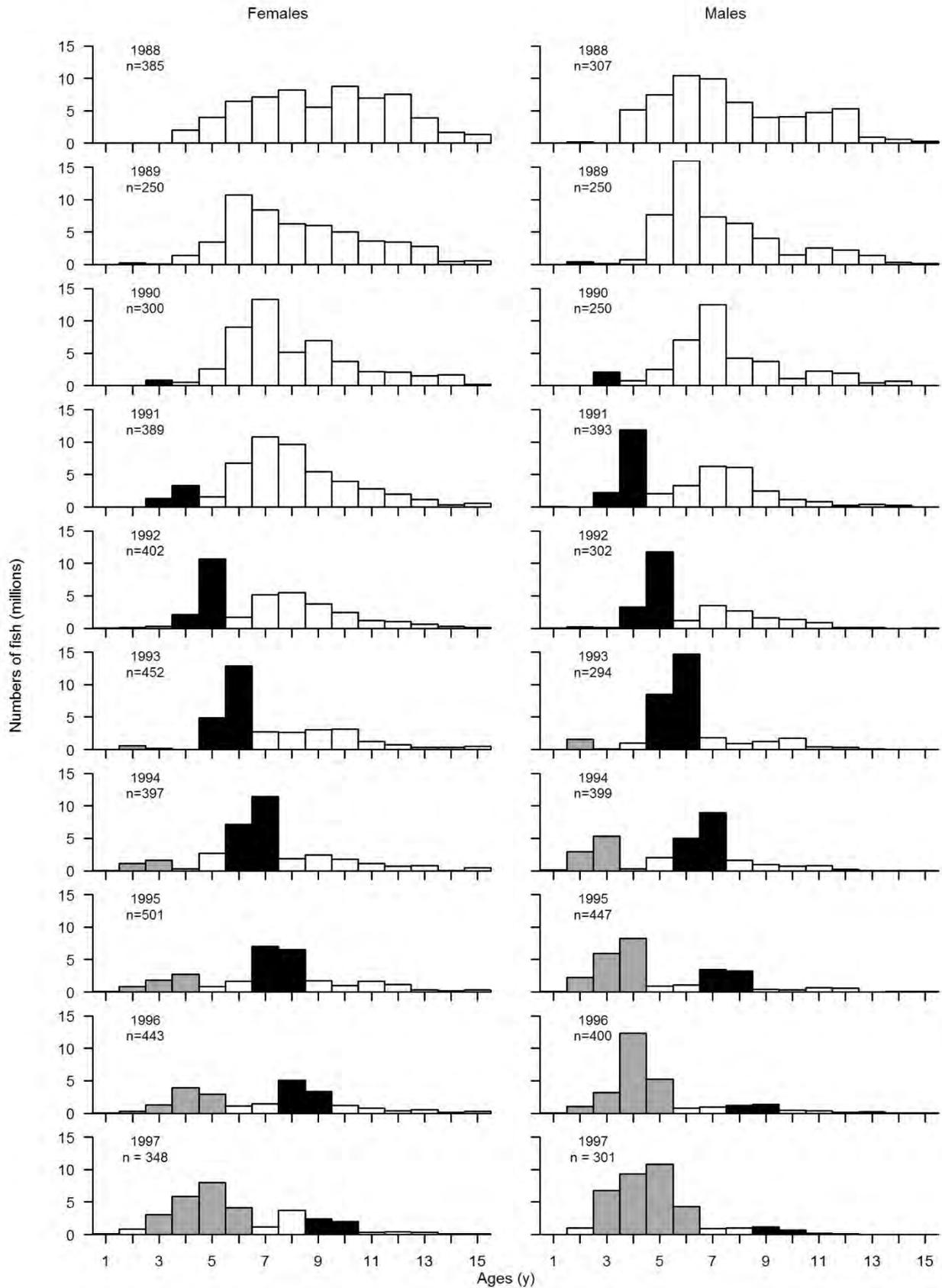


Figure 10: Catch-at-age of hoki in commercial catches from the west coast South Island spawning fishery from 1988 to 2017. n, number of fish aged. Black bars show 1987 and 1988 year-classes and dark grey bars show 1991–94 year-classes.

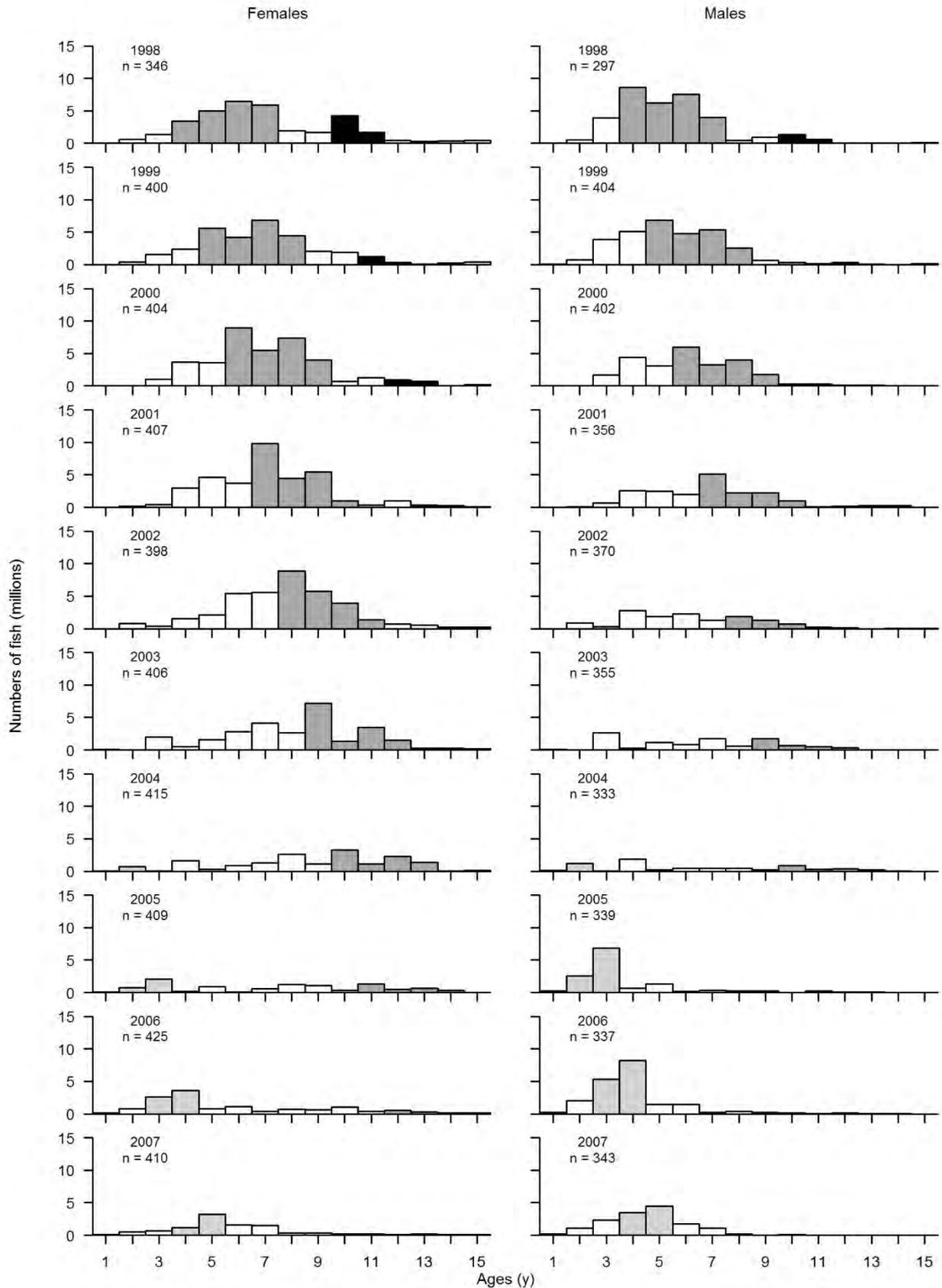


Figure 10 continued. Black bars show 1987 and 1988 year-classes and dark grey bars show 1991–94 year-classes, and light grey bars (from 2004 on) represent the 2002 and 2003 year classes.

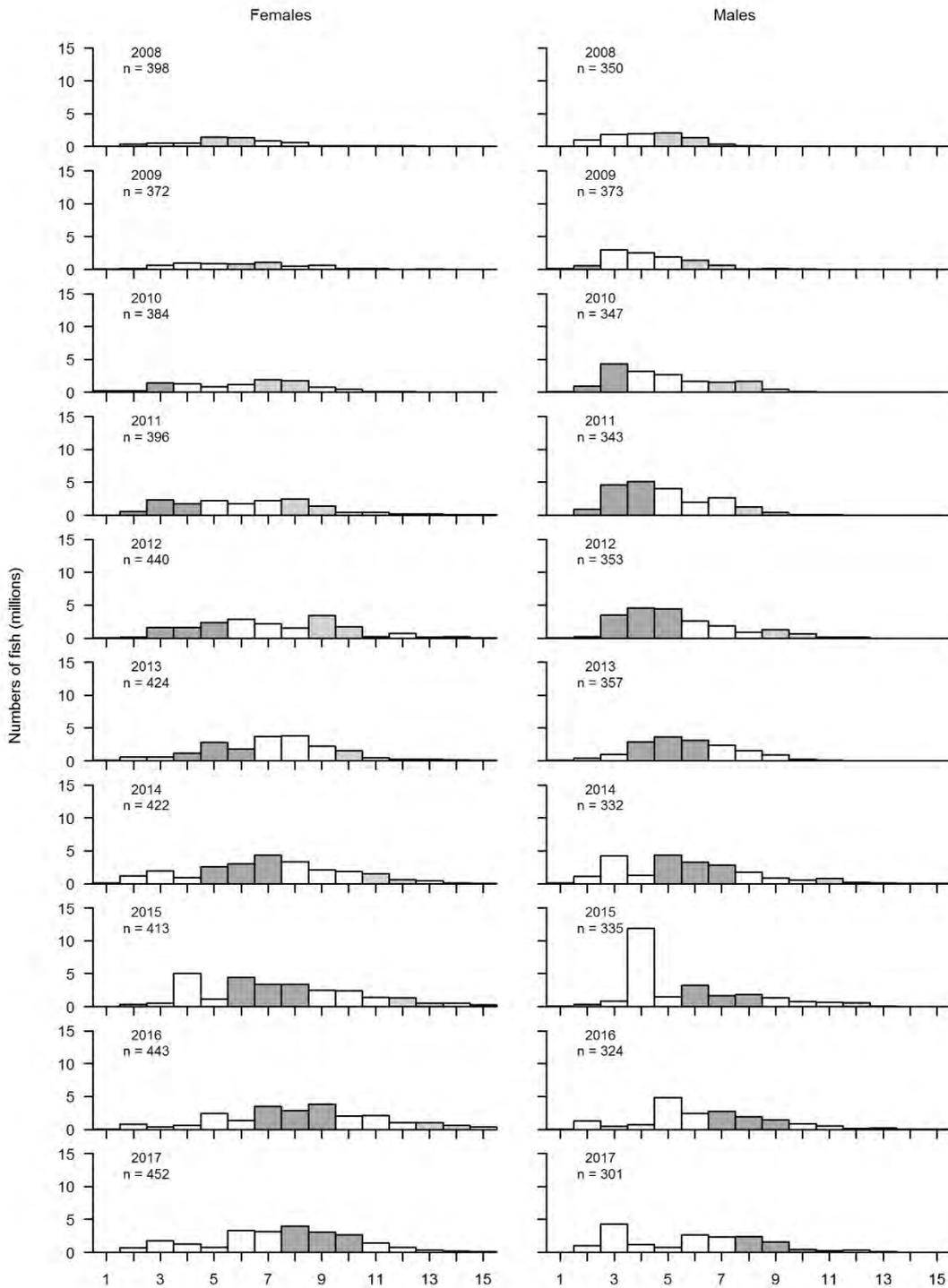


Figure 10 continued. Light grey bars represent the 2003 and 2002 year classes, and dark grey bars represent the 2007–2009 year classes.

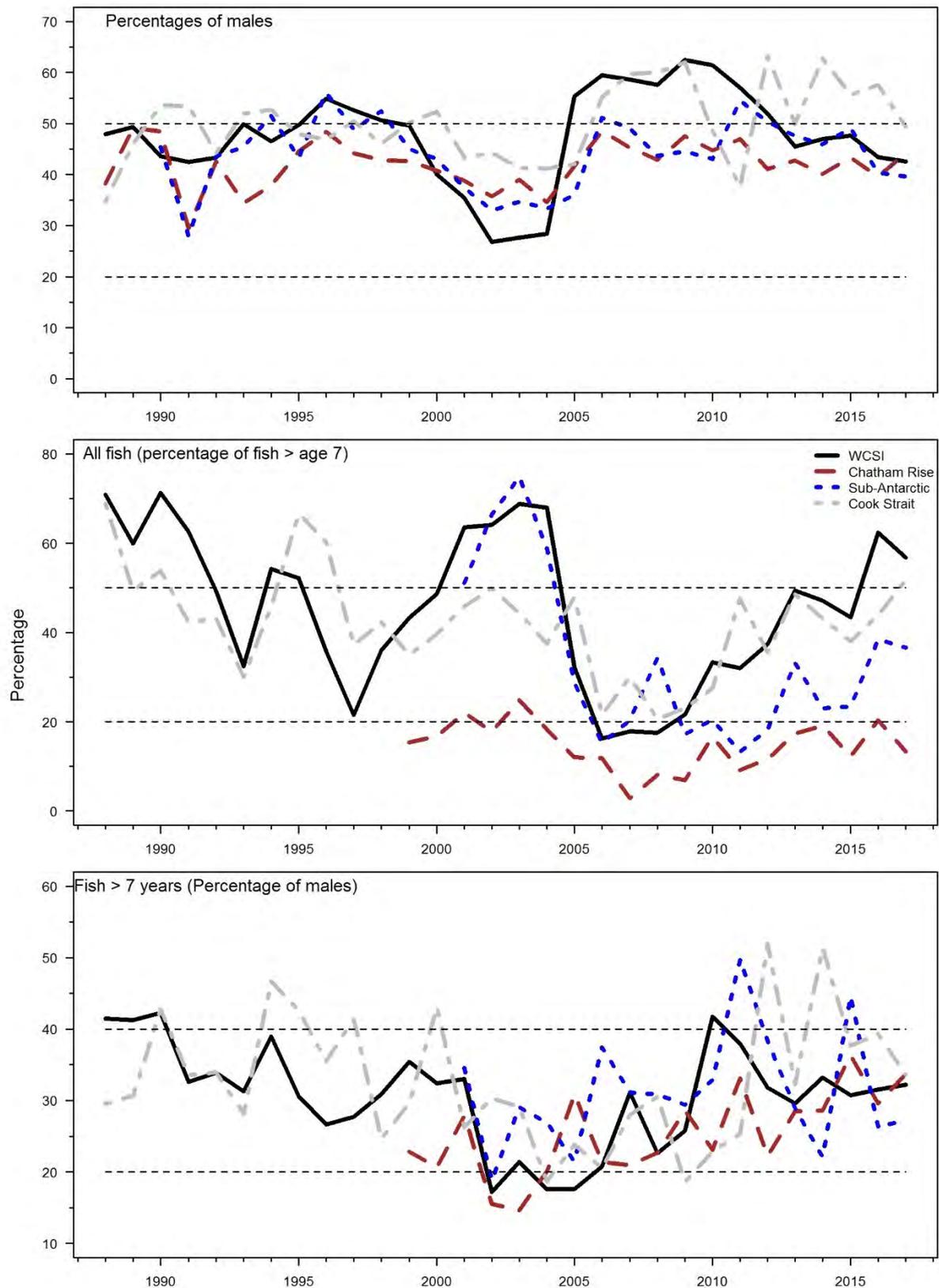


Figure 11a: Percentage of males in the catch, percentage of all fish aged 7 and older in the catch, and percentage of male fish (older than seven) in the catch, by area and fishing year. Legend for middle panel also applies to upper and lower panels.

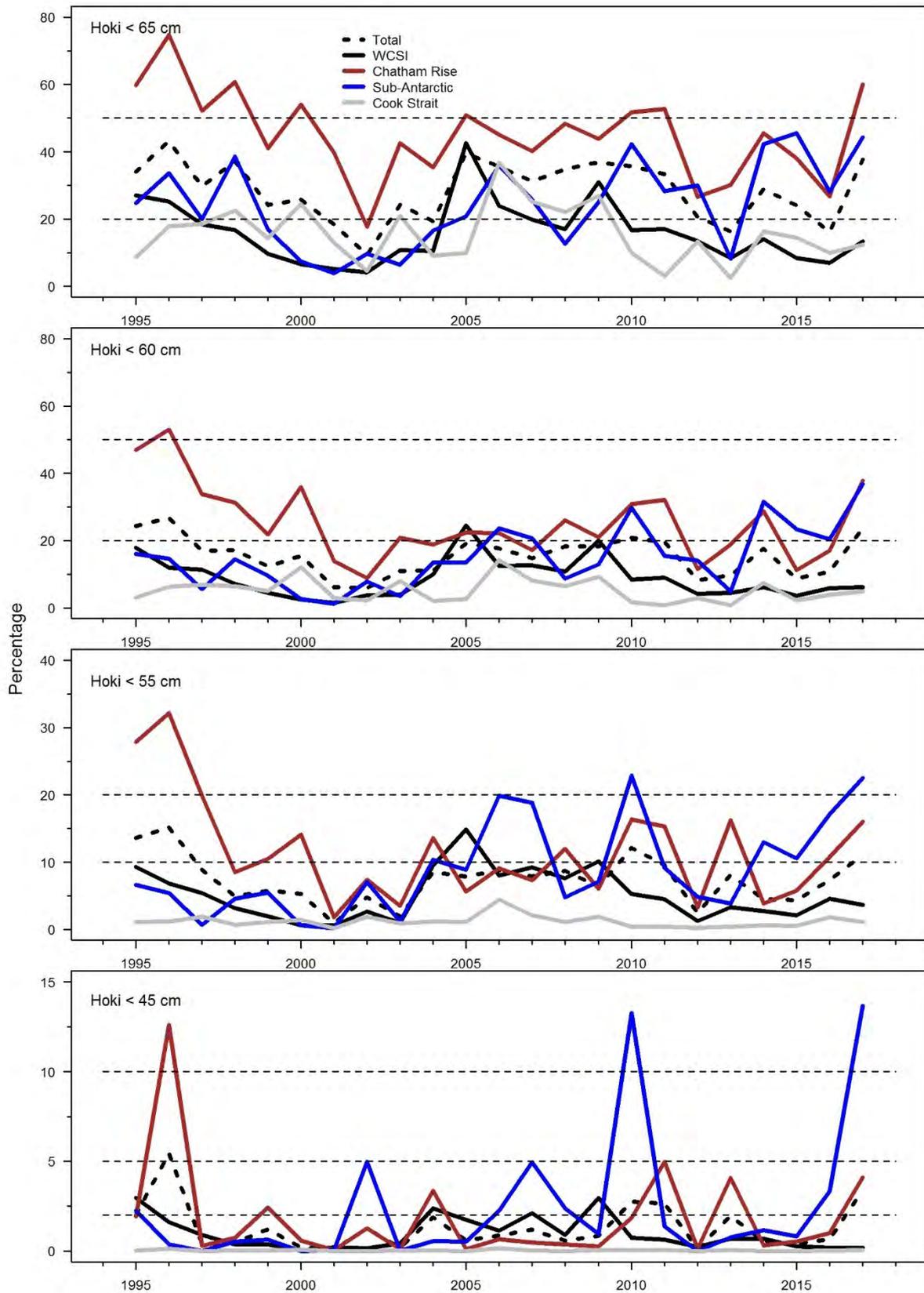


Figure 11b: Percentage of small fish in the catch by area and fishing year. Legend for top panel also applies to other panels.

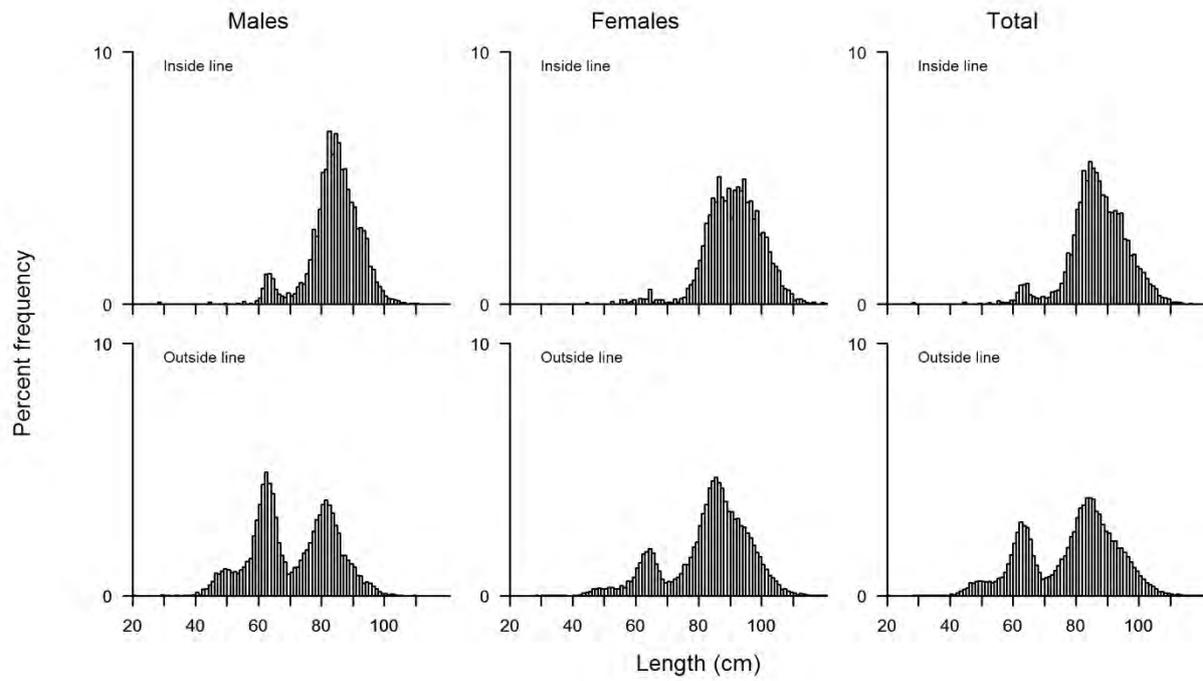


Figure 12: Comparison of length frequency distributions for WCSI hoki from inside and outside the 25 n. mile line in 2017. Inside the line length frequencies came from fish sampled at sea by the Observer Programme and from fish sampled in processing sheds by the land-based sampling programme, and outside the line length frequencies came from fish sampled at sea by the Observer Programme.

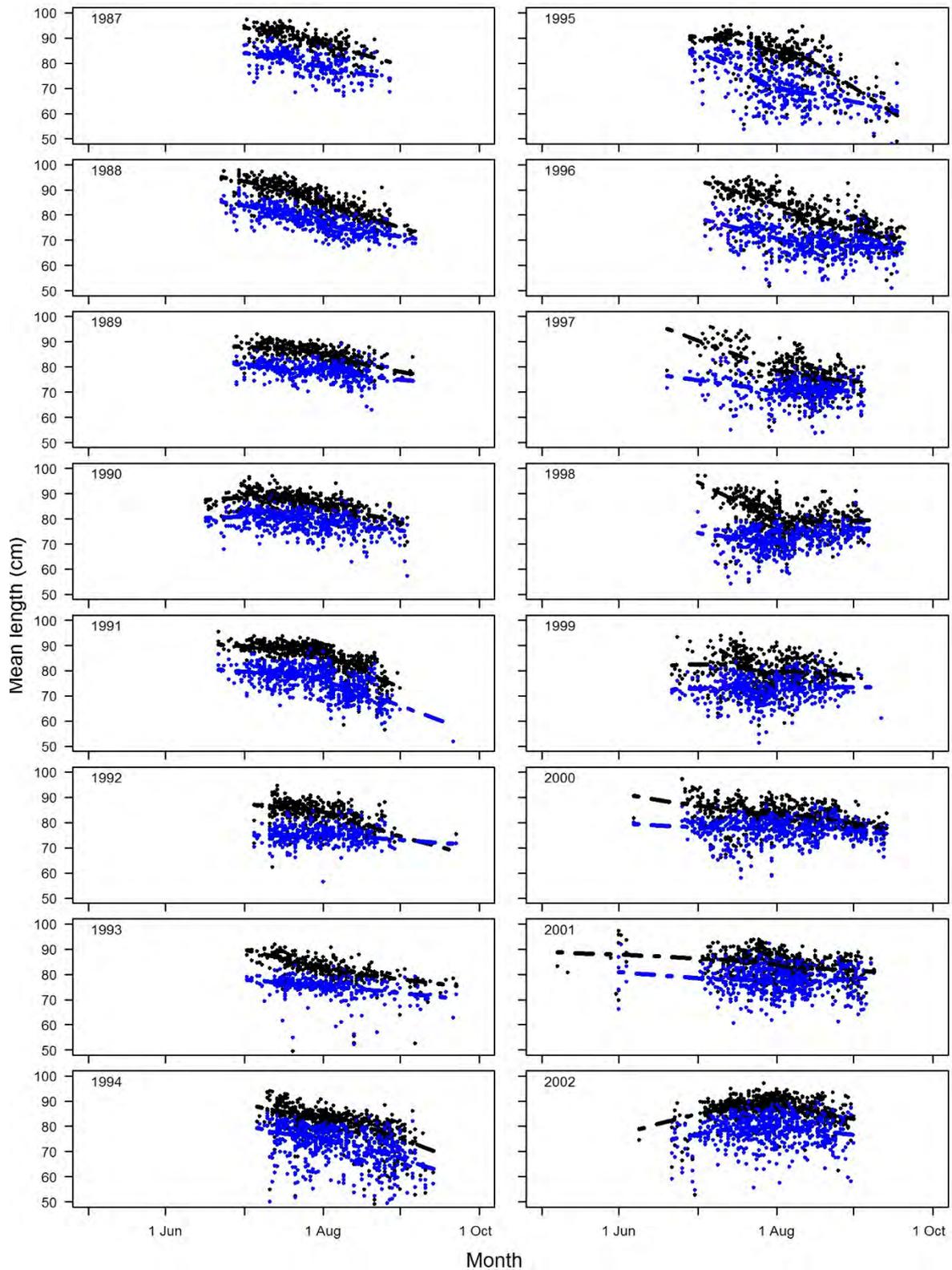


Figure 13: Mean length of female (black) and male (blue) hoki taken in commercial catches from the west coast South Island spawning fishery 1987–2017 sampled at sea by the Observer Programme. Dashed lines are a loess fit.

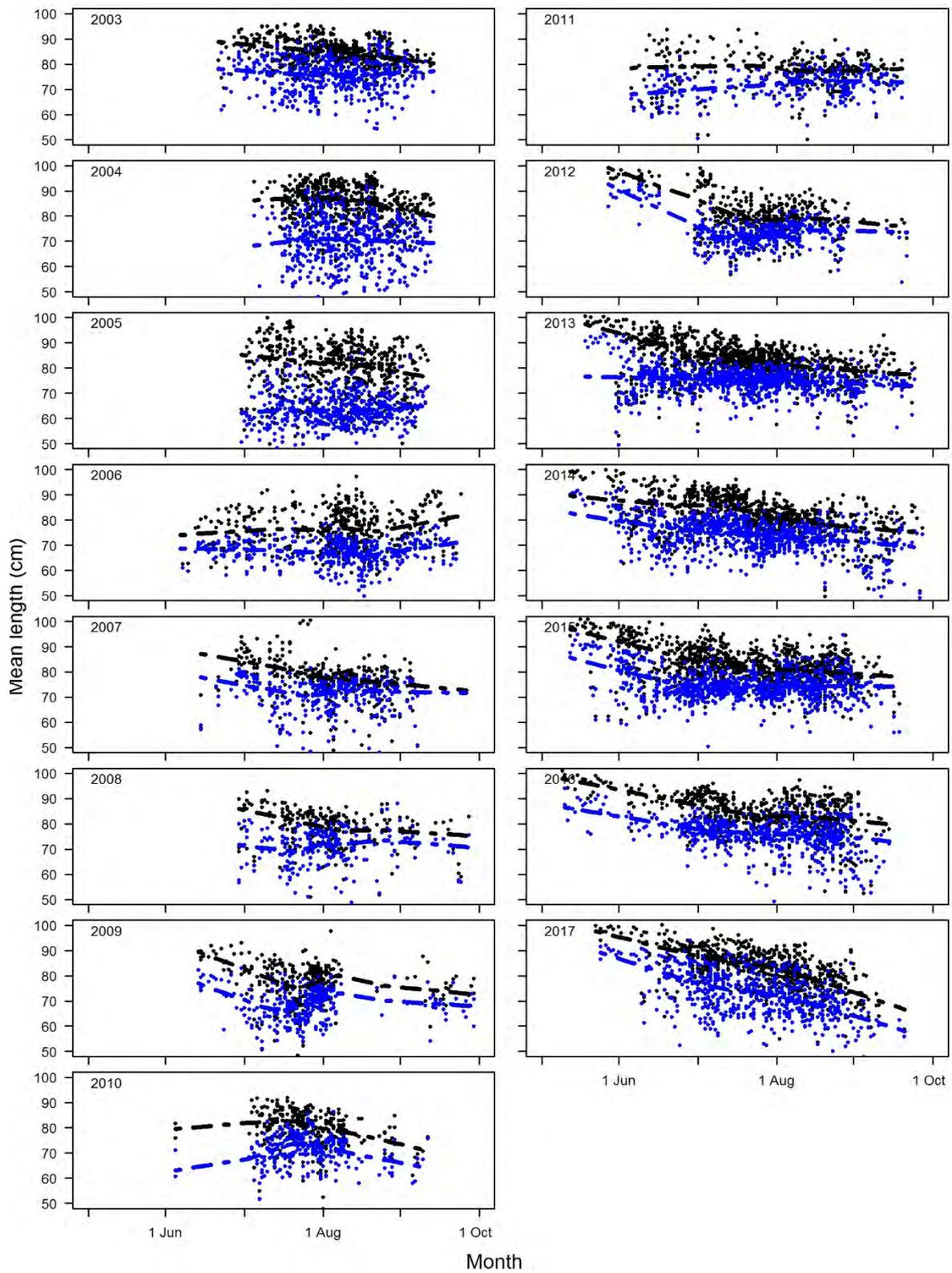


Figure 13 continued.

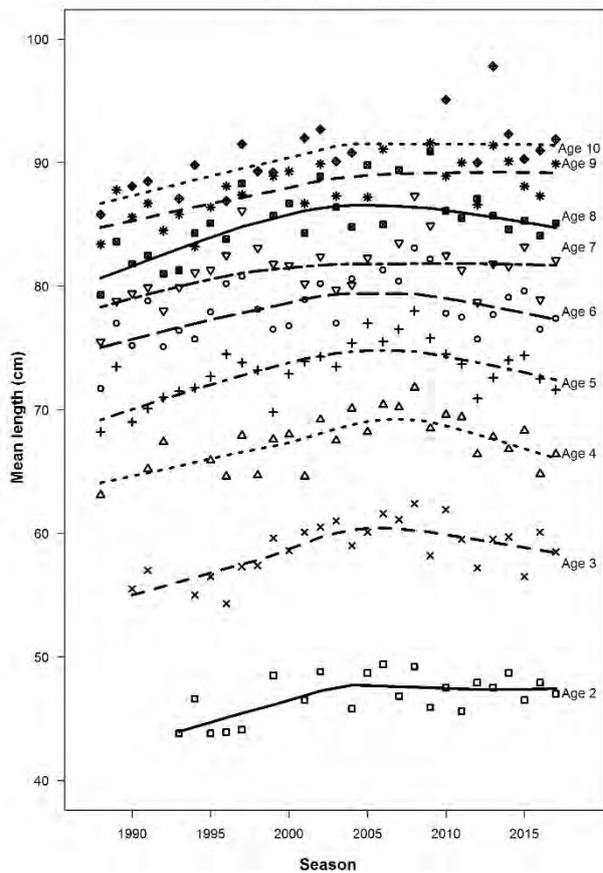
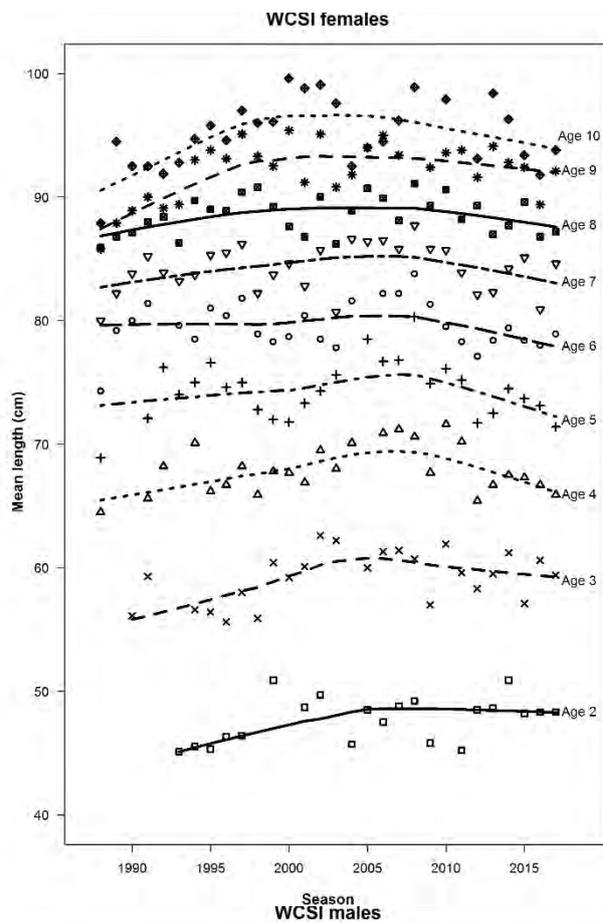


Figure 14: Mean length-at-age of female and male hoki taken in commercial catches from the west coast South Island spawning fishery 1988–2017 sampled at sea by the Observer Programme, and by NIWA in a land-based sampling programme in some years. Lines are a loess fit. Points with fewer than ten records were excluded.

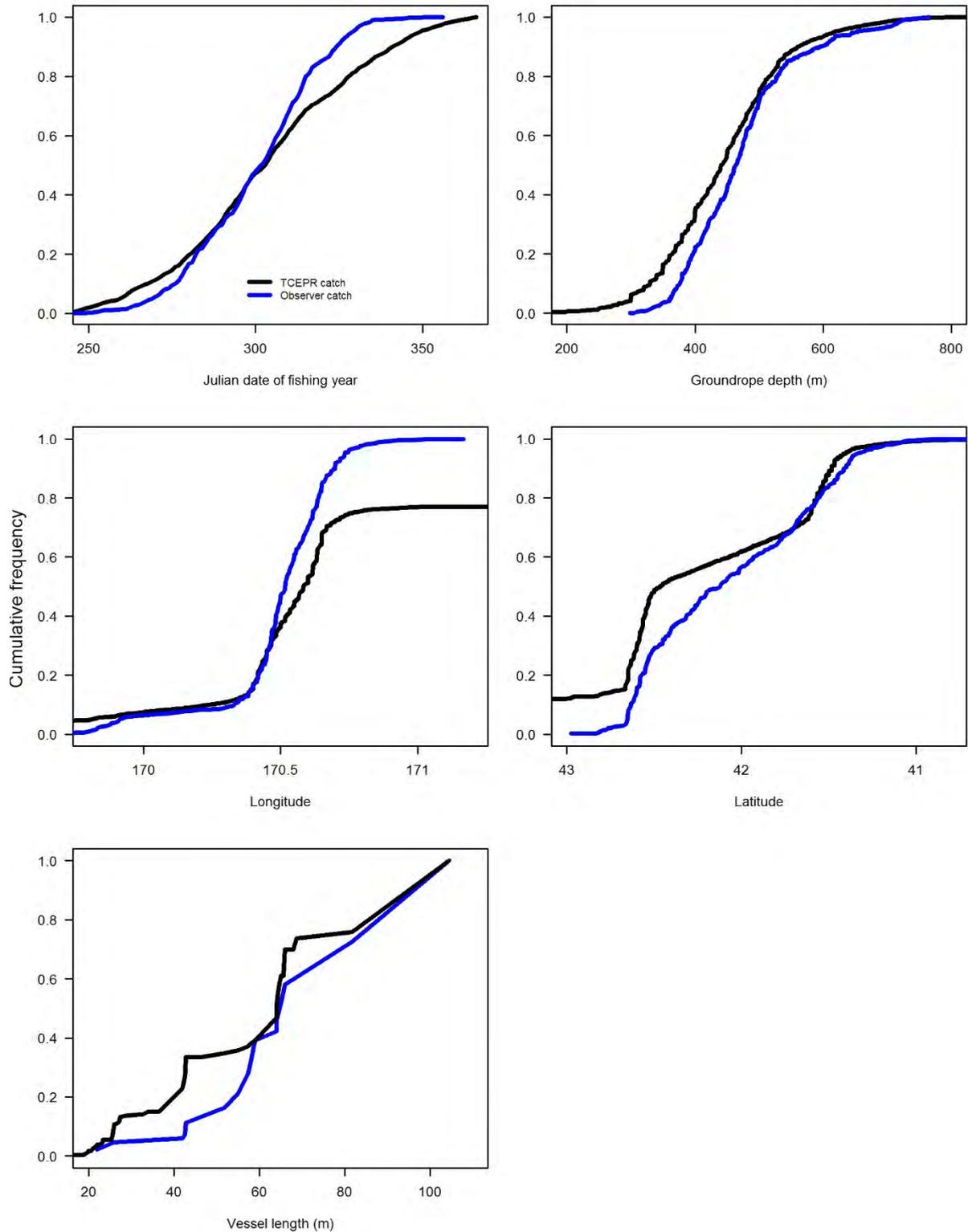


Figure 15: Comparison of WCSI 2016–17 Observer Programme catch coverage with TCEPR catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then the blue lines (observed catches) should overlay the black lines (TCEPR catch).

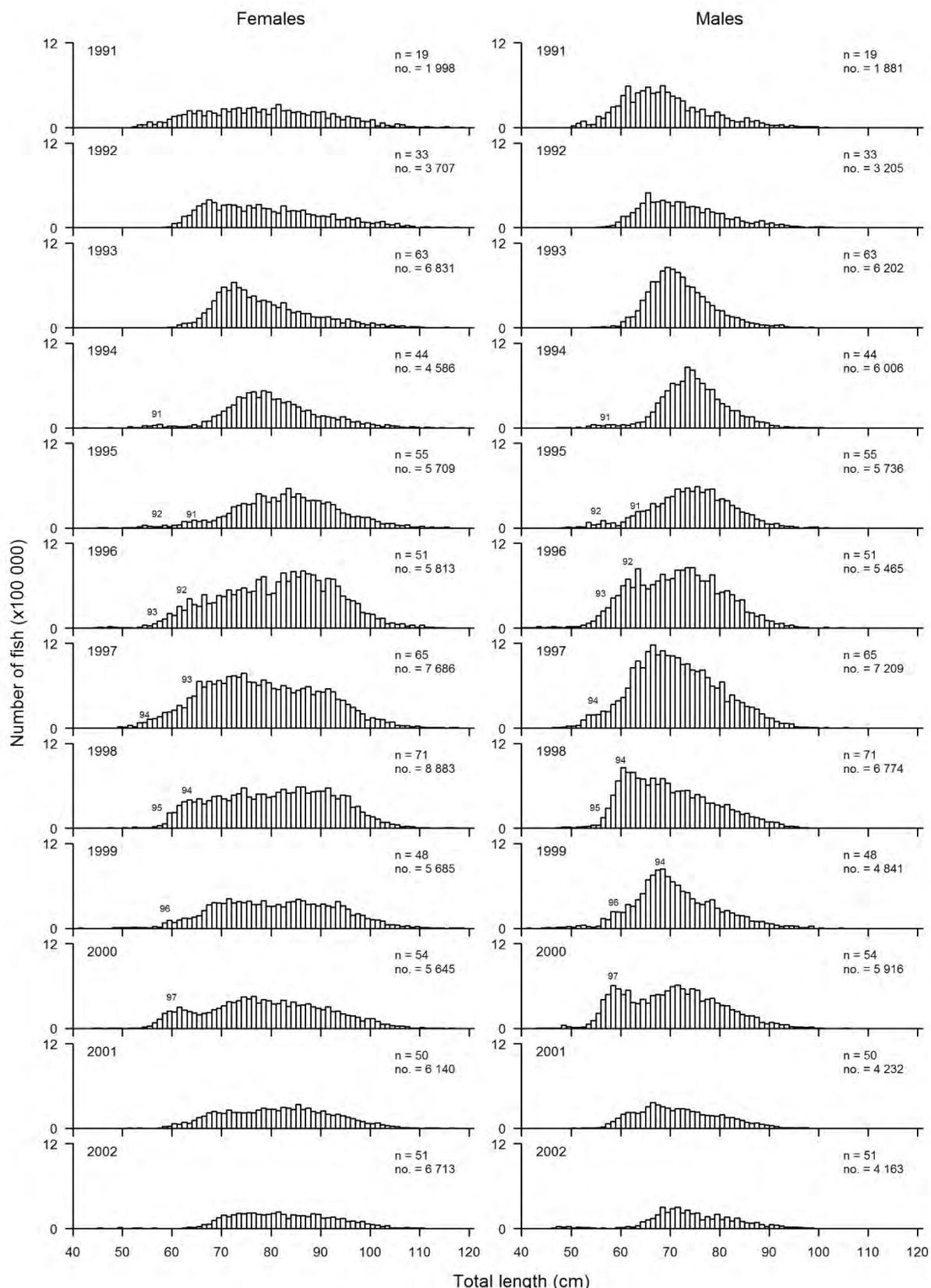


Figure 16: Length frequency distributions of hoki in commercial catches from the Cook Strait spawning fishery from 1991 to 2017 sampled by the land-based sampling programme, and at sea by the Observer Programme. n, number of landings sampled; no., number of fish sampled. Numbers above the histograms mark year-class modes, e.g., 91 = 1991 year-class.

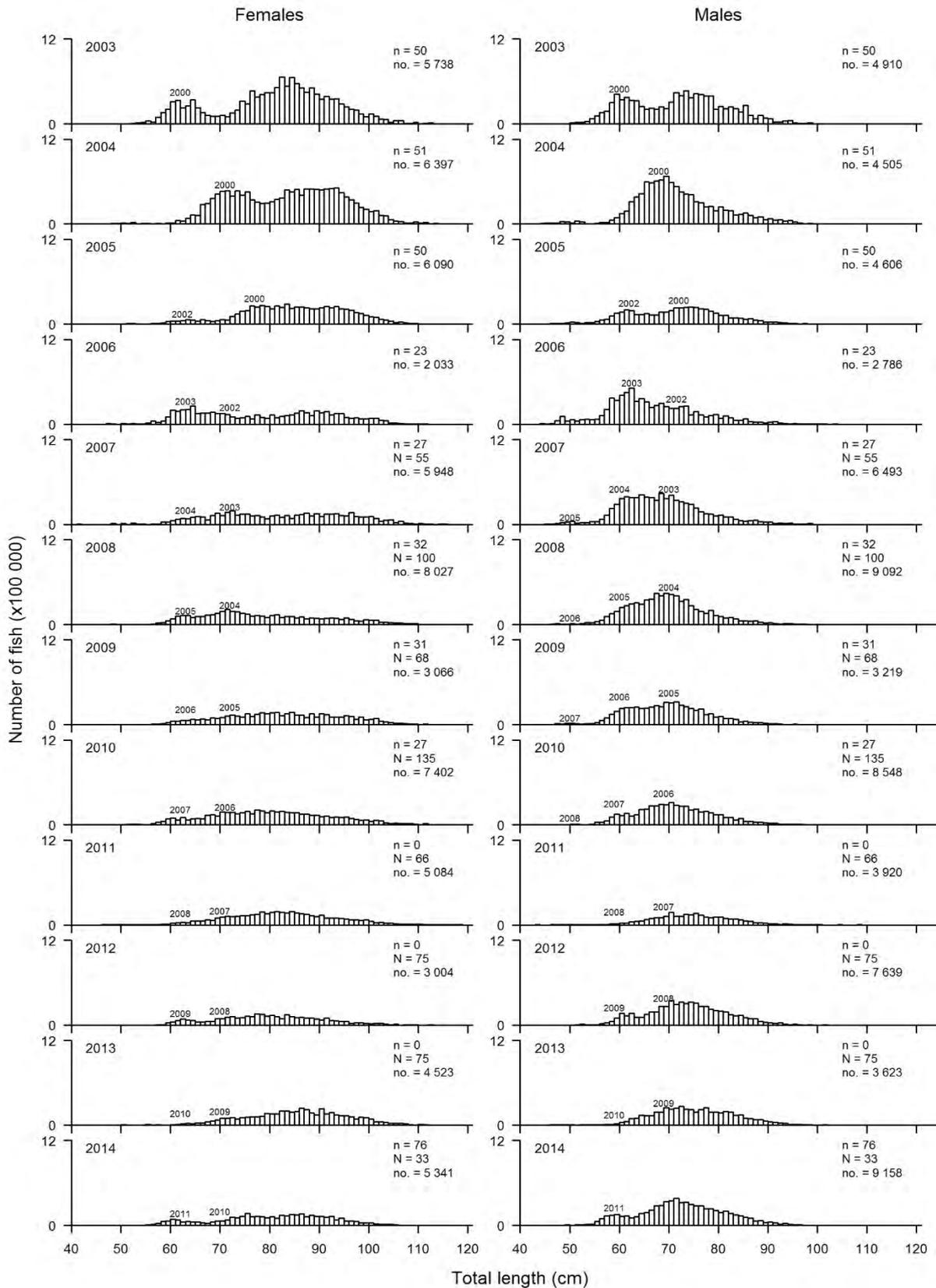


Figure 16 continued.

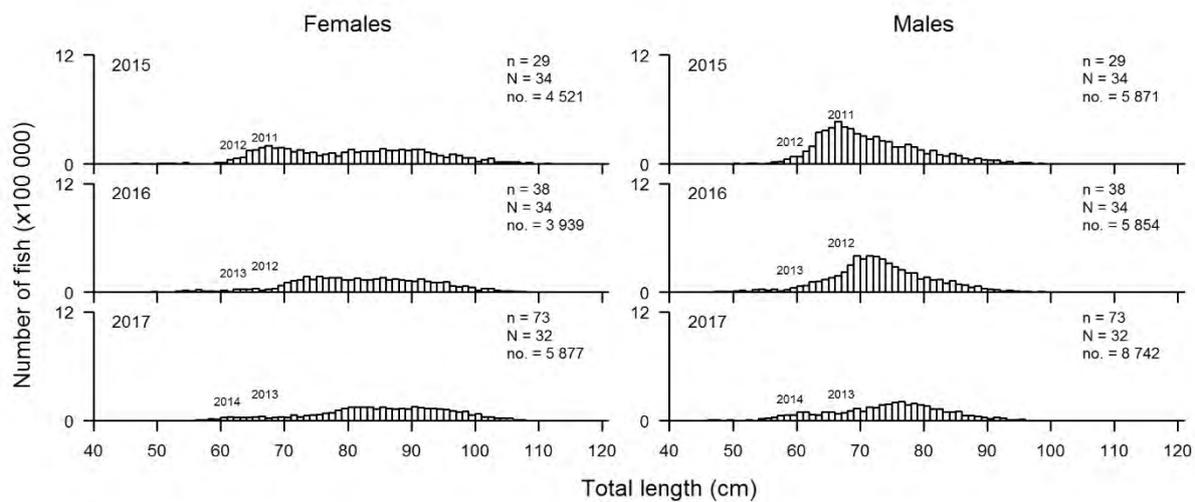


Figure 16 continued.

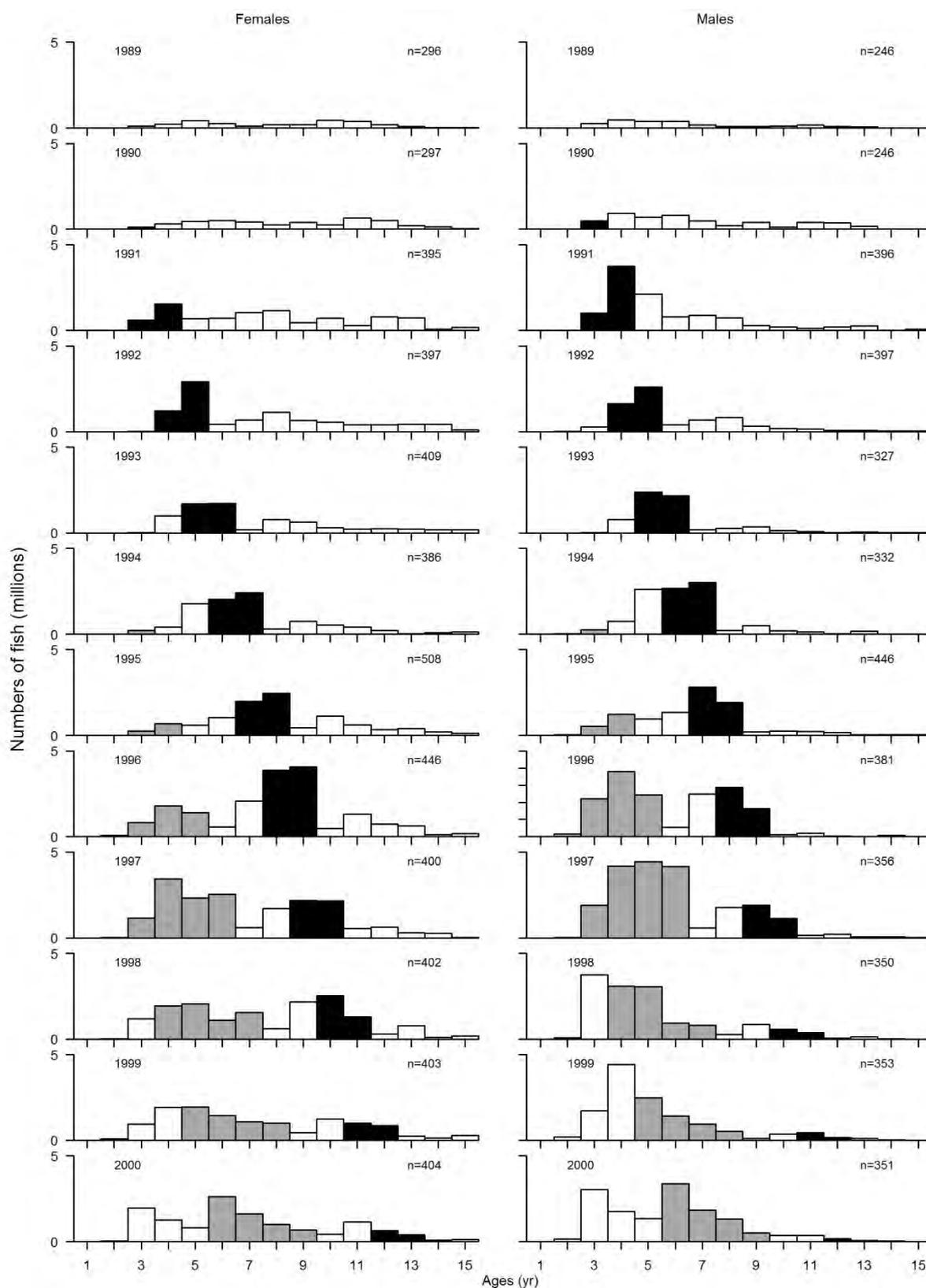


Figure 17: Catch-at-age of hoki in commercial catches from the Cook Strait spawning fishery from 1988 to 2017 sampled by the land-based sampling programme, and at sea by observers. 2006 data excluded Nelson land-based samples from vessels of at least 40 m length which sorted their catch at sea. Black bars show 1987 and 1988 year-classes; dark grey bars show 1991–94 year-classes.

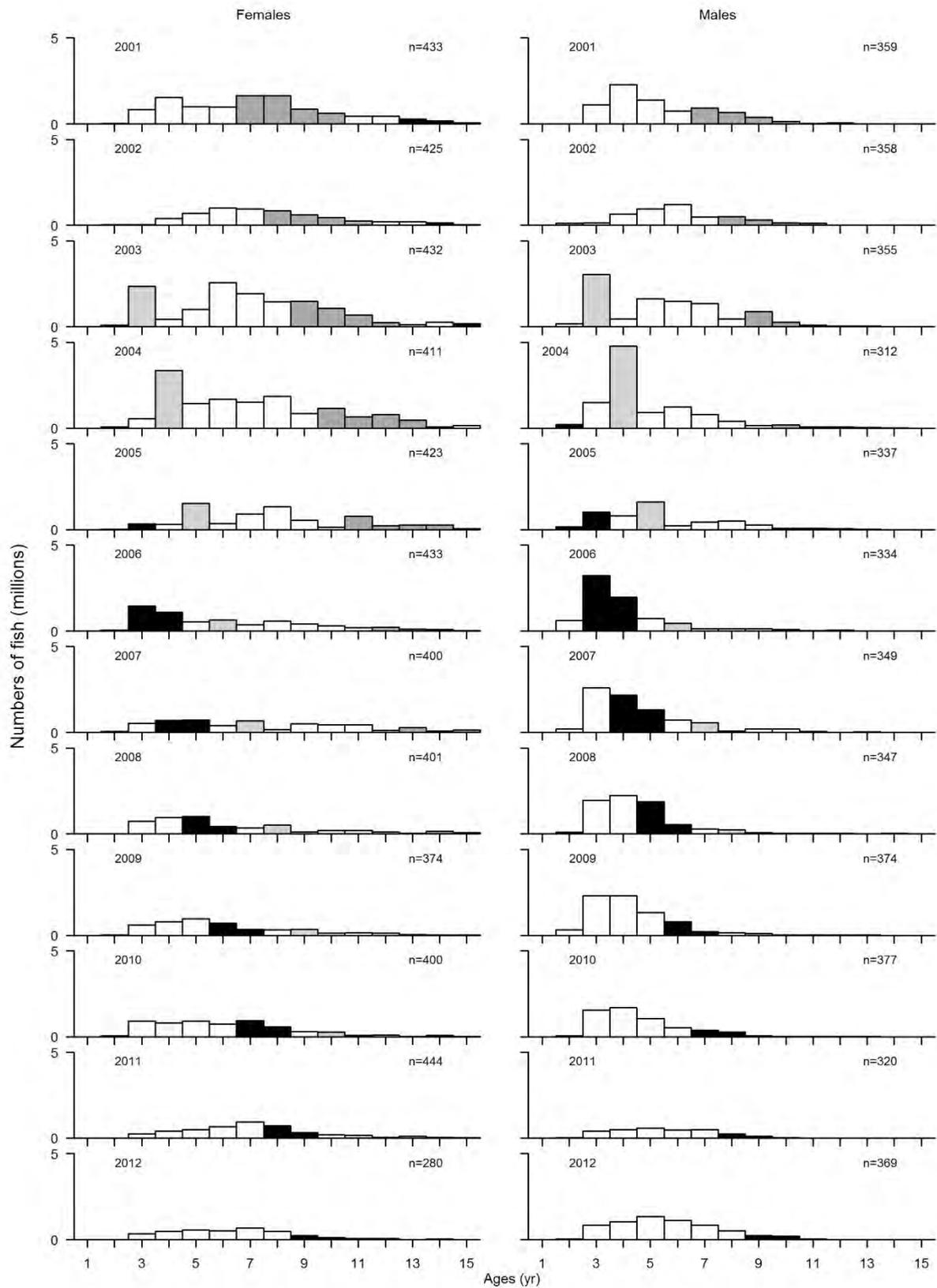


Figure 17 continued. Dark grey bars show 1991–94 year-classes; light grey bars show the 2000 year-class; and black bars show the 2002–2003 year-classes.

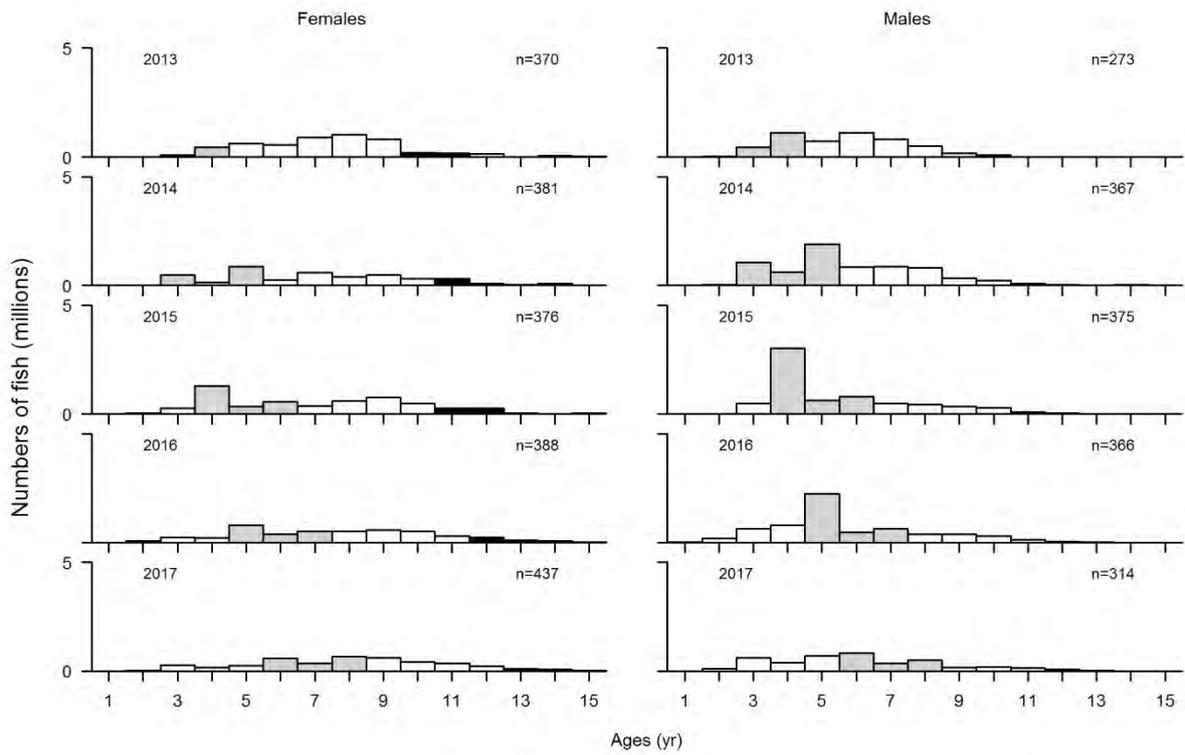


Figure 17 continued. Black bars show the 2002–2003 year-classes; dark grey bars represent the 2009–2011 year classes.

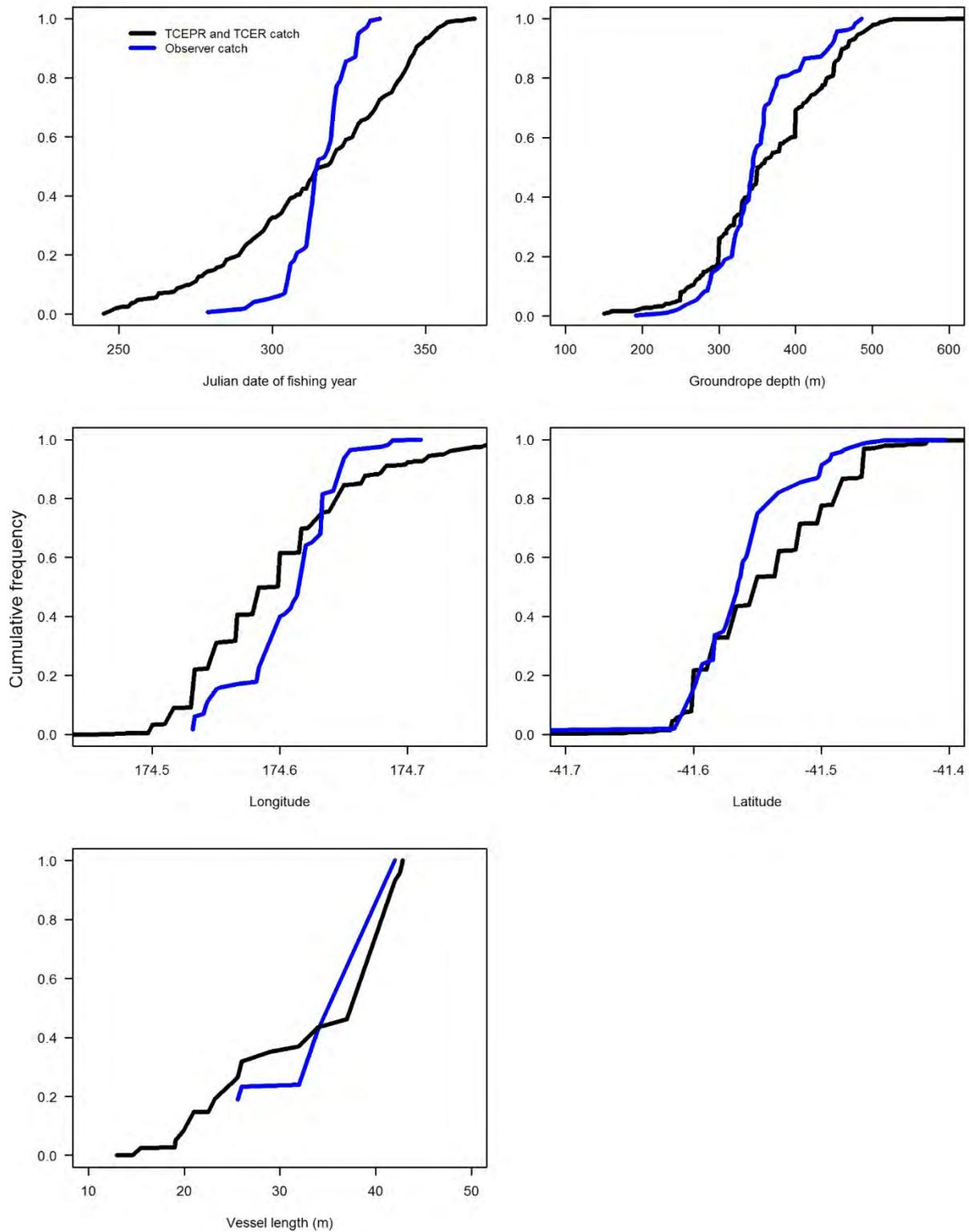


Figure 18: Comparison of Cook Strait 2016–17 Observer Programme catch coverage for TCEPR and TCER catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then the blue lines (sampled catches) should overlay the black lines (catches).

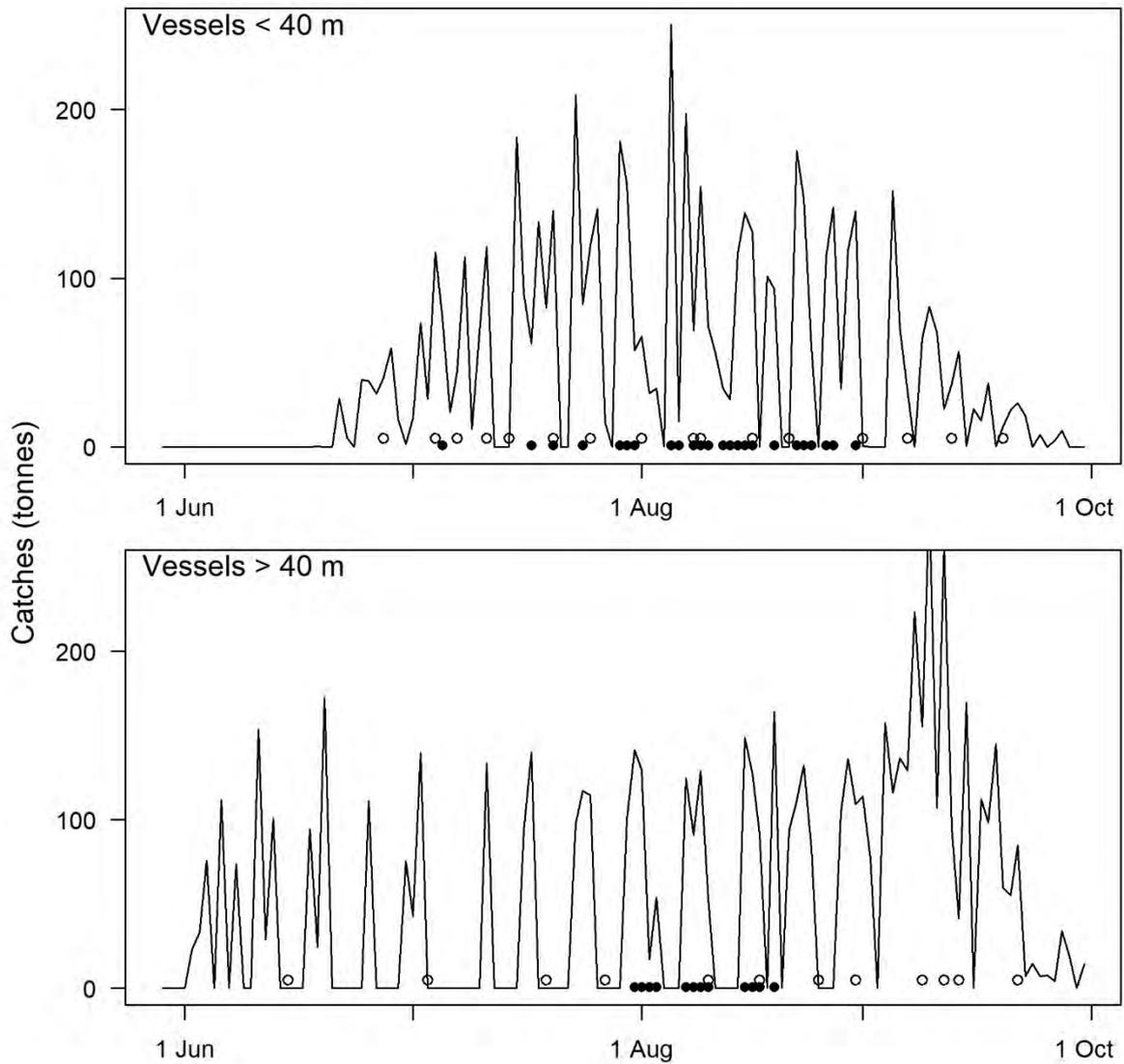


Figure 19: Cook Strait 2016–17 catch by day for vessels less than 40 m and 40 m or longer during the spawning season, showing timing of Observer Programme samples (black dots), and land-based samples (hollow dots).

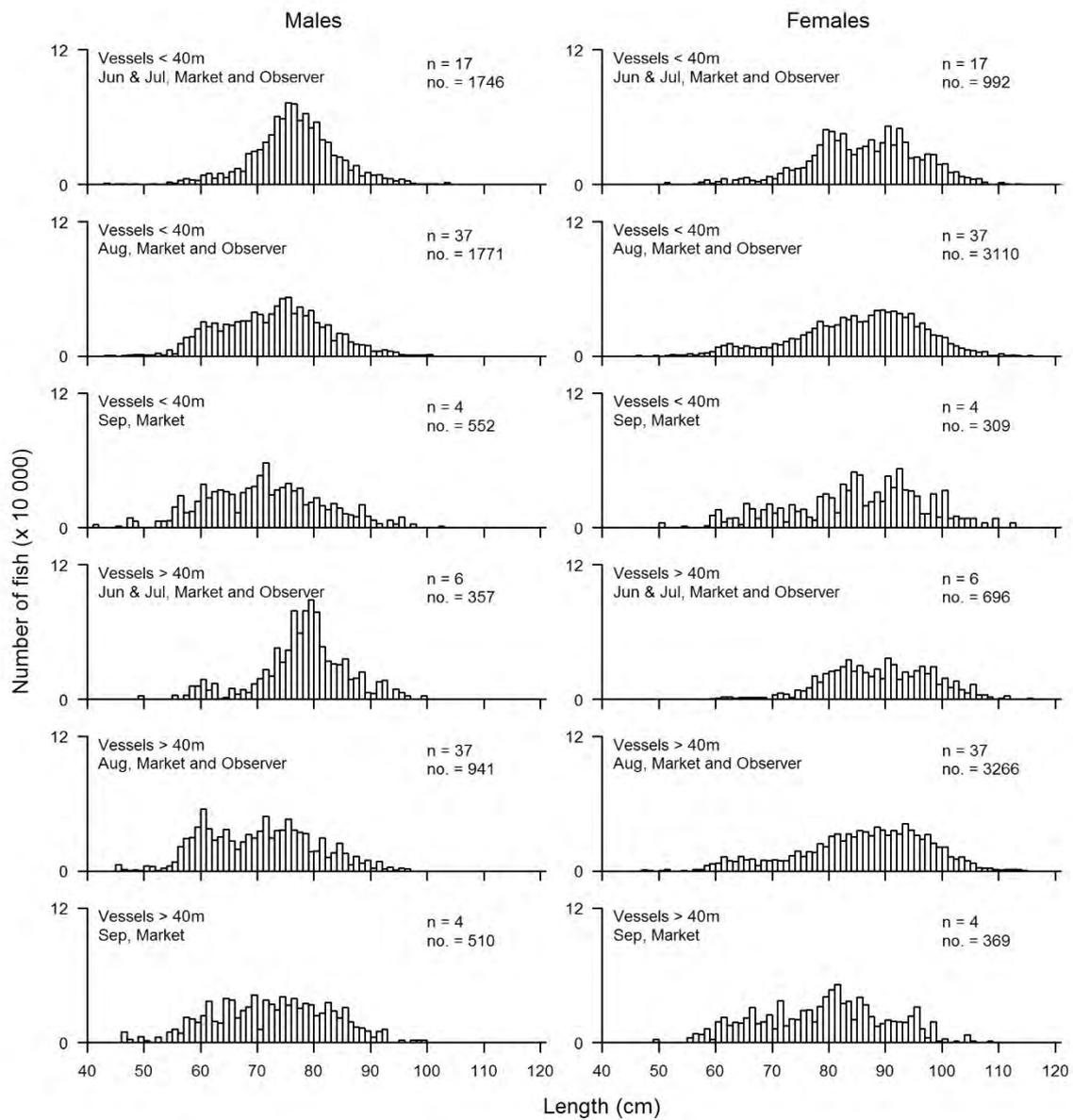


Figure 20: Comparison of length frequency distributions of hoki, by strata, taken in commercial catches from Cook Strait during 2017. Data from Observer Programme and land-based sampling. n, number of tows or landings sampled; no., number of fish sampled.

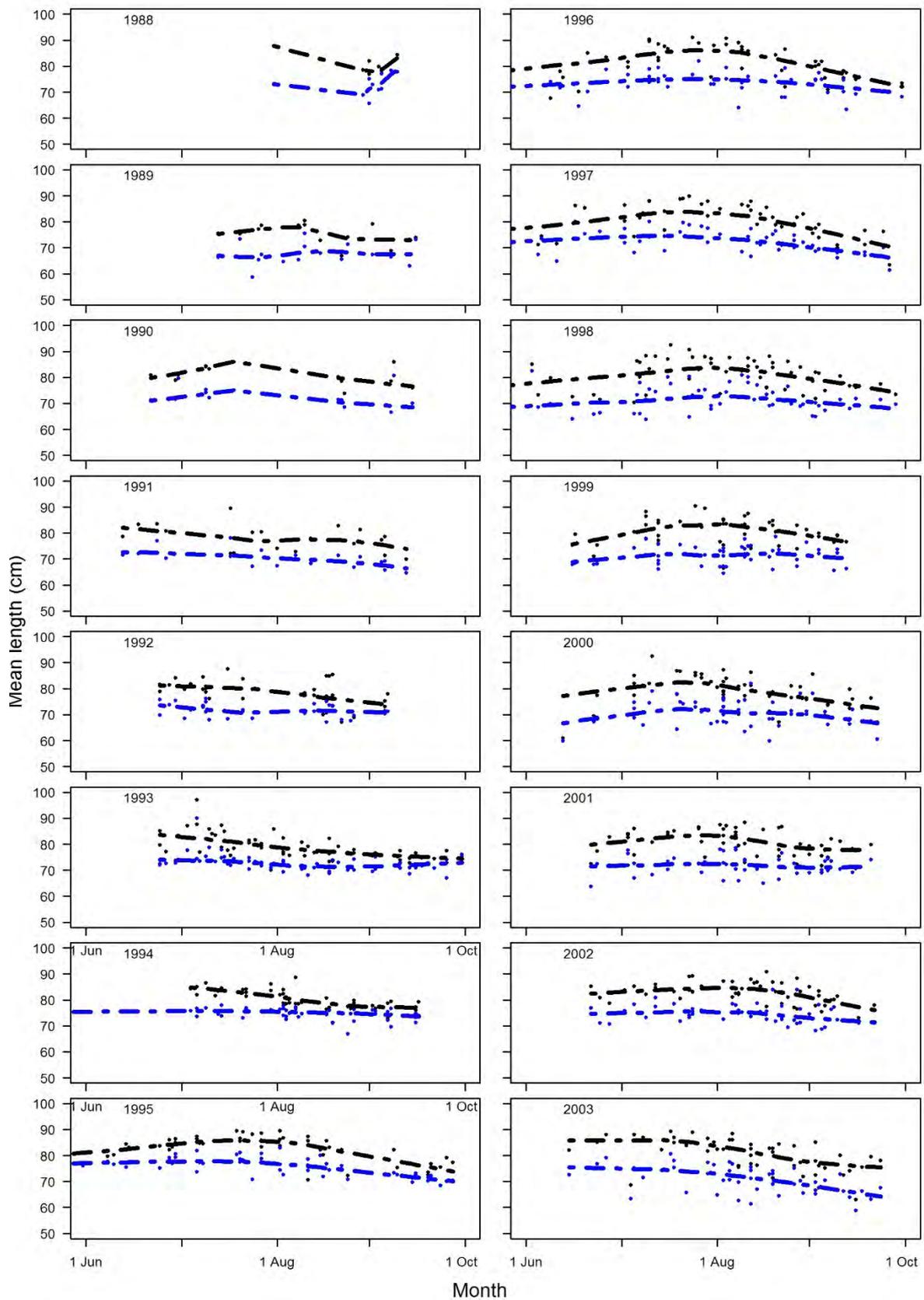


Figure 21: Mean length of female (black) and male (blue) hoki taken in commercial catches from the Cook Strait spawning fishery 1989–2017 sampled by NIWA in a land-based sampling programme. Lines are a loess fit.

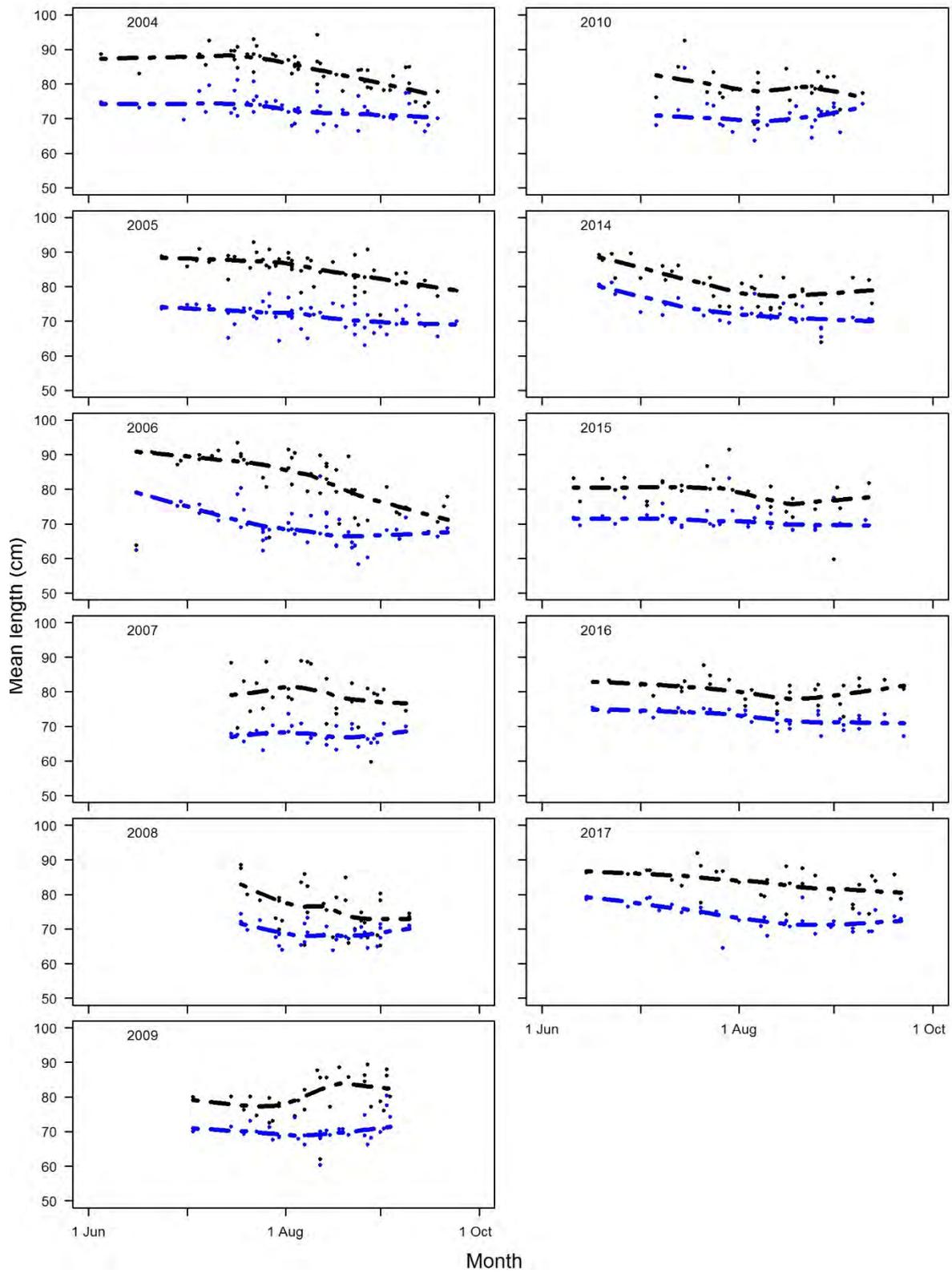


Figure 21 continued.

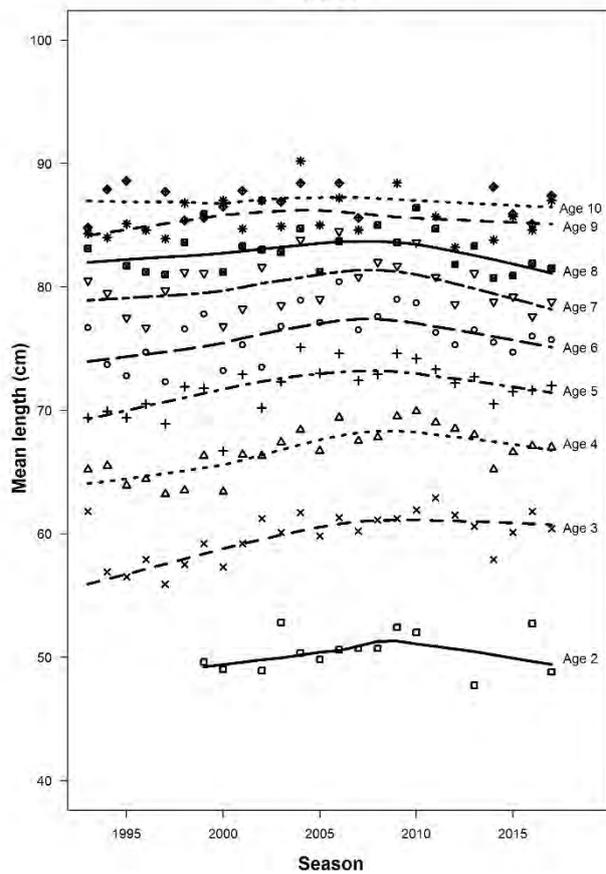
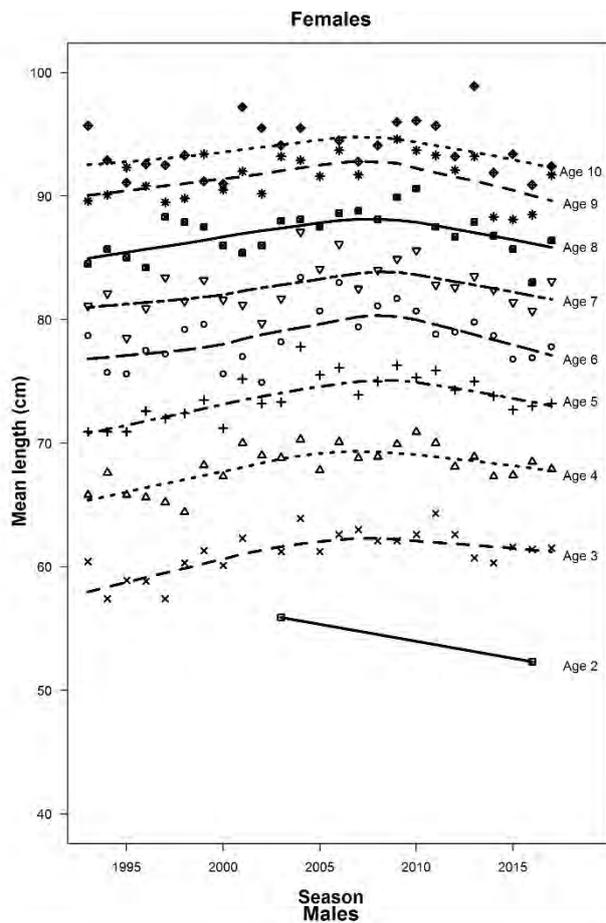


Figure 22: Mean length-at-age of female and male hoki taken in commercial catches from the Cook Strait spawning fishery 1988–2017 sampled at sea by the Observer Programme and by NIWA in a land-based sampling programme. Lines are a loess fit. Points with fewer than ten records were excluded.

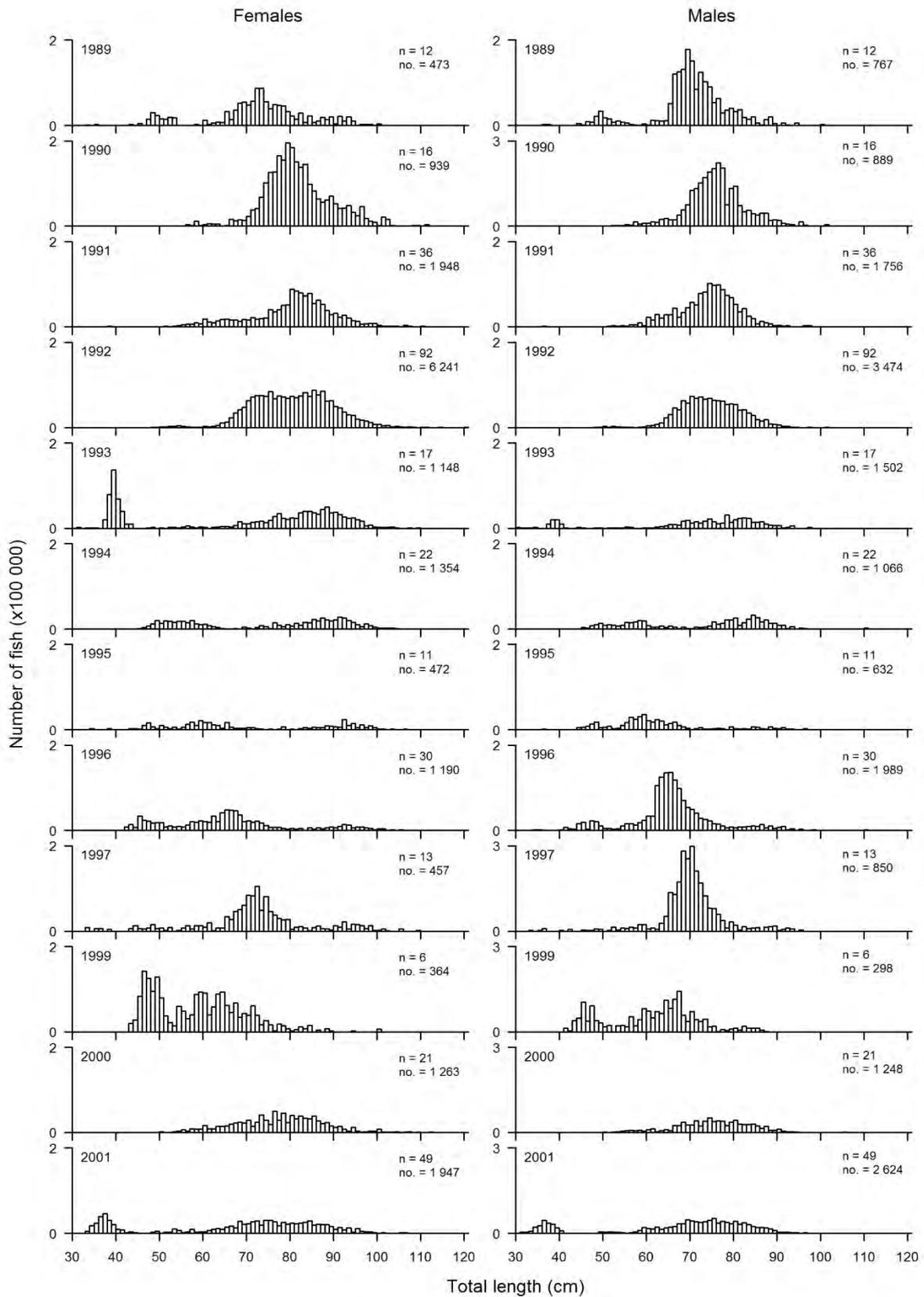


Figure 23: Length frequency distributions of hoki in commercial catches from the Puysegur spawning fishery from 1989 to 1997, and 1999 to 2017 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled.

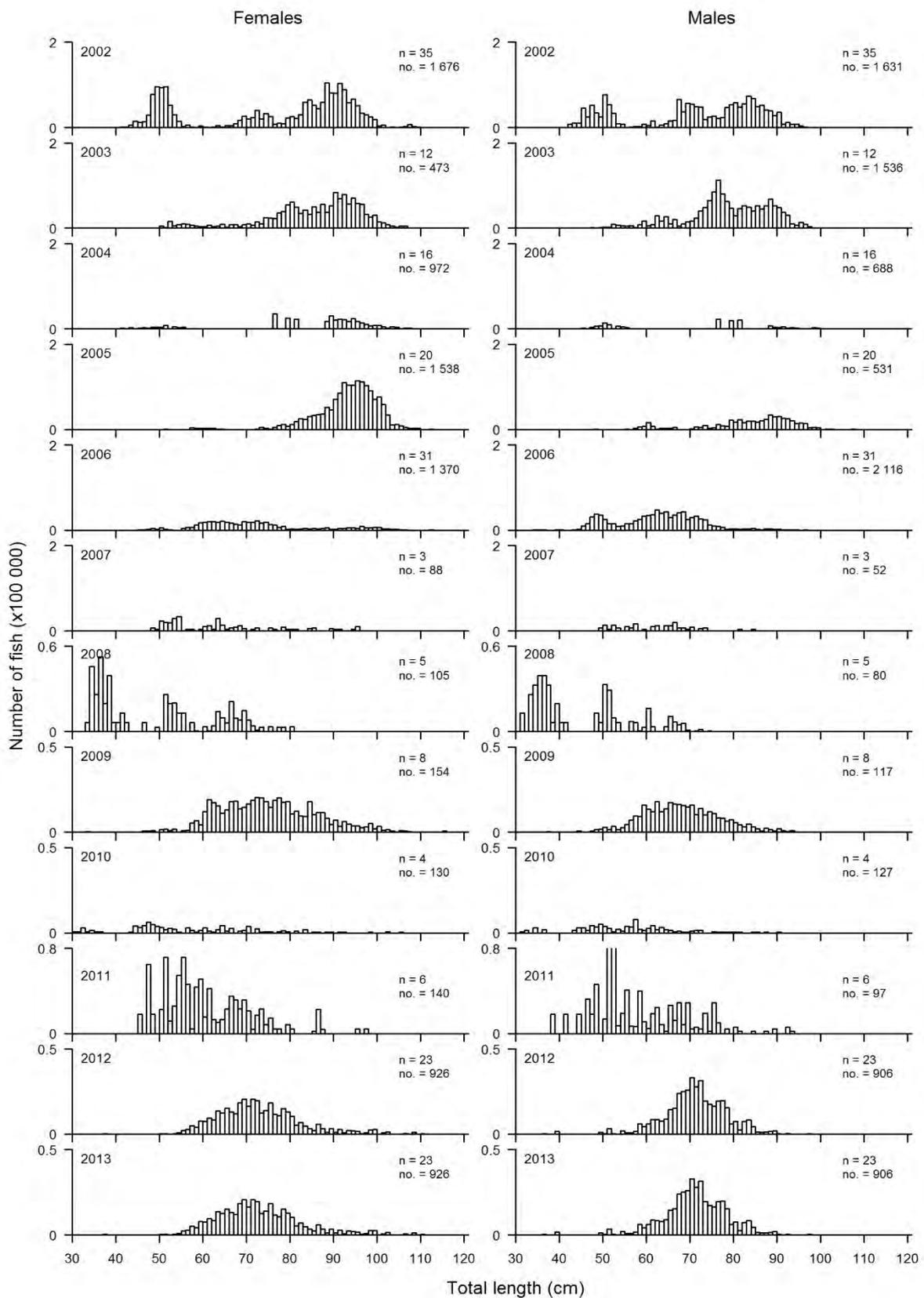


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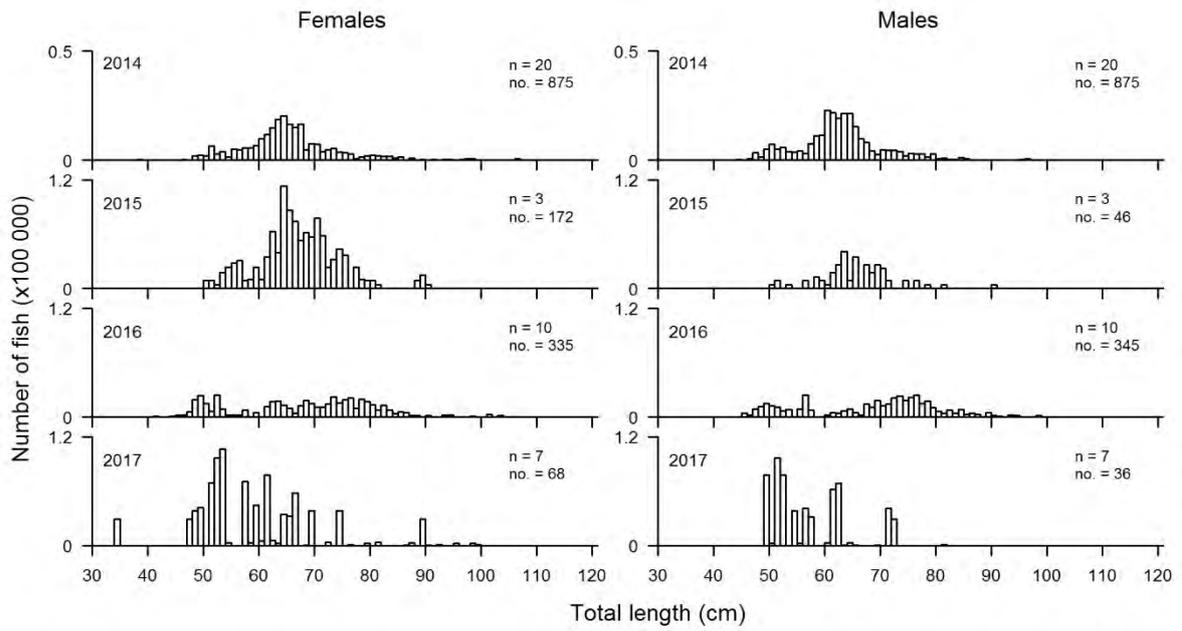


Figure 23 continued.

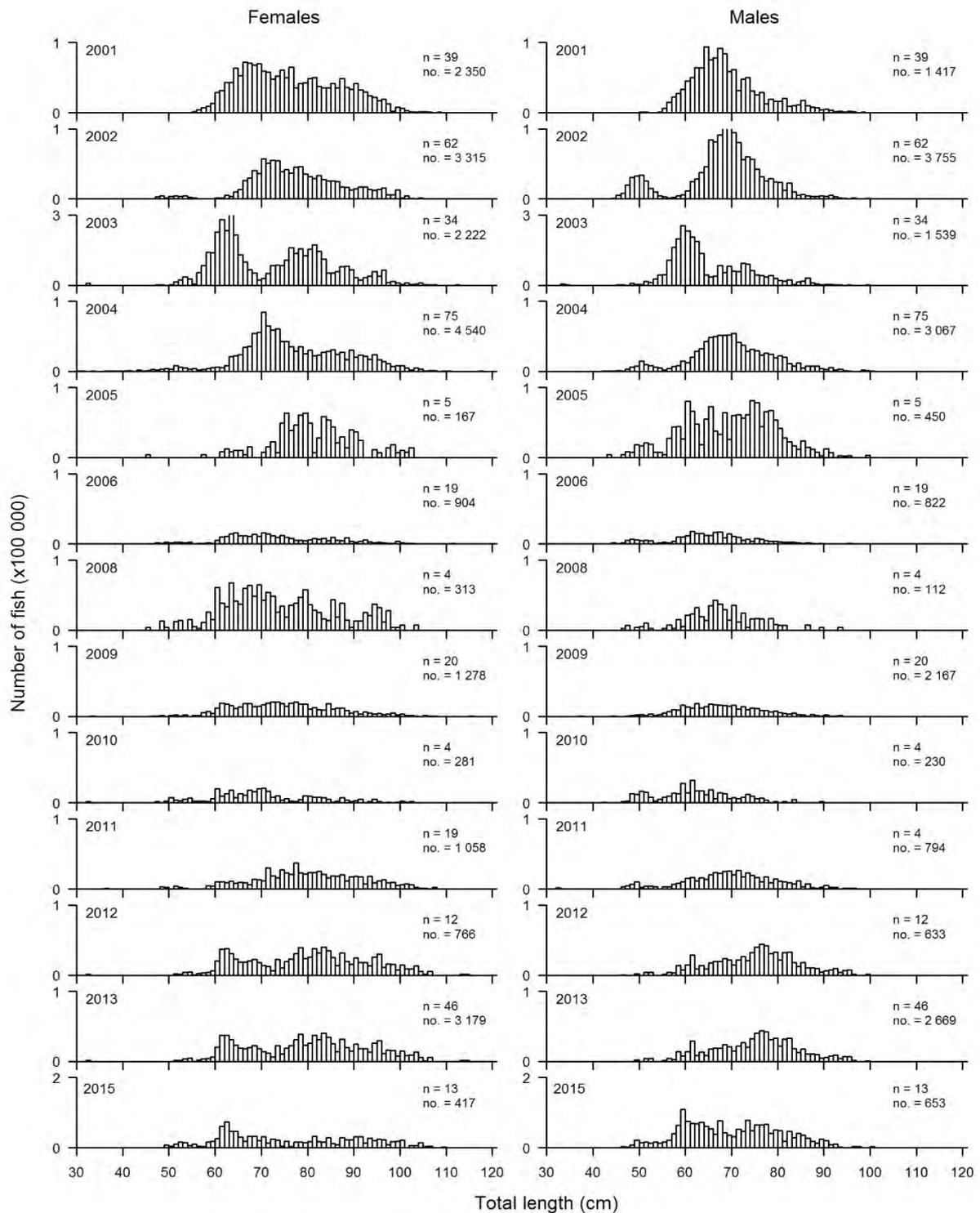


Figure 24: Length frequency distributions of hoki taken in commercial catches from the ECSI spawning fishery from 2001 to 2017 sampled by the Scientific Observer Programme (2001–2006, 2008–2013, 2015–2017), combined with Hoki Management Company data (2001 to 2005). n, number of tows sampled; no., number of fish sampled.

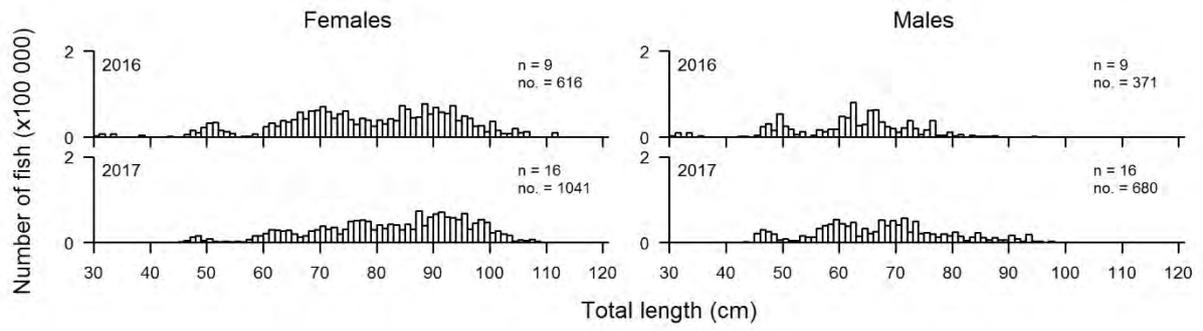


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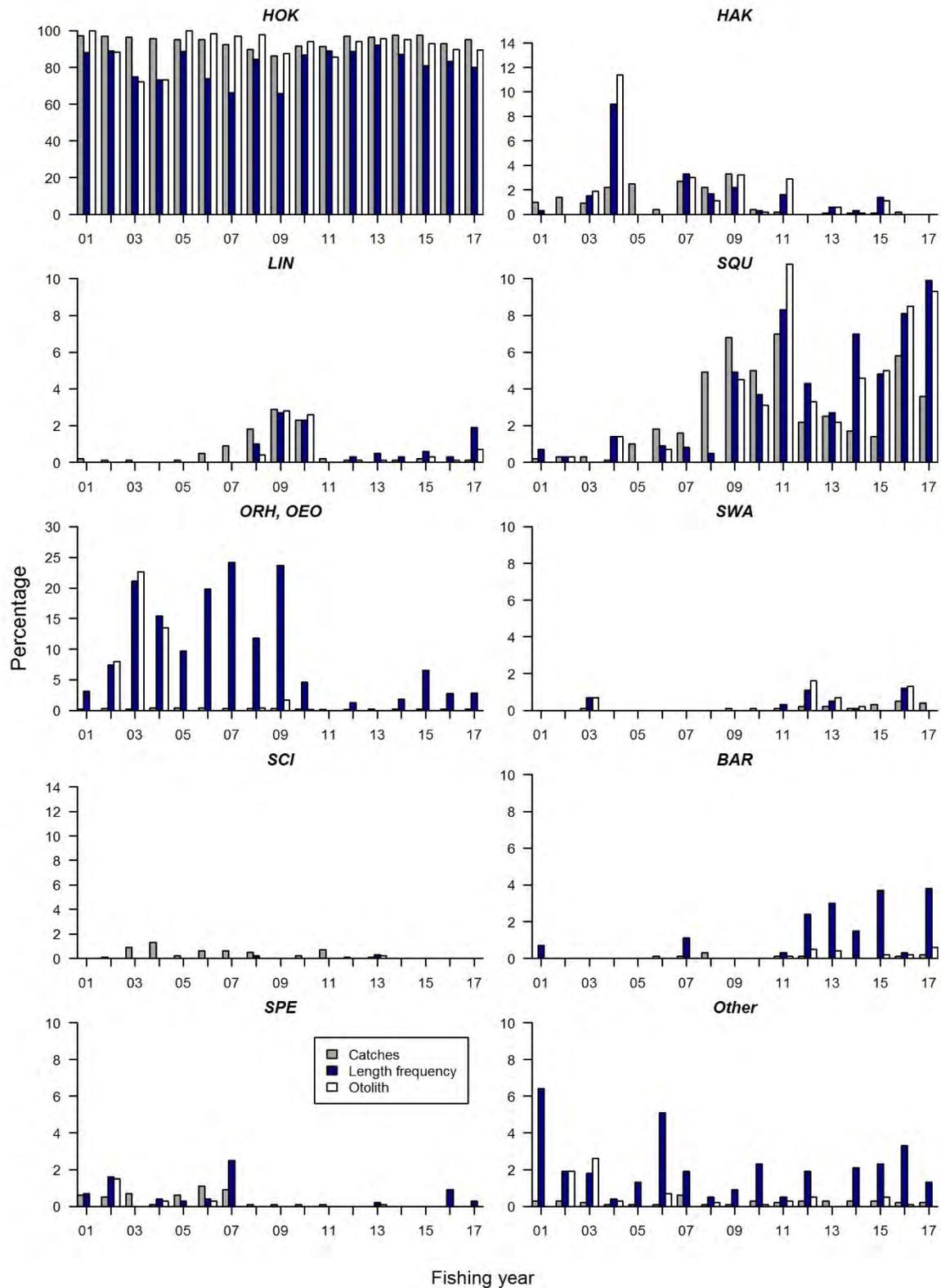


Figure 25: Percentage of hoki TCEPR, CELR and TCER catch, hoki length frequency samples, and hoki otoliths collected by the Observer Programme, by target species for the Chatham Rise fishery from 2000–01 to 2016–17. Three-letter codes denote target species: HOK, hoki; ORH, orange roughy; OEO, oreos; SQU, squid; SWA, silver warehou; HAK, hake; SCI, scampi; LIN, ling; BAR, barracouta; SPE, sea perch; Other, all other target species combined.

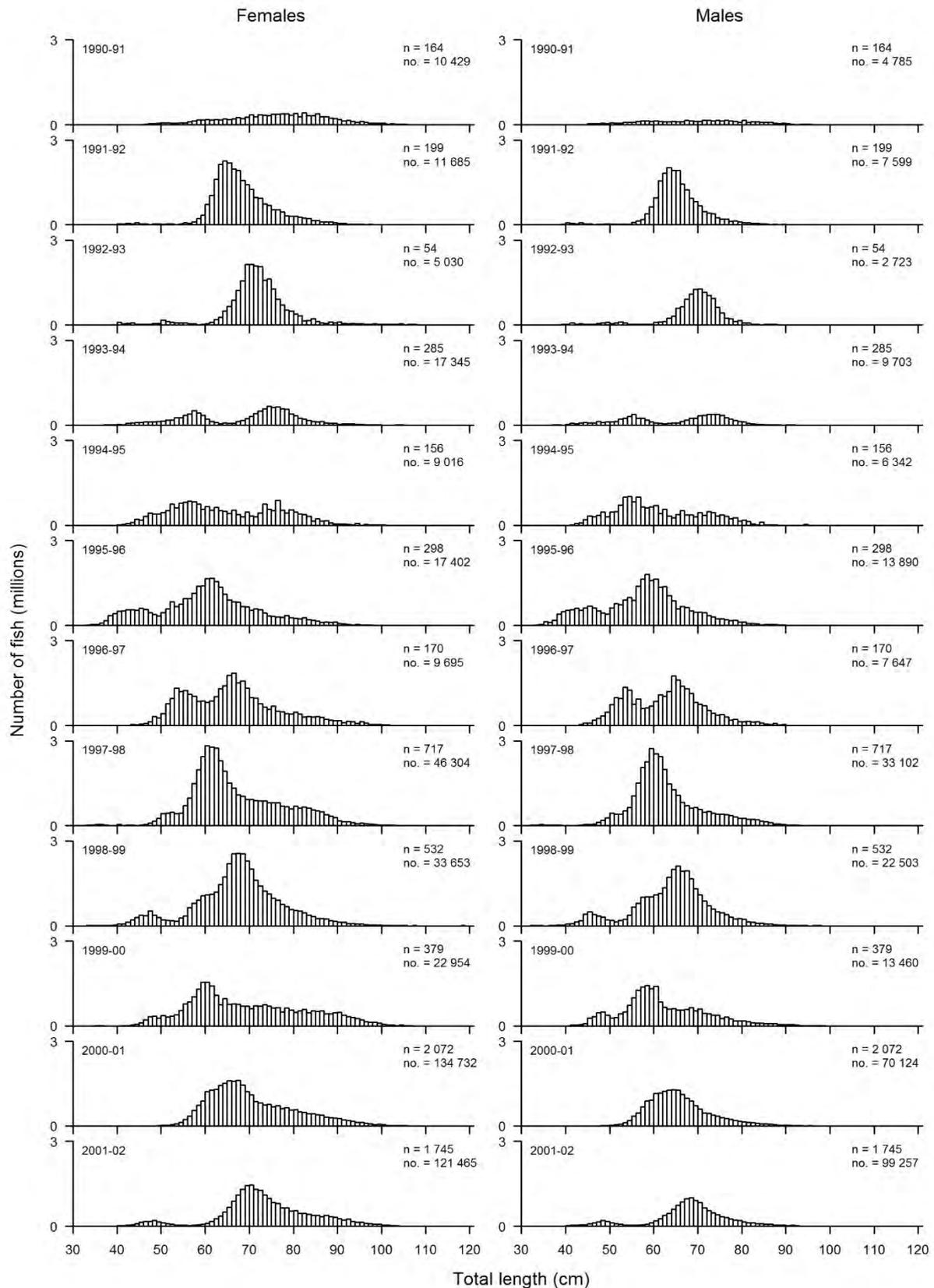


Figure 26: Length frequency distributions of hoki taken in commercial catches from the Chatham Rise fishery from 1990–91 to 2016–17 sampled by the Observer Programme (and combined with Hoki Management Company data in 2000–01 to 2003–04) for all target species. 2006–07 data included only target hoki and hake tows. n, number of tows sampled; no., number of fish sampled.

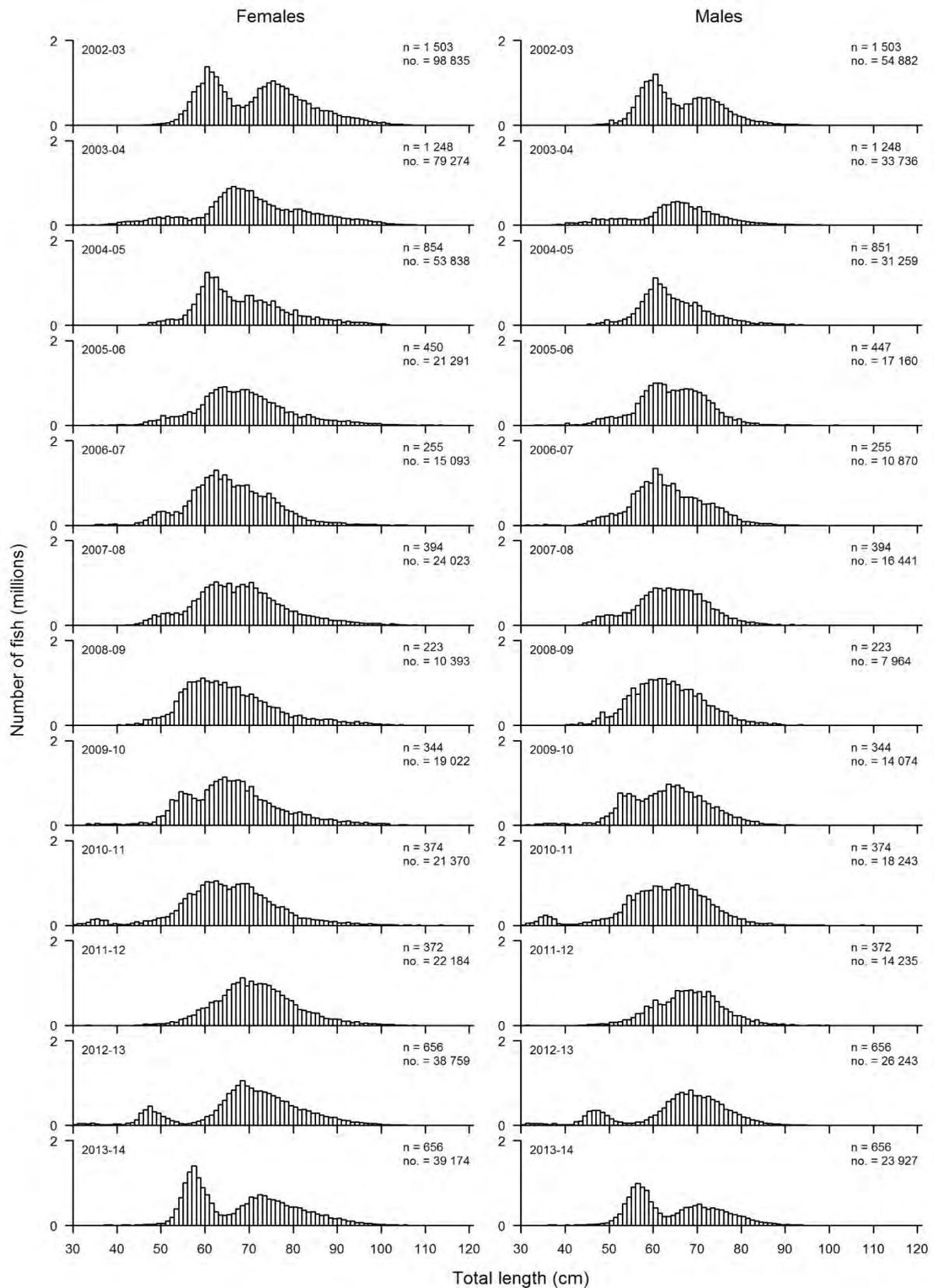


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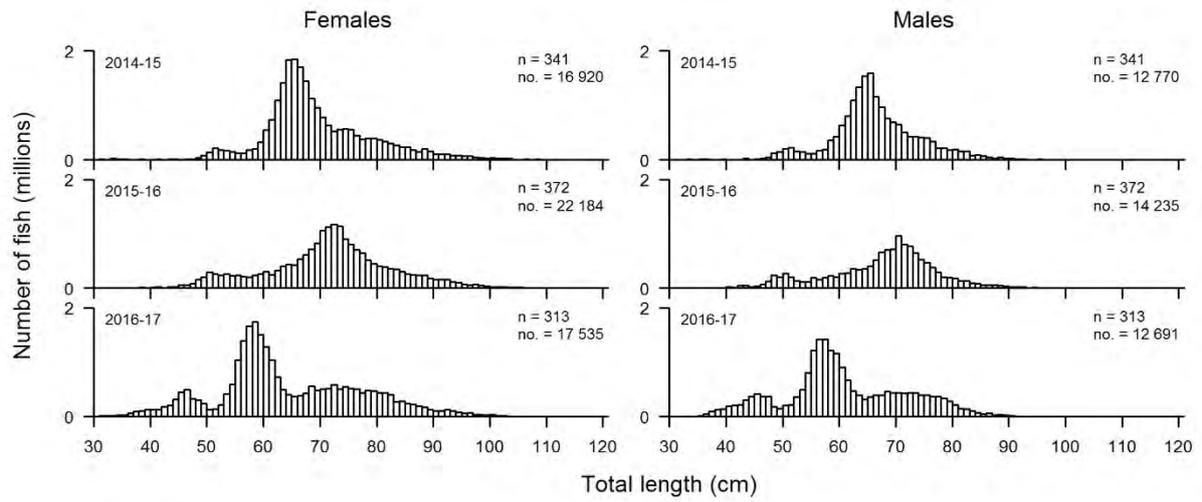


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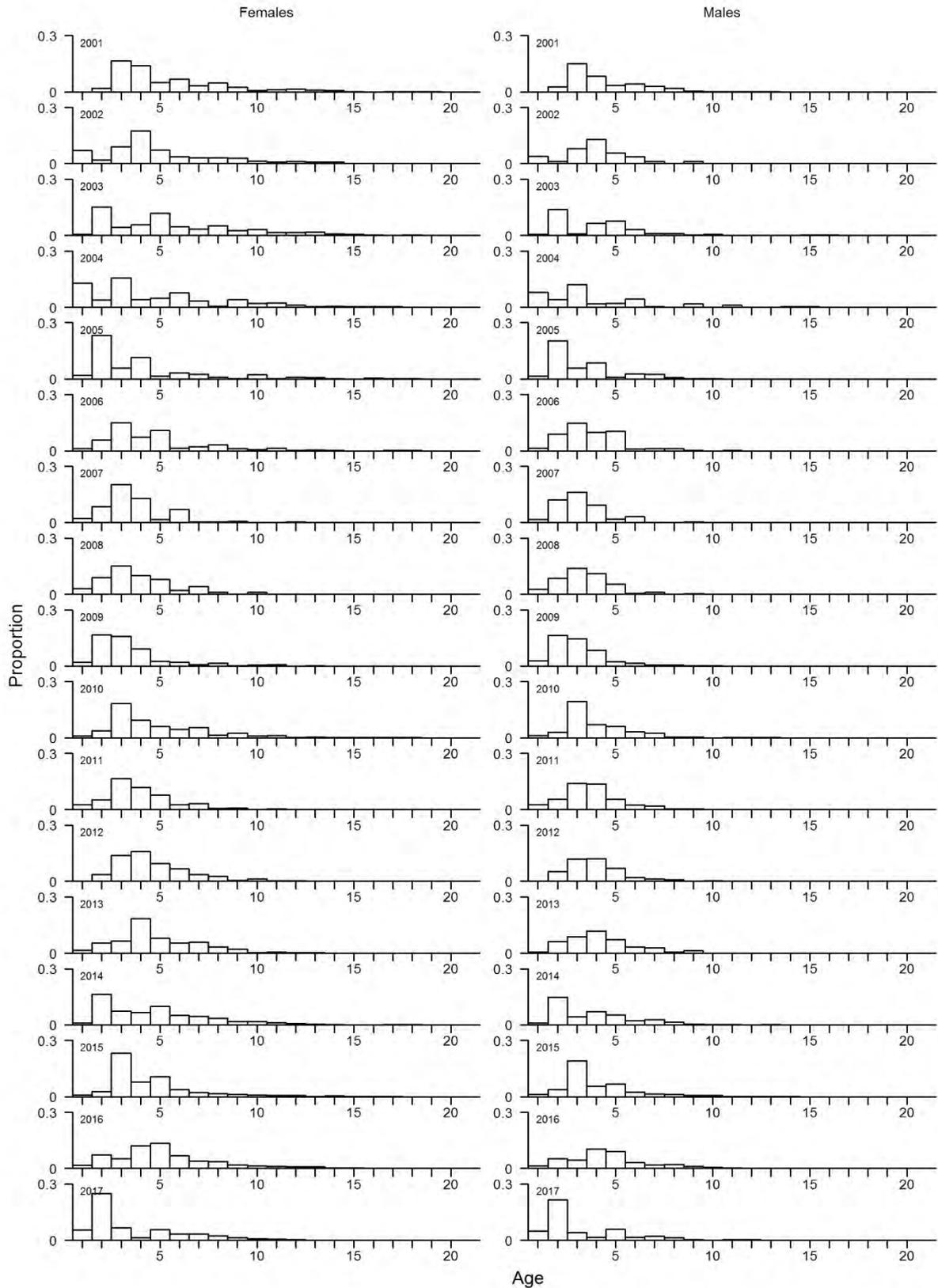


Figure 27: Proportions at age and sex in the catch from the Chatham Rise fishery estimated by direct ageing of otoliths from 2000–01 to 2016–17.

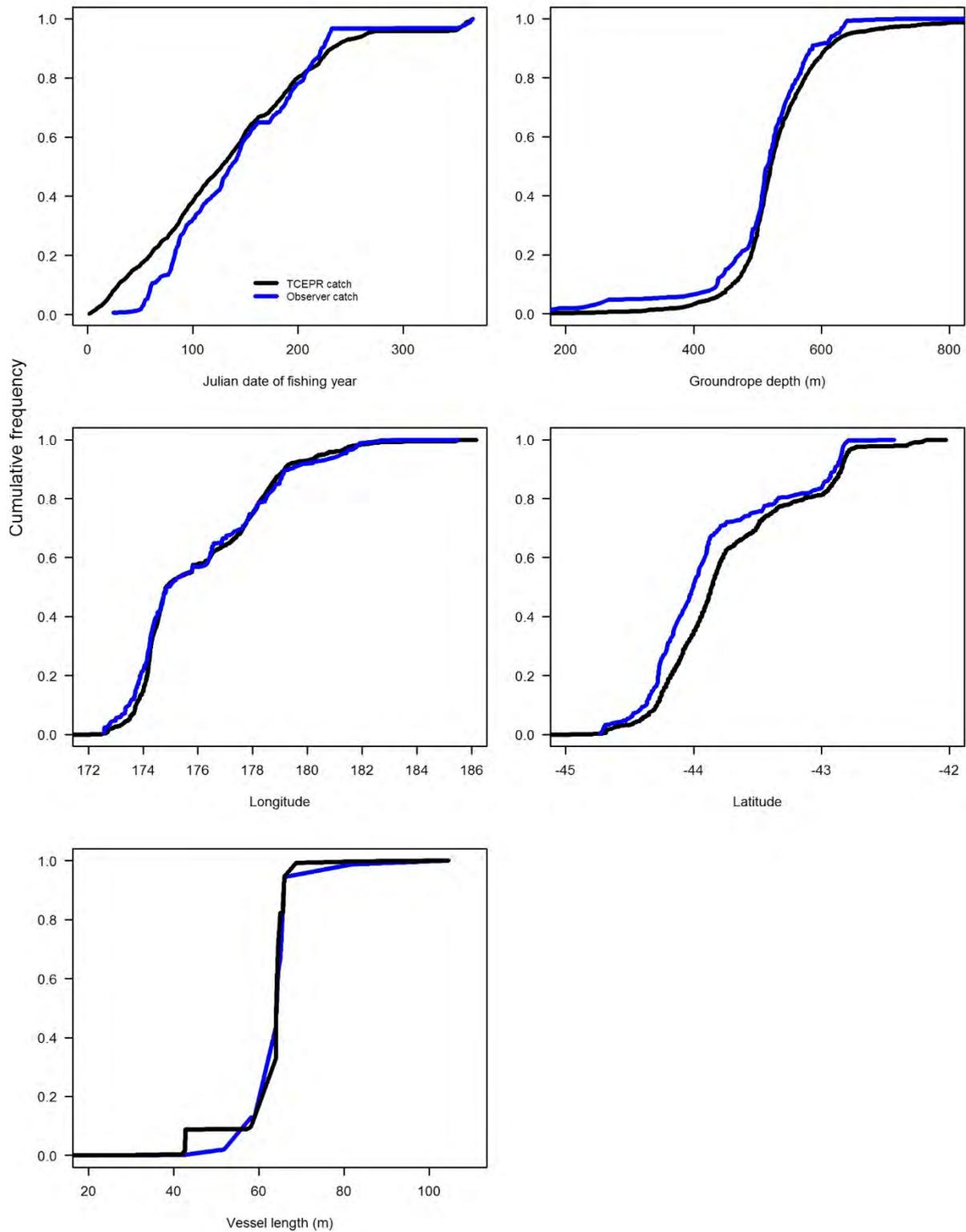


Figure 28: Comparison of Chatham Rise 2016–17 Observer Programme catch coverage with TCEPR catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then the blue lines (observed catches) should overlay the black lines (TCEPR catch).

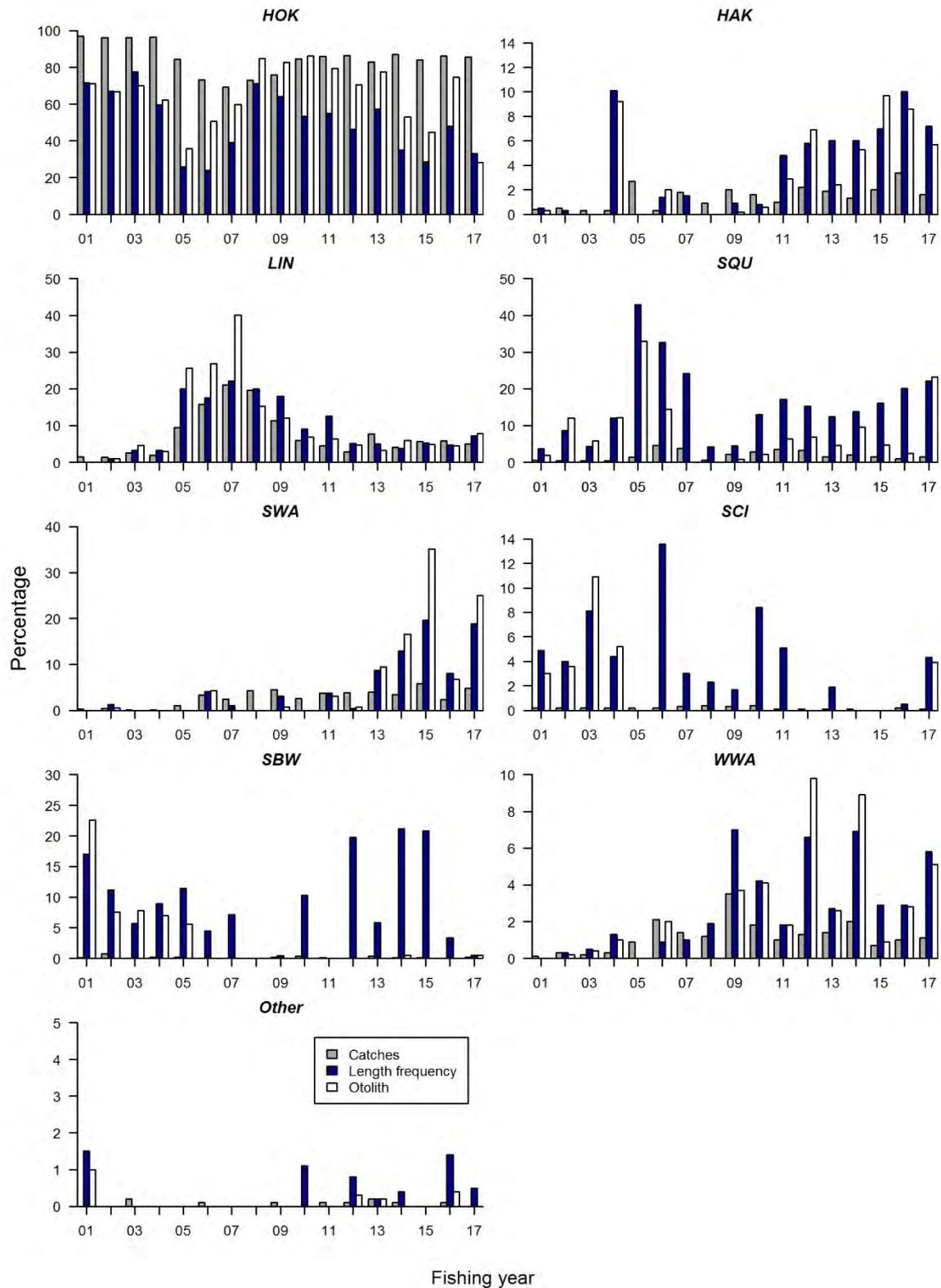


Figure 29: Percentages of hoki TCEPR, TCER and CELR catch, hoki length frequency samples, and hoki otoliths collected by the Observer Programme, by target species for the Sub-Antarctic fishery from 2000–01 to 2016–17. Three-letter codes denote target species: HOK, hoki; HAK, hake; SQU, squid; SWA, silver warehou; SBW, southern blue whiting; SCI, scampi; LIN, ling; WWA, white warehou; Other, other target species combined.

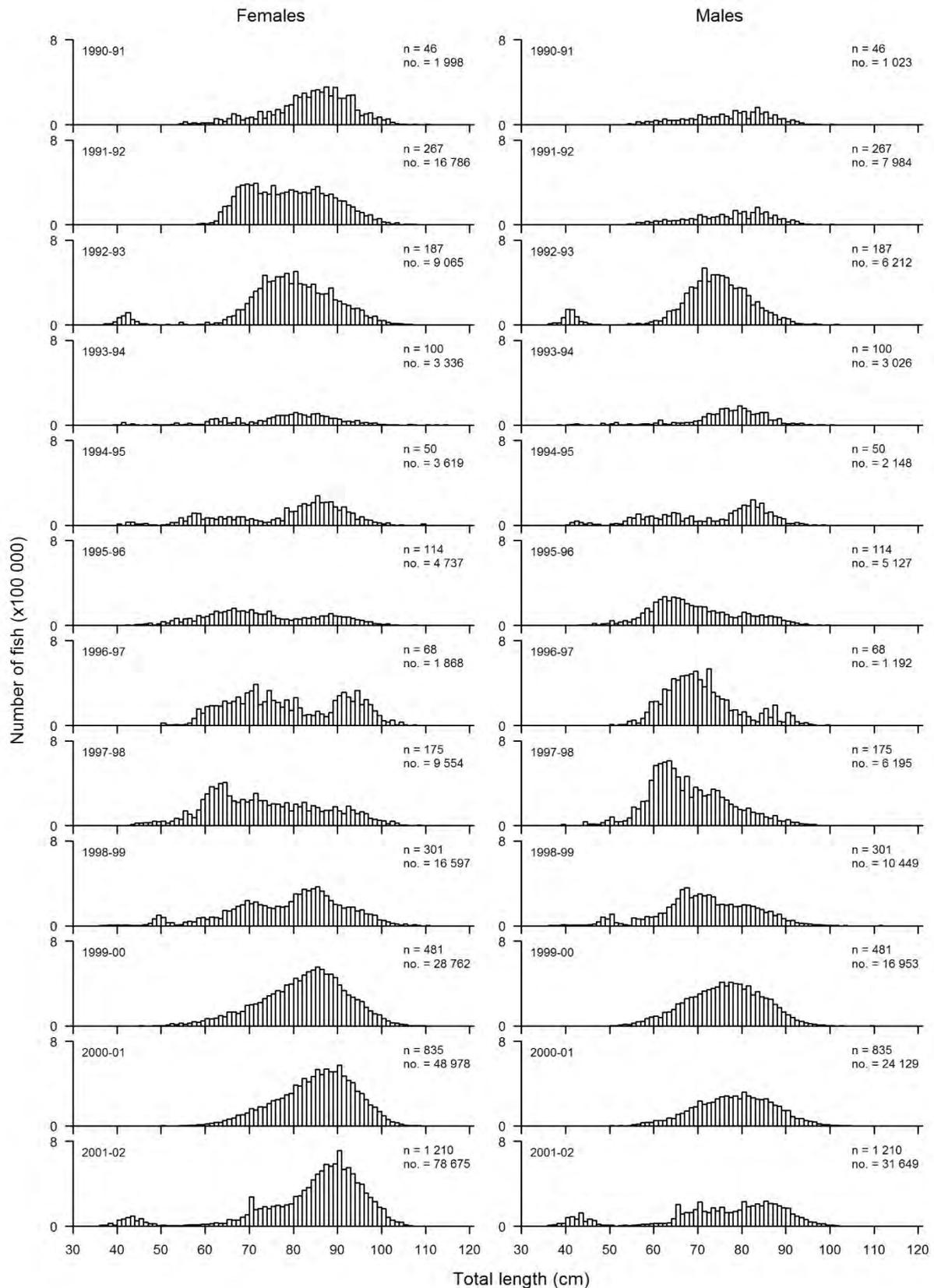


Figure 30: Length frequency distributions of hoki taken in commercial catches from the Sub-Antarctic fishery from 1990–91 to 2016–17 sampled by the Observer Programme (and combined with Hoki Management Company data in 2000–01 to 2004–05). n, number of tows sampled; no., number of fish sampled.

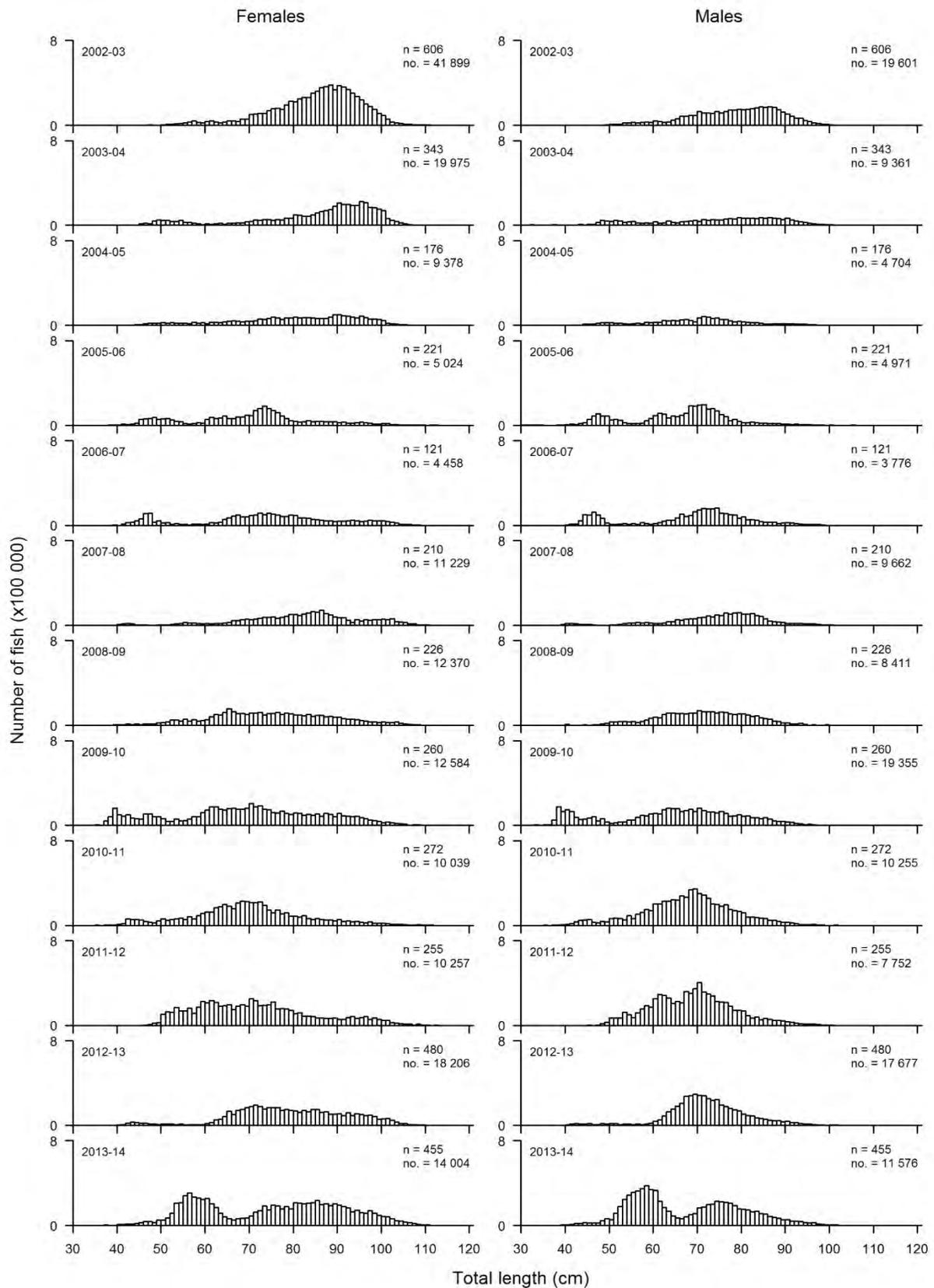


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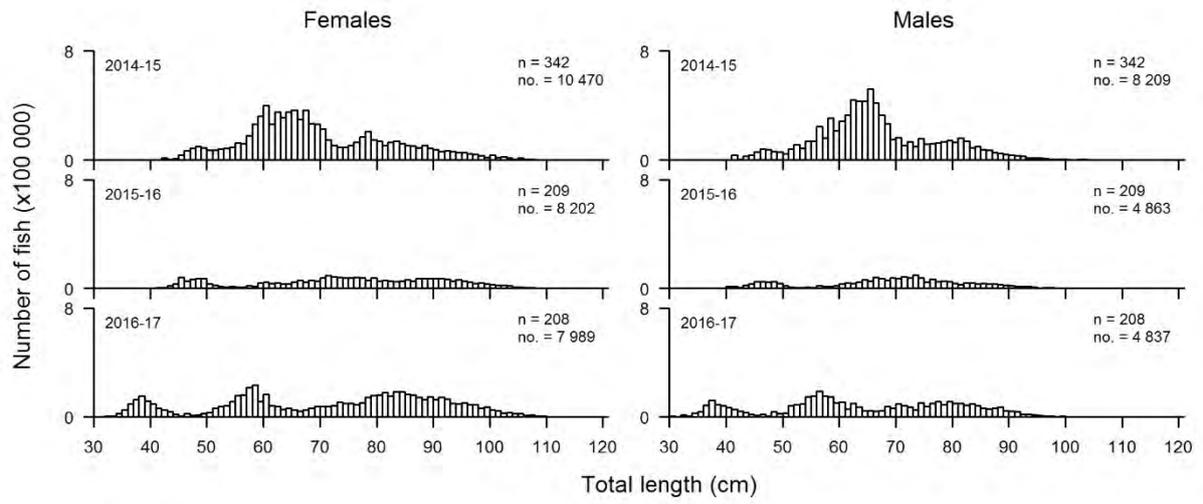


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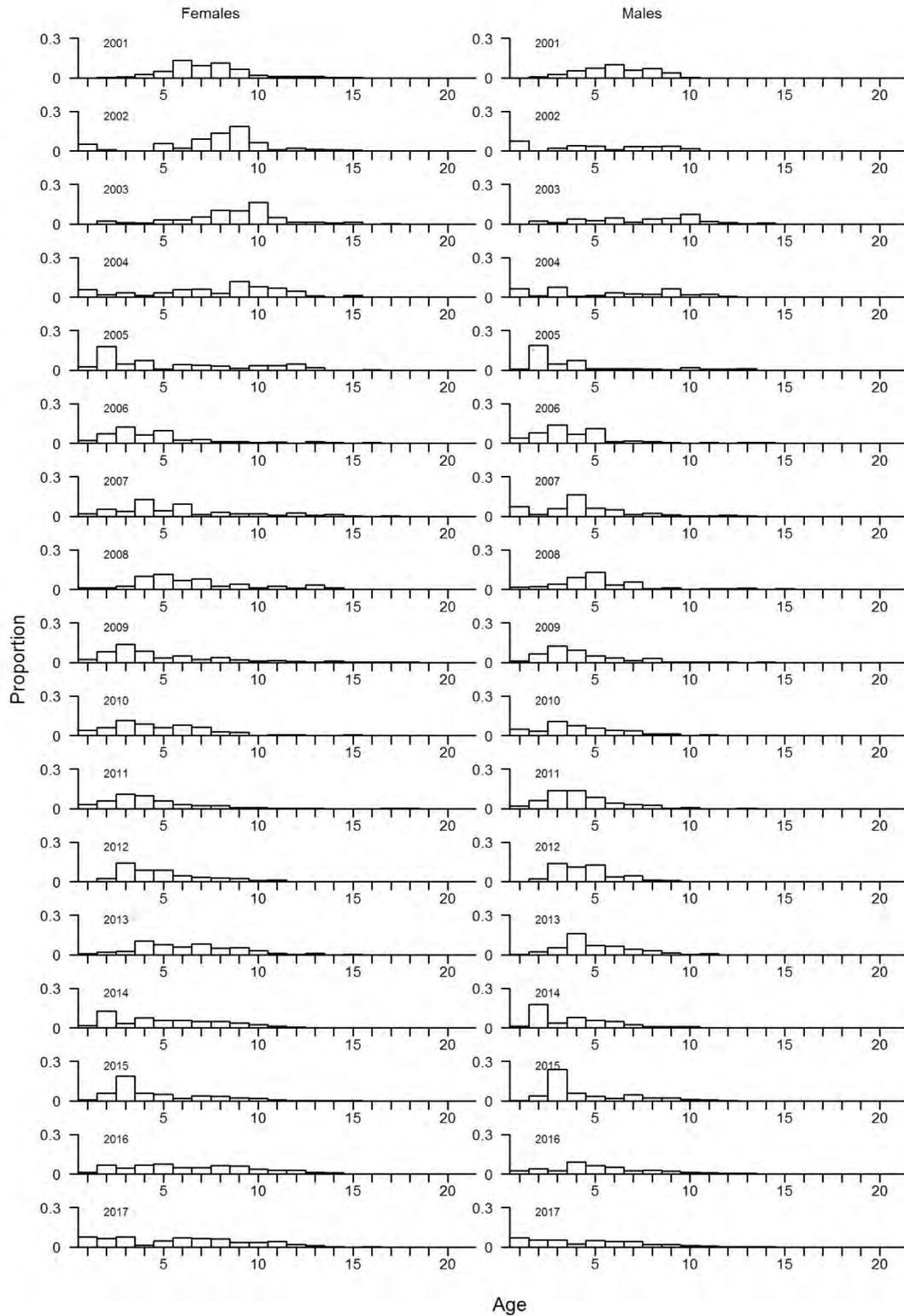


Figure 31: Proportions-at-age and sex in the catch from the Sub-Antarctic fishery as estimated by direct ageing of otoliths from 2000–01 to 2016–17.

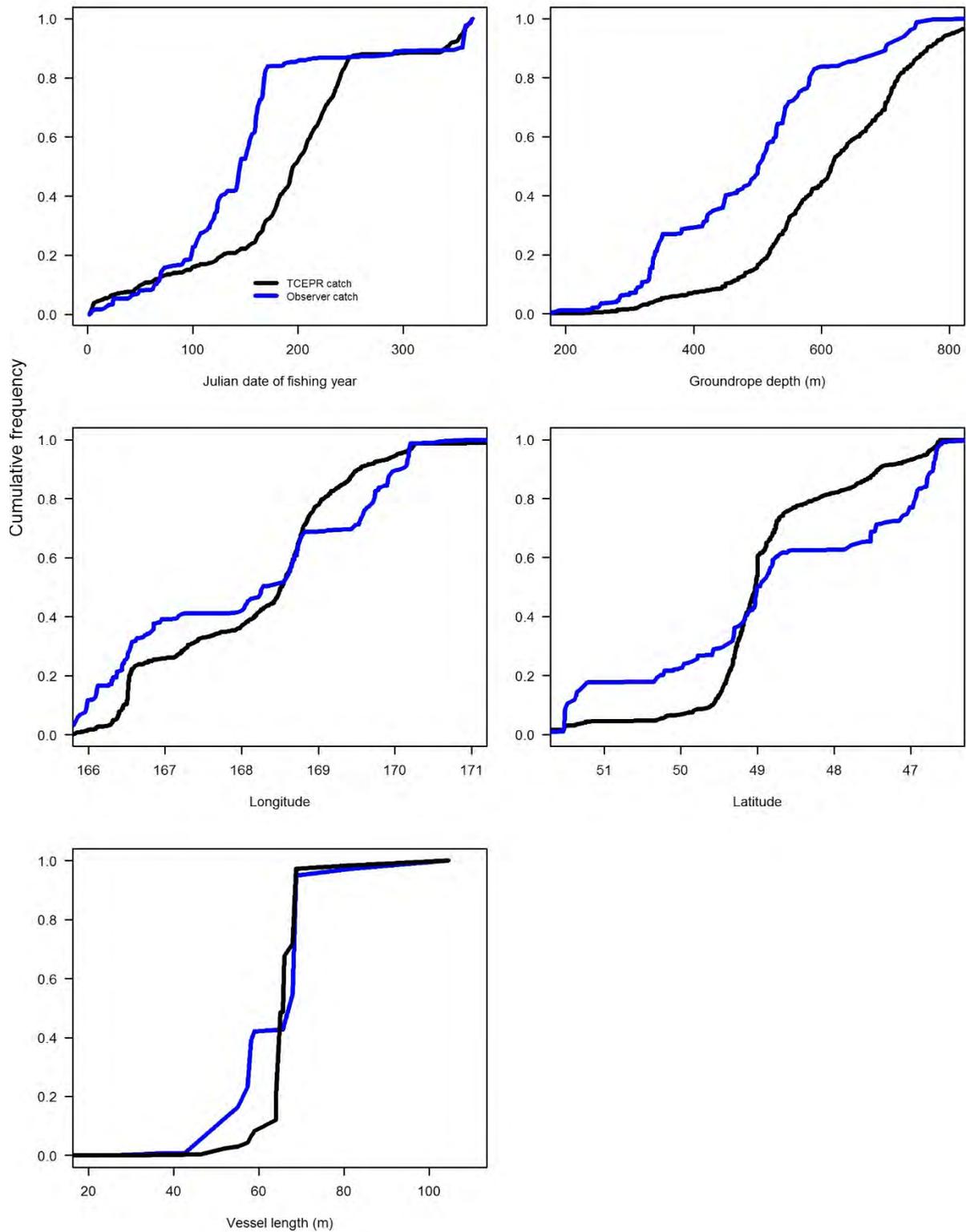


Figure 32: Comparison of Sub-Antarctic 2016–17 Observer Programme catch coverage with TCEPR catches by day of year, depth, latitude, longitude and vessel length (m). If sampling is representative of the fishery, then the blue lines (observed catches) should overlay the black lines (TCEPR catch).

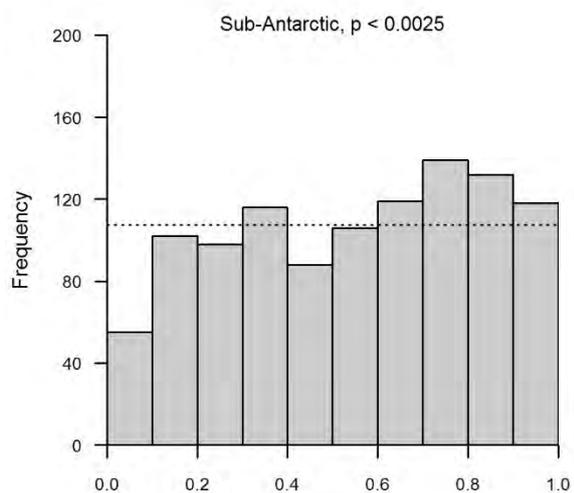
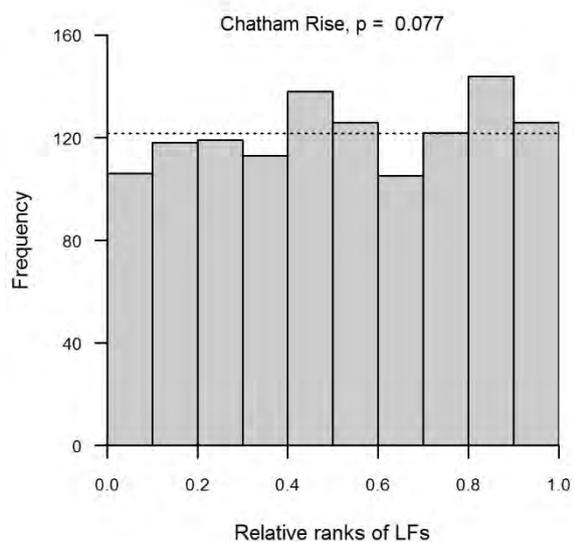


Figure 33: Histograms of ranks of the lengths that yielded 2016–17 Chatham Rise and Sub-Antarctic otoliths relative to the lengths of hoki measured for each tow. If sampling was random then the expected counts are given by the dotted line. The p-value was calculated using the rank-sum test.

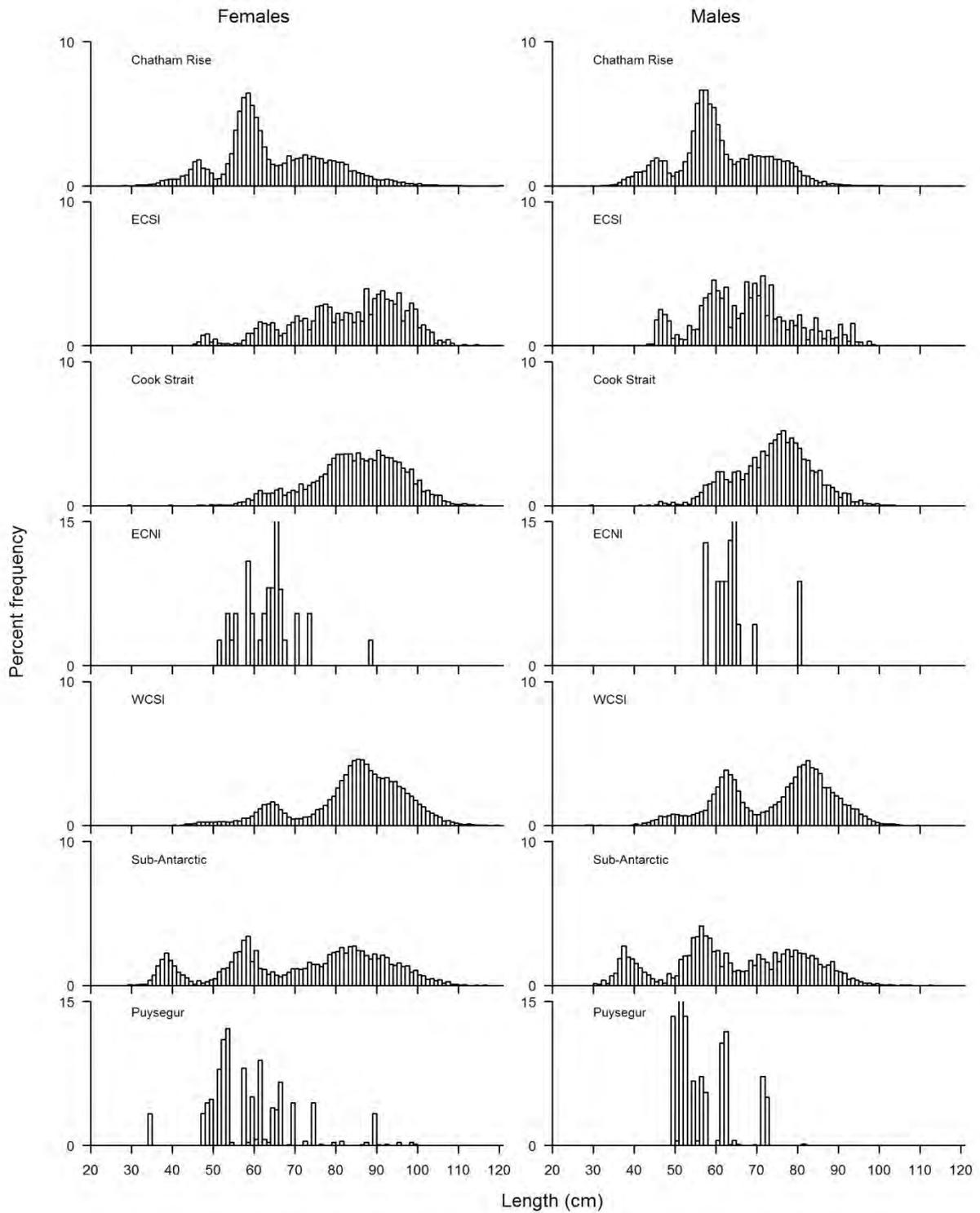


Figure 34: Length frequency distributions of female and male hoki taken in commercial catches from different areas during the 2016–17 fishing year.

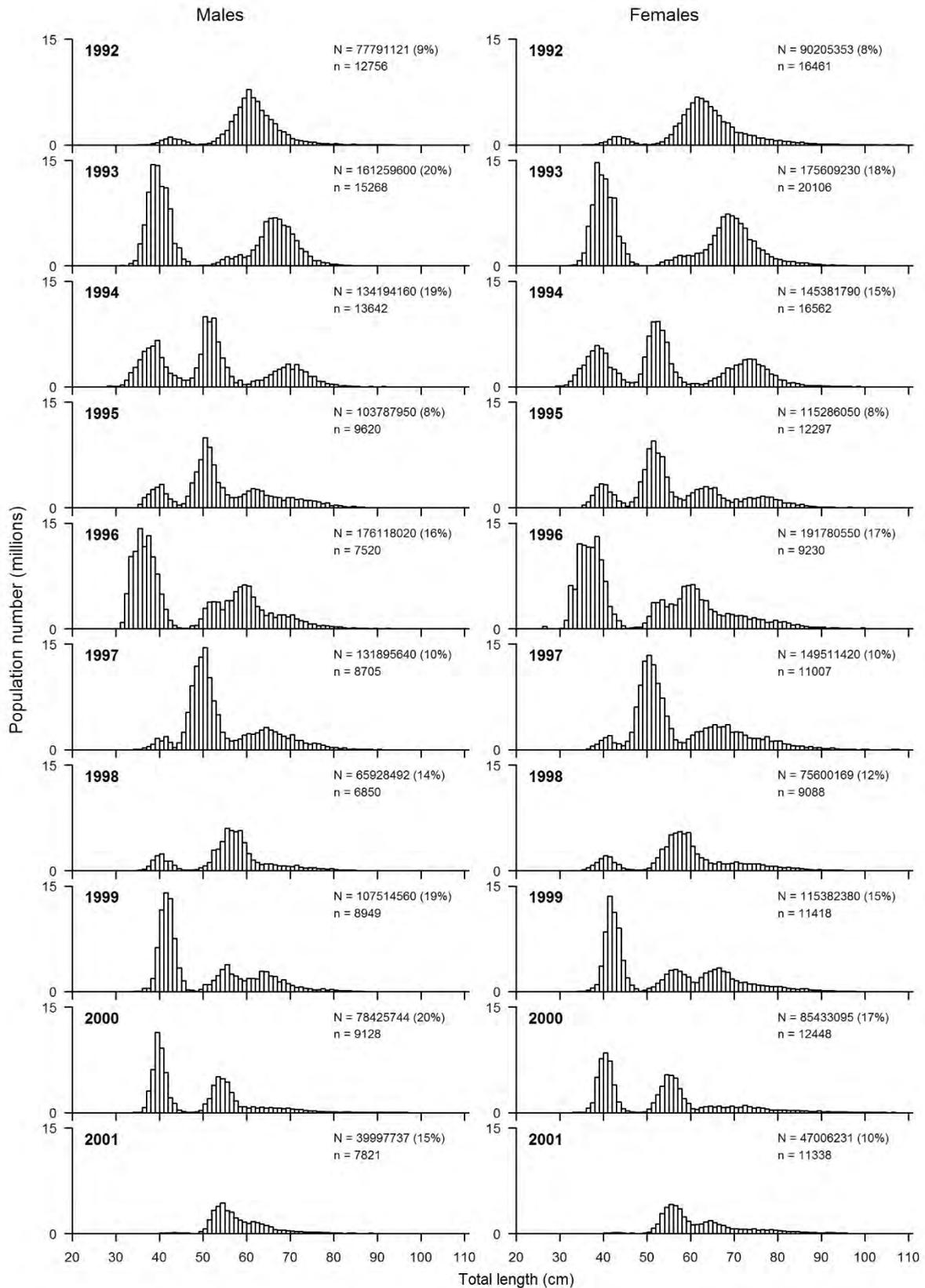


Figure 35: Scaled length frequency distributions for hoki from Chatham Rise *Tangaroa* trawl surveys. N, population numbers of fish; CV, in brackets, coefficients of variation; n., number of fish measured.

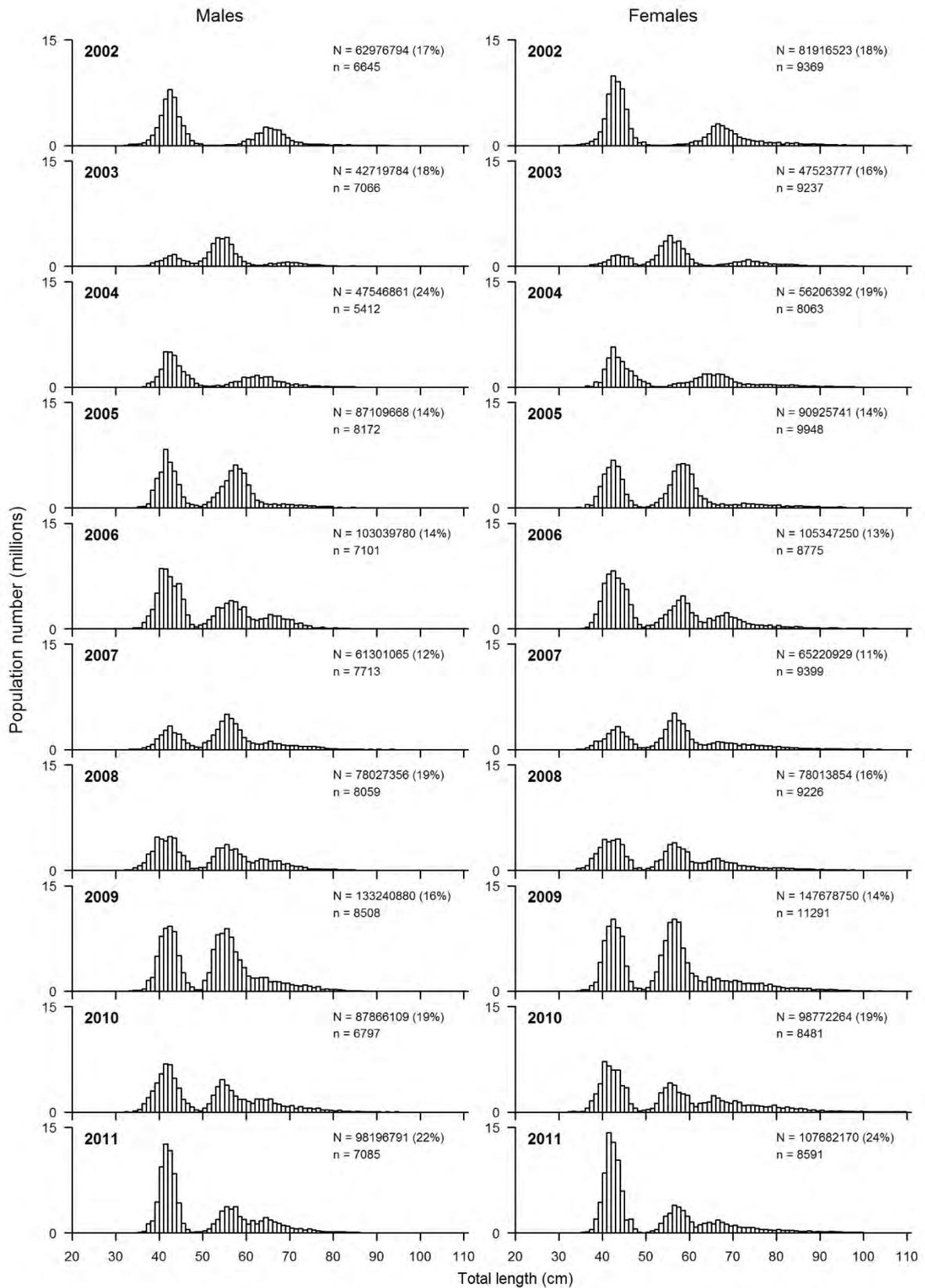


Figure 35 continued.

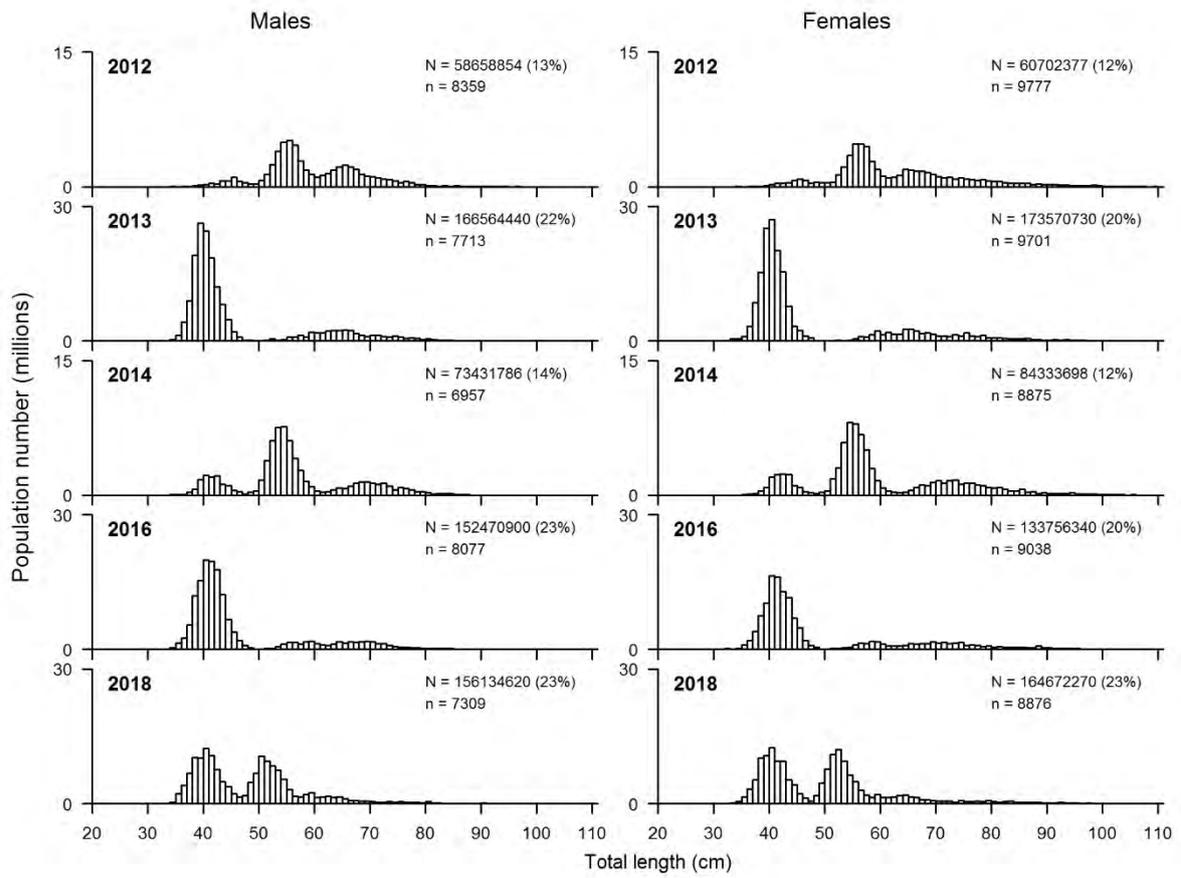


Figure 35 continued.

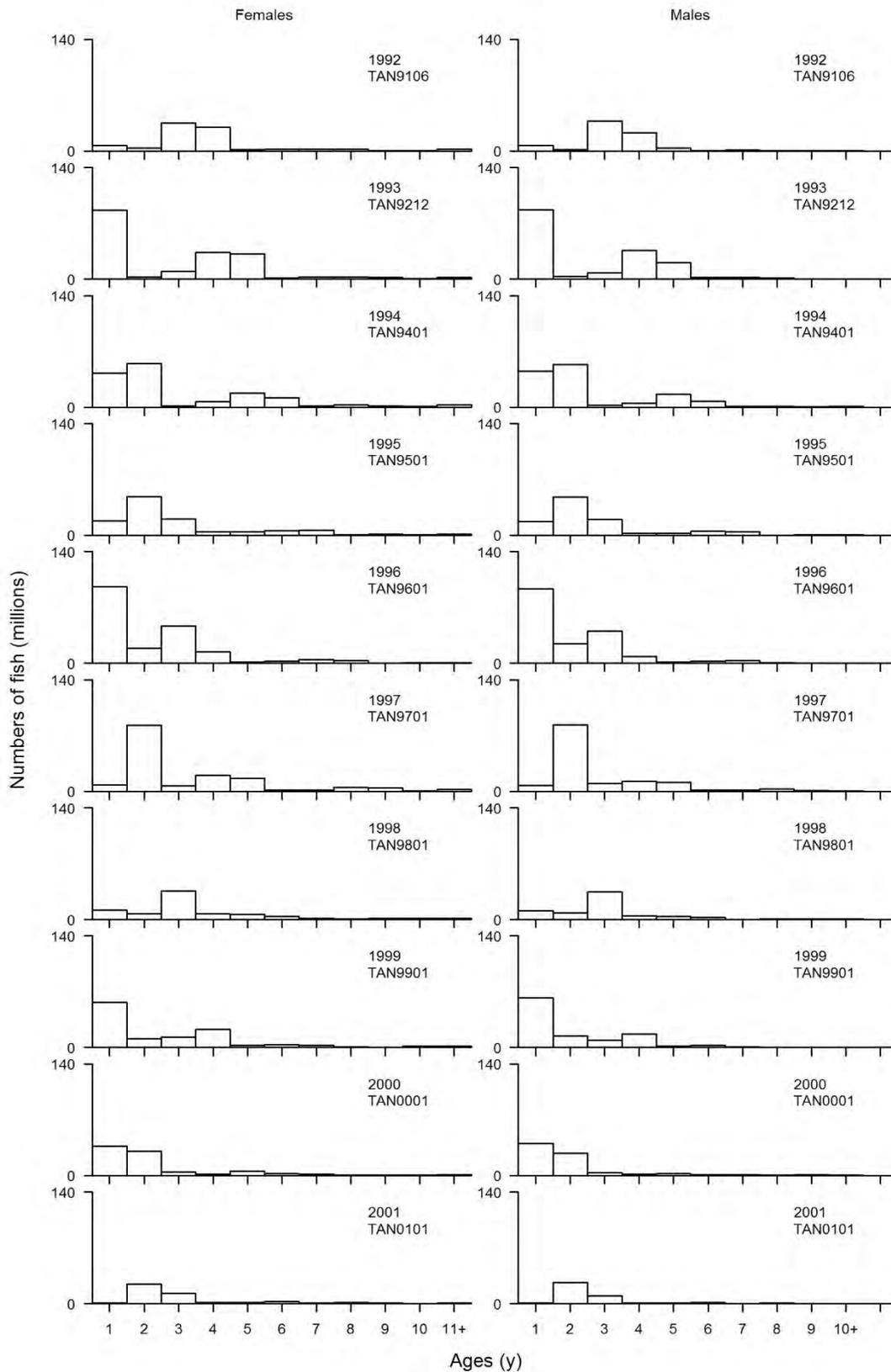


Figure 36: Scaled age frequency distributions for hoki from Chatham Rise *Tangaroa* trawl surveys 1992–2014, 2016, and 2018.

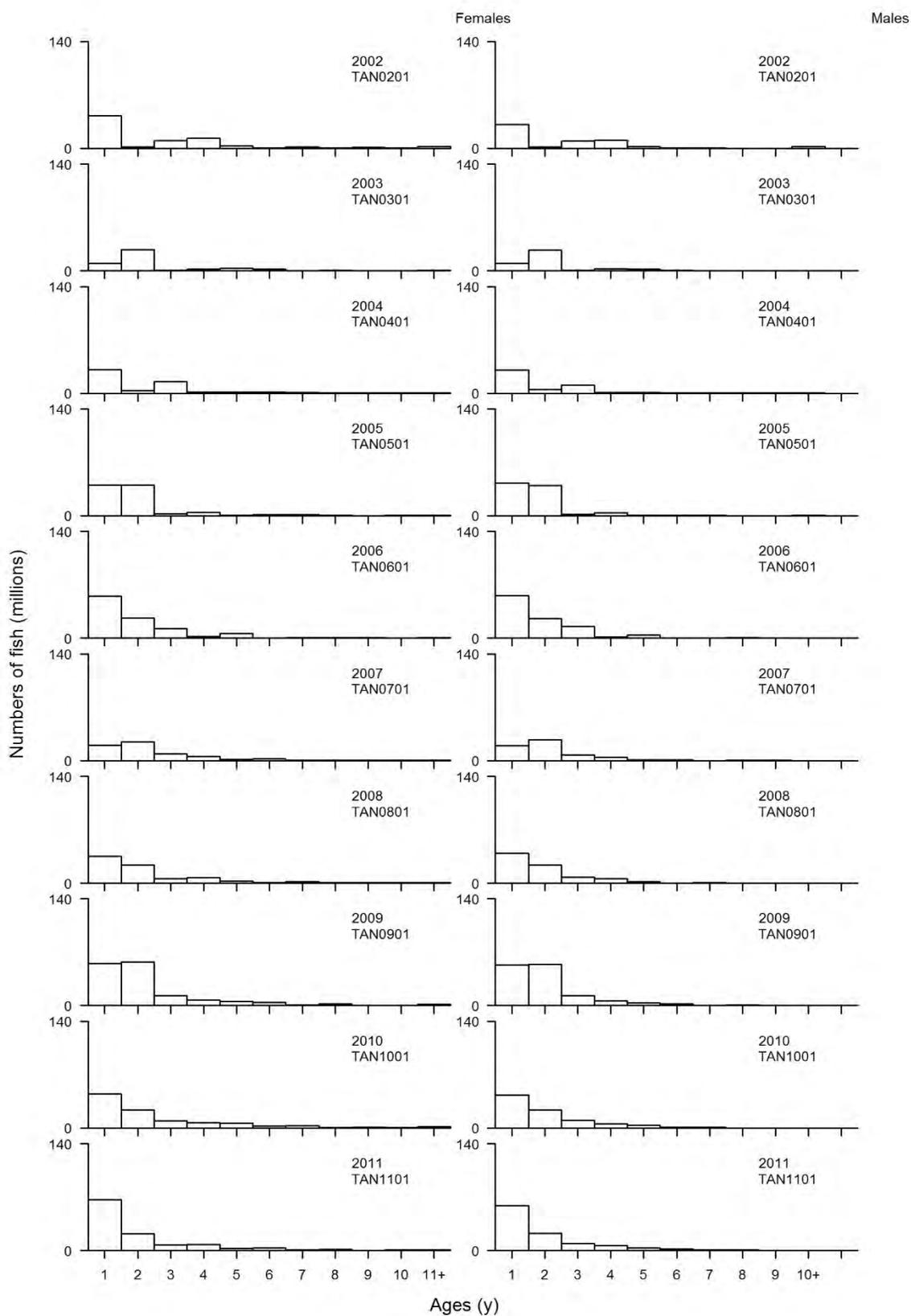


Figure 36 continued.

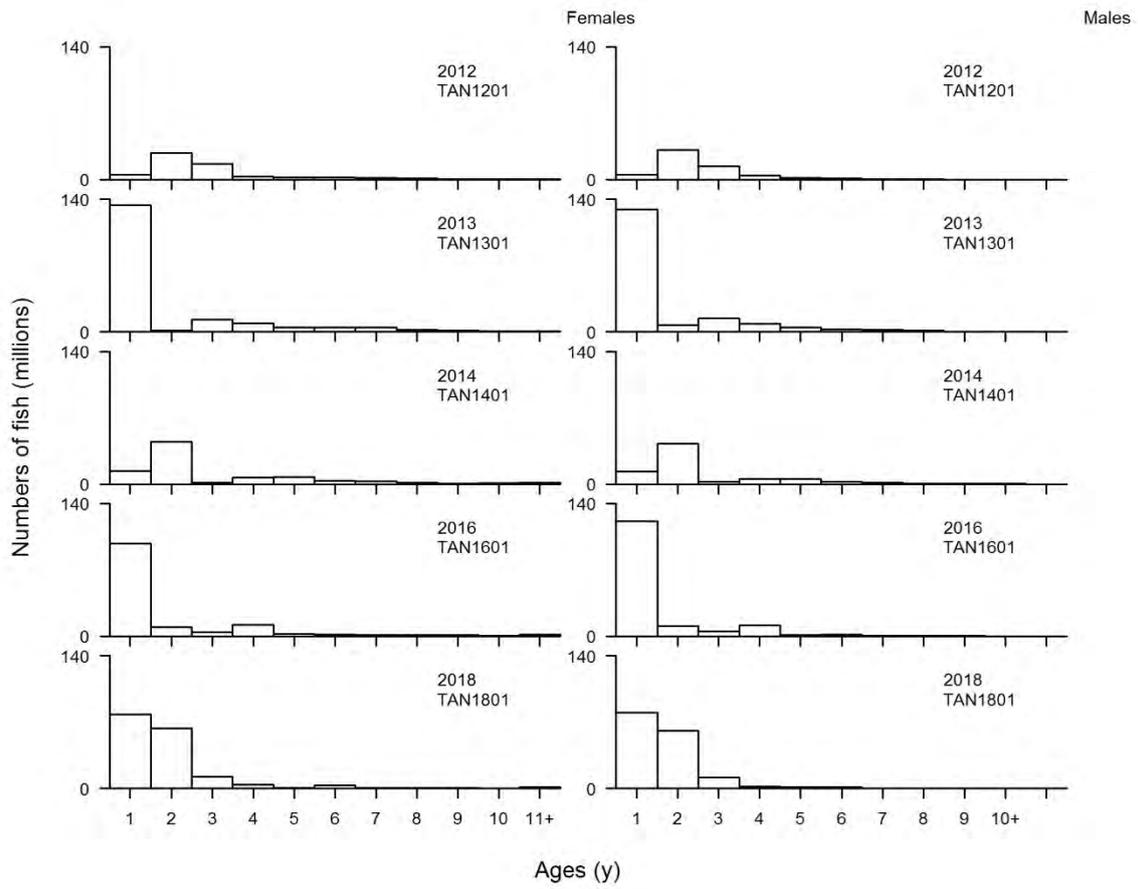


Figure 36 continued.

APPENDICES

Table A1a: Number of vessels, tows, and total catch inside and outside the 25 n. mile line off WCSI, by year. Data source was ungrouped non-zero TCEPR, TCER, and CELR data. Year defined as June to September. It was assumed that CELR data all came from inside the 25 nautical mile line, and included mid-water and bottom trawl tows reported on the CELR form only.

Fishing year	Number of vessels					Number of tows				
	TCEPR Outside	TCER Outside	TCEPR Inside	TCER Inside	CELR	TCEPR Outside	TCER Outside	TCEPR Inside	TCER Inside	CELR
1990	79	-	37	-	13	7 988	-	83	-	196
1991	75	-	41	-	12	8 134	-	68	-	258
1992	71	-	25	-	12	6 171	-	47	-	314
1993	64	-	22	-	13	6 876	-	107	-	482
1994	69	-	29	-	18	8 458	-	135	-	373
1995	65	-	36	-	18	8 511	-	185	-	258
1996	58	-	27	-	19	6 588	-	157	-	455
1997	71	-	44	-	20	7 586	-	439	-	642
1998	66	-	35	-	19	7 585	-	361	-	384
1999	53	-	34	-	17	6 785	-	273	-	610
2000	46	-	28	-	13	6 593	-	723	-	816
2001	52	-	45	-	13	6 896	-	1 380	-	804
2002	47	-	37	-	11	6 401	-	1 251	-	551
2003	44	-	29	-	6	6 612	-	829	-	674
2004	42	-	31	-	10	5 065	-	1 271	-	748
2005	37	-	15	-	10	3 575	-	530	-	464
2006	34	-	19	-	5	3 933	-	209	-	348
2007	30	-	8	-	6	2 605	-	143	-	250
2008	24	5	8	9	-	2 311	18	41	131	-
2009	25	5	3	10	-	1 955	14	3	225	-
2010	28	5	8	10	-	2 307	13	55	264	-
2011	29	6	9	14	-	2 777	36	298	415	-
2012	29	9	12	12	-	2 844	54	379	470	-
2013	24	10	11	12	-	3 057	90	181	579	-
2014	25	9	9	13	-	3 469	126	371	661	-
2015	29	10	16	14	-	3 917	99	559	673	-
2016	27	8	9	15	-	3 608	76	818	827	-
2017	25	8	13	13	-	3 642	47	926	693	-

Fishing year	Catches (kg)								
	TCEPR Outside	TCER Outside	Total Outside	TCEPR Inside	TCER Inside	CELR	Total Inside	Total Overall	Percent Inside
1990	158 447	-	158 447	1 585	-	339	1 924	160 371	1
1991	128 259	-	128 259	1 015	-	222	1 237	129 496	1
1992	100 507	-	100 507	849	-	183	1 032	101 539	1
1993	95 400	-	95 400	737	-	521	1 258	96 658	1
1994	113 786	-	113 786	1 109	-	690	1 799	115 585	1
1995	79 081	-	79 081	1 851	-	744	2 595	81 676	3
1996	67 221	-	67 221	2 492	-	1 907	4 399	71 620	3
1997	82 139	-	82 139	5 637	-	2 358	7 995	90 134	6
1998	96 135	-	96 135	5 522	-	2 609	8 131	104 266	5
1999	85 355	-	85 355	4 293	-	3 846	8 139	93 494	5
2000	87 535	-	87 535	9 443	-	4 719	14 162	101 697	9
2001	80 464	-	80 464	16 627	-	4 979	21 606	102 070	16
2002	70 674	-	70 674	17 846	-	4 179	22 025	92 699	19
2003	57 210	-	57 210	11 583	-	4 944	16 527	73 737	16
2004	26 272	-	26 272	13 922	-	4 885	18 807	45 079	31
2005	24 791	-	24 791	5 574	-	2 223	7 797	32 588	17
2006	33 106	-	33 106	2 681	-	2 438	5 119	38 225	7
2007	30 188	-	30 188	1 128	-	1 962	3 090	33 278	3
2008	19 897	32	19 929	326	566	-	892	20 821	4
2009	19 282	23	19 305	36	1 100	-	1 136	20 441	6
2010	33 171	36	33 207	951	1 981	-	2 932	36 139	8
2011	40 627	168	40 795	4 047	3 439	-	7 486	48 281	16
2012	45 834	148	45 982	4 641	3 597	-	8 238	54 220	15
2013	49 028	97	49 125	2 596	3 588	-	6 184	55 309	11
2014	58 654	124	58 778	4 467	4 451	-	8 918	67 696	13
2015	64 486	268	64 754	7 481	5 106	-	12 587	77 341	16
2016	52 424	203	52 627	9 964	5 700	-	15 664	68 291	23
2017	48 522	130	48 652	10 117	6 224	-	16 341	64 993	25

Table A1b: TCEPR, TCER and CELR Cook Strait number of vessels, tows, and total catch by year. Data source was ungrouped non-zero TCEPR, TCER, and CELR tows that caught hoki. ‘CELR trawl’ includes mid-water and bottom trawl tows reported on the CELR form only. Year defined as June to September.

Fishing year	Number of vessels				Number of tows			
	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	18	-	29	47	1 069	-	560	1 629
1991	22	-	39	61	2 092	-	1 463	3 555
1992	24	-	29	53	1 684	-	788	2 472
1993	20	-	26	46	1 531	-	898	2 429
1994	31	-	38	69	1 937	-	1 323	3 260
1995	25	-	30	55	2 232	-	1 127	3 359
1996	42	-	36	78	4 391	-	1 355	5 746
1997	39	-	27	66	4 706	-	971	5 677
1998	30	-	28	58	2 848	-	1 249	4 097
1999	21	-	27	48	2 467	-	883	3 350
2000	22	-	32	54	2 202	-	1 142	3 344
2001	25	-	23	48	1 915	-	973	2 888
2002	19	-	21	40	1 086	-	516	1 602
2003	21	-	25	46	1 826	-	992	2 818
2004	19	-	31	50	1 784	-	1 132	2 916
2005	15	-	15	30	1 366	-	474	1 840
2006	12	-	13	25	1 010	-	327	1 337
2007	8	-	14	22	925	-	491	1 416
2008	6	19	-	25	592	575	-	1 167
2009	10	20	1	31	828	510	1	1 339
2010	8	18	-	26	814	513	-	1 327
2011	7	18	-	25	488	504	-	992
2012	9	19	-	28	733	386	-	1 119
2013	10	17	-	27	920	306	-	1 226
2014	10	20	-	30	919	324	-	1 243
2015	10	18	-	28	829	332	-	1 161
2016	9	17	-	26	694	371	-	1 065
2017	9	11	-	20	599	317	-	916

Fishing year	Catches (kg)			
	TCEPR	TCER	CELR	Total
1990	12 109	-	2 596	14 705
1991	22 146	-	7 012	29 158
1992	19 583	-	4 971	24 554
1993	17 533	-	4 196	21 728
1994	26 707	-	9 068	35 775
1995	26 226	-	7 352	33 578
1996	49 947	-	7 997	57 944
1997	49 418	-	6 553	55 971
1998	35 583	-	9 405	44 988
1999	33 396	-	6 219	39 615
2000	30 287	-	8 985	39 272
2001	24 232	-	8 188	32 420
2002	17 517	-	4 102	21 620
2003	27 073	-	7 266	34 339
2004	28 297	-	10 520	38 818
2005	18 340	-	4 369	22 709
2006	16 439	-	3 035	19 474
2007	12 393	-	5 403	17 796
2008	8 926	6 660	-	15 586
2009	9 726	5 109	-	14 836
2010	10 823	4 874	-	15 697
2011	7 131	4 515	-	11 646
2012	9 722	3 153	-	12 875
2013	12 171	3 114	-	15 286
2014	11 436	3 160	-	14 596
2015	12 667	3 520	-	16 187
2016	11 351	4 080	-	15 432
2017	9 351	3 367	-	12 718

Table A1c: Number of vessels, tows and catch for all vessels by year in the Chatham Rise and ECSI for the non-spawning season. Data source was ungroomed non-zero TCEPR, TCER, and CELR tows that caught hoki. ‘CELR’ includes all fishing methods reported on the CELR form, and ‘CELR trawl’ includes mid-water and bottom trawl tows only. Chatham Rise data included data from October to September, and ECSI data included data from November to May. Fishing year: “1990” = 1989–90.

Fishing year	Number of vessels				Number of tows			
	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	47	-	23	70	3 305	-	507	3 812
1991	69	-	36	105	5 711	-	811	6 522
1992	76	-	30	106	8 574	-	516	9 090
1993	75	-	29	104	8 565	-	495	9 060
1994	78	-	25	103	6 427	-	467	6 894
1995	87	-	31	118	10 017	-	671	10 688
1996	102	-	26	128	11 600	-	375	11 975
1997	105	-	18	123	12 558	-	290	12 848
1998	97	-	18	115	16 142	-	212	16 354
1999	86	-	24	110	14 939	-	402	15 341
2000	70	-	15	85	13 387	-	321	13 708
2001	68	-	11	79	12 348	-	363	12 711
2002	60	-	13	73	10 320	-	253	10 573
2003	63	-	15	78	11 363	-	249	11 612
2004	58	-	11	69	9 473	-	207	9 680
2005	51	-	12	63	7 365	-	132	7 497
2006	52	-	14	66	7 226	-	134	7 360
2007	47	-	11	58	7 305	-	152	7 457
2008	42	11	-	53	6 994	65	-	7 059
2009	37	12	1	50	6 205	79	2	6 286
2010	39	16	-	55	5 984	276	-	6 260
2011	38	13	-	51	5 428	137	-	5 565
2012	37	13	-	50	5 645	189	-	5 834
2013	39	14	-	53	5 433	413	-	5 846
2014	39	17	-	56	5 402	408	-	5 810
2015	41	13	-	54	5 793	203	-	5 996
2016	35	13	-	48	5 624	234	-	5 858
2017	37	13	-	50	5 431	268	-	5 699

Fishing year	Catches (kg)			
	TCEPR	TCER	CELR	Total
1990	13 088	-	69	13 156
1991	29 963	-	155	30 117
1992	48 018	-	98	48 115
1993	44 161	-	62	44 223
1994	22 658	-	61	22 720
1995	38 988	-	182	39 170
1996	49 962	-	81	50 043
1997	55 573	-	90	55 664
1998	76 987	-	93	77 080
1999	72 536	-	928	73 465
2000	55 839	-	98	55 937
2001	49 294	-	532	49 826
2002	39 046	-	36	39 082
2003	38 986	-	17	39 003
2004	33 449	-	39	33 488
2005	29 946	-	8	29 955
2006	34 387	-	6	34 393
2007	37 737	-	8	37 745
2008	37 831	60	-	37 892
2009	38 901	8	-	38 909
2010	39 010	47	-	39 057
2011	38 364	40	-	38 404
2012	39 165	72	-	39 237
2013	36 345	89	-	36 434
2014	33 649	45	-	33 694
2015	39 913	45	-	39 958
2016	36 621	29	-	36 650
2017	39 848	31	-	39 879

Table A1d: Number of vessels, tows and catch for all vessels by year in the ECSI for the spawning season. Data source was ungroomed non-zero TCEPR, TCER, and CELR tows that caught hoki. Year defined as June to October. ‘CELR trawl’ included mid-water and bottom trawl tows reported on the CELR form only. There were no data available for October 2018.

Fishing year	Number of vessels				Number of tows			
	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	8	-	17	25	45	-	123	168
1991	12	-	20	32	134	-	234	368
1992	10	-	12	22	106	-	242	348
1993	9	-	13	22	32	-	274	306
1994	9	-	12	21	44	-	215	259
1995	12	-	10	22	48	-	72	120
1996	26	-	10	36	192	-	77	269
1997	21	-	6	27	194	-	154	348
1998	20	-	6	26	213	-	81	294
1999	19	-	9	28	141	-	151	292
2000	16	-	9	25	126	-	229	355
2001	16	-	8	24	197	-	251	448
2002	17	-	10	27	257	-	146	403
2003	21	-	11	32	555	-	219	774
2004	14	-	10	24	114	-	248	362
2005	12	-	3	15	284	-	69	353
2006	6	-	5	11	141	-	76	217
2007	12	-	4	16	108	-	27	135
2008	10	4	-	14	239	47	-	286
2009	11	3	-	14	103	37	-	140
2010	10	4	-	14	78	97	-	175
2011	8	5	-	13	129	74	-	203
2012	11	6	-	17	183	88	-	271
2013	12	6	-	18	245	55	-	300
2014	13	6	-	19	188	18	-	206
2015	9	4	-	13	238	10	-	248
2016	11	7	-	18	313	15	-	328
2017	10	6	-	16	280	17	-	297

Fishing year	Catches (kg)			
	TCEPR	TCER	CELR	Total
1990	51	-	229	280
1991	841	-	503	1 345
1992	547	-	396	943
1993	137	-	172	309
1994	164	-	353	517
1995	52	-	103	155
1996	1 199	-	103	1 301
1997	817	-	973	1 790
1998	1 300	-	371	1 671
1999	765	-	1 329	2 094
2000	599	-	1 822	2 421
2001	1 658	-	760	2 418
2002	2 806	-	225	3 031
2003	6 460	-	1 006	7 466
2004	1 370	-	927	2 297
2005	4 683	-	50	4 733
2006	1 137	-	57	1 194
2007	1 001	-	63	1 064
2008	2 302	40	-	2 342
2009	1 117	29	-	1 146
2010	600	138	-	738
2011	1 504	152	-	1 657
2012	2 355	175	-	2 530
2013	3 283	110	-	3 393
2014	2 758	38	-	2 797
2015	3 660	40	-	3 700
2016	4 150	29	-	4 178
2017	4 369	60	-	4 430

Table A1e: Number of vessels, tows and catch for all vessels by fishing year in the Sub-Antarctic. Data source was ungroomed non-zero TCEPR, TCER, and CELR tows that caught hoki. ‘CELR trawl’ included mid-water and bottom trawl tows reported on the CELR form only. Fishing year: “1990” = 1989–90.

Fishing year	Number of vessels				Number of tows			
	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	64	-	-	64	2 787	-	-	2 787
1991	66	-	-	66	4 617	-	-	4 617
1992	76	-	-	76	7 025	-	-	7 025
1993	63	-	2	65	6 143	-	4	6 147
1994	65	-	-	65	3 718	-	-	3 718
1995	62	-	-	62	3 585	-	-	3 585
1996	68	-	1	69	4 170	-	2	4 172
1997	74	-	-	74	5 003	-	-	5 003
1998	68	-	1	69	5 419	-	4	5 423
1999	68	-	-	68	5 145	-	-	5 145
2000	56	-	1	57	7 677	-	3	7 680
2001	56	-	-	56	7 401	-	-	7 401
2002	55	-	1	56	8 443	-	25	8 468
2003	50	-	3	53	5 689	-	10	5 699
2004	46	-	-	46	3 850	-	-	3 850
2005	43	-	-	43	2 638	-	-	2 638
2006	41	-	-	41	2 507	-	-	2 507
2007	36	-	-	36	3 004	-	-	3 004
2008	35	-	-	35	2 731	-	-	2 731
2009	32	1	-	33	2 914	1	-	2 915
2010	34	2	-	36	3 171	2	-	3 173
2011	35	1	-	36	2 931	1	-	2 932
2012	34	3	-	37	2 731	3	-	2 734
2013	35	1	-	36	2 844	1	-	2 845
2014	30	1	-	31	3 385	2	-	3 387
2015	31	3	-	34	3 115	16	-	3 131
2016	30	3	-	33	1 819	13	-	1 832
2017	31	4	-	35	2 465	12	-	2 477

Fishing year	Catches (kg)			
	TCEPR	TCER	CELR	Total
1990	11 748	-	-	11 748
1991	16 669	-	-	16 669
1992	30 688	-	-	30 688
1993	24 836	-	-	24 836
1994	11 636	-	-	11 636
1995	13 128	-	-	13 128
1996	14 269	-	1	14 270
1997	21 771	-	-	21 771
1998	25 129	-	1	25 129
1999	23 753	-	-	23 753
2000	33 772	-	-	33 772
2001	30 076	-	-	30 076
2002	30 175	-	-	30 175
2003	20 194	-	5	20 199
2004	11 635	-	-	11 635
2005	6 337	-	-	6 337
2006	6 961	-	-	6 961
2007	7 661	-	-	7 661
2008	8 708	-	-	8 708
2009	9 807	-	-	9 807
2010	12 275	-	-	12 275
2011	12 655	-	-	12 655
2012	15 743	-	-	15 743
2013	14 095	-	-	14 095
2014	19 926	1	-	19 927
2015	16 376	1	-	16 378
2016	6 638	-	-	6 638
2017	13 156	1	-	13 157

Table A1f: Number of Puysegur vessels, tows and catch for all vessels by year for the spawning season. Data source was ungroomed non-zero TCEPR, TCER, and CELR tows that caught hoki. Year defined as June to December. ‘CELR trawl’ included mid-water and bottom trawl tows reported on the CELR form only. There were no October to December data available for 2018.

Fishing year	Number of vessels				Number of tows			
	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	44	-	-	44	992	-	-	992
1991	41	-	-	41	780	-	-	780
1992	40	-	-	40	918	-	-	918
1993	28	-	2	30	385	-	10	395
1994	38	-	2	40	407	-	16	423
1995	28	-	2	30	422	-	6	428
1996	29	-	-	29	609	-	-	609
1997	39	-	-	39	799	-	-	799
1998	32	-	-	32	539	-	-	539
1999	30	-	1	31	535	-	3	538
2000	25	-	1	26	584	-	29	613
2001	37	-	1	38	856	-	8	864
2002	27	-	2	29	555	-	16	571
2003	31	-	1	32	493	-	10	503
2004	16	-	1	17	213	-	20	233
2005	24	-	1	25	468	-	12	480
2006	21	-	1	22	361	-	23	384
2007	14	-	2	16	191	-	21	212
2008	16	-	-	16	212	-	-	212
2009	8	1	-	9	146	12	-	158
2010	12	1	-	13	108	1	-	109
2011	13	4	-	17	178	13	-	191
2012	15	3	-	18	215	22	-	237
2013	15	2	-	17	130	6	-	136
2014	11	2	-	13	137	18	-	155
2015	16	2	-	18	193	8	-	201
2016	12	4	-	16	214	22	-	236
2017	16	6	-	22	153	23	-	176

Fishing year	Catches (kg)			
	TCEPR	TCER	CELR	Total
1990	7 378	-	-	7 378
1991	4 870	-	-	4 870
1992	4 744	-	-	4 744
1993	2 039	-	-	2 039
1994	2 382	-	-	2 382
1995	1 413	-	-	1 413
1996	2 401	-	-	2 401
1997	5 847	-	-	5 847
1998	2 137	-	-	2 137
1999	2 867	-	4	2 871
2000	2 757	-	-	2 757
2001	6 586	-	1	6 587
2002	5 222	-	7	5 229
2003	5 821	-	16	5 837
2004	1 124	-	5	1 129
2005	5 480	-	-	5 481
2006	1 321	-	6	1 327
2007	376	-	9	385
2008	304	-	-	304
2009	198	4	-	203
2010	198	2	-	200
2011	1 155	2	-	1 157
2012	1 144	1	-	1 145
2013	647	-	-	648
2014	647	7	-	654
2015	1 797	-	-	1 798
2016	1 055	1	-	1 056
2017	1 039	2	-	1 041

Table A1g: Number of vessels, tows and catch for all vessels in the ECNI by fishing year. Data source is ungrouped non-zero tows sets or lines catching hoki. Year defined as October to September. ‘CELR trawl’ includes mid-water and bottom trawl tows reported on the CELR form only. Year defined as October–September. Fishing year: “1990” = 1989–90.

Fishing year	Number of vessels							Number of tows			
	TCP	TCE	CEL	LCE	LTC	NCE	Total	TCP	TCE	CEL	Total
1990	18	-	81	-	-	-	99	1 789	-	2 404	4 193
1991	29	-	93	-	-	-	122	3 315	-	2 611	5 926
1992	27	-	99	-	-	-	126	2 630	-	3 506	6 136
1993	30	-	110	-	-	-	140	2 486	-	3 929	6 415
1994	46	-	105	-	-	-	151	3 195	-	3 358	6 553
1995	49	-	109	-	-	-	158	2 470	-	3 400	5 870
1996	73	-	80	-	-	-	153	3 516	-	2 401	5 917
1997	71	-	81	-	-	-	152	3 807	-	2 637	6 444
1998	59	-	71	-	-	-	130	3 638	-	2 486	6 124
1999	48	-	62	-	-	-	110	3 220	-	1 685	4 905
2000	41	-	60	-	-	-	101	3 234	-	995	4 229
2001	37	-	48	-	-	-	85	3 240	-	555	3 795
2002	40	-	35	-	-	-	75	4 405	-	386	4 791
2003	43	-	45	-	1	-	89	2 703	-	533	3 236
2004	40	-	33	-	-	-	73	2 262	-	186	2 448
2005	36	-	27	-	-	-	63	1 630	-	180	1 810
2006	35	-	30	1	-	-	66	1 275	-	136	1 411
2007	29	-	33	1	-	1	64	1 689	-	333	2 022
2008	27	20	8	6	20	2	83	1 407	396	-	1 803
2009	21	28	4	7	16	3	79	1 219	425	-	1 644
2010	22	30	8	7	24	2	93	1 769	806	-	2 575
2011	24	26	4	8	26	1	89	1 931	764	-	2 695
2012	24	26	2	1	23	3	79	1 581	870	-	2 451
2013	23	22	2	-	22	3	72	1 469	1 069	-	2 538
2014	25	25	4	-	22	3	79	1 369	1 105	-	2 474
2015	22	29	2	-	27	5	85	1 055	671	-	1 726
2016	21	26	1	-	20	4	72	1 047	934	-	1 981
2017	21	24	3	-	27	3	78	1 169	779	-	1 948

Fishing year	Catches (kg)						
	TCP	TCE	CEL	LCE	LTC	NCE	Total
1990	282	-	619	-	-	-	901
1991	379	-	385	-	-	-	764
1992	366	-	697	-	-	-	1 063
1993	747	-	652	-	-	-	1 400
1994	1 146	-	614	-	-	-	1 760
1995	1 119	-	1 006	-	-	-	2 125
1996	1 999	-	825	-	-	-	2 823
1997	2 842	-	1 757	-	-	-	4 599
1998	2 635	-	2 084	-	-	-	4 718
1999	1 433	-	882	-	-	-	2 315
2000	1 043	-	345	-	-	-	1 387
2001	1 630	-	405	-	-	-	2 035
2002	1 123	-	24	-	-	-	1 147
2003	879	-	50	-	-	-	929
2004	851	-	29	-	-	-	880
2005	500	-	16	-	-	-	516
2006	664	-	9	-	-	-	673
2007	572	-	95	-	-	-	667
2008	514	120	-	1	5	-	640
2009	490	75	14	1	7	1	588
2010	388	214	8	-	7	-	618
2011	1 430	141	13	1	4	-	1 588
2012	691	161	3	-	3	-	858
2013	806	234	8	-	3	-	1 051
2014	927	387	10	-	2	1	1 326
2015	591	167	1	-	6	1	766
2016	592	289	1	-	5	1	888
2017	628	190	2	-	5	1	826

Table A2a: Number of vessels, total hoki catch, number of tows, median tow duration, median catch per tow, and median catch per hour for all WCSI vessels by year. Year defined as June to September. Data are non-zero catches for TCEPR midwater tows, and excludes MHS tows.

MW all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	69	149 295	6 779	4.2	10.3	2.6
1991	66	118 323	6 744	4.0	10.2	2.6
1992	61	92 024	5 193	3.6	12.4	3.5
1993	57	82 482	5 258	3.2	10.3	3.7
1994	63	105 195	7 139	3.0	8.9	3.2
1995	59	75 135	7 392	3.5	4.9	1.4
1996	59	64 802	5 169	3.5	6.8	1.9
1997	76	82 636	6 609	3.8	7.4	2.0
1998	66	95 766	6 675	3.5	10.4	2.8
1999	56	76 766	5 255	3.1	10.3	3.3
2000	51	79 534	5 314	2.8	12.0	4.4
2001	62	78 853	5 879	2.6	9.0	3.4
2002	56	61 528	4 654	2.3	9.8	4.1
2003	51	51 748	4 295	3.0	8.1	2.4
2004	51	32 036	4 223	2.4	4.7	1.5
2005	37	19 682	2 364	2.5	5.1	1.8
2006	36	21 067	2 015	3.0	6.7	2.5
2007	31	21 093	1 432	3.5	9.3	3.5
2008	15	12 046	884	1.8	6.4	3.8
2009	23	12 586	879	3.2	9.1	3.2
2010	26	23 033	1 216	2.6	15.3	5.2
2011	24	29 603	1 514	2.0	17.2	8.4
2012	27	30 122	1 567	2.1	16.3	7.9
2013	24	33 851	1 811	2.6	15.4	6.2
2014	26	43 805	2 317	2.8	15.1	5.9
2015	27	50 970	2 681	2.7	15.4	6.0
2016	24	38 311	2 641	2.2	11.7	5.0
2017	24	35 265	2 311	2.2	11.8	5.5
All years	242	1 617 560	110 210	3.2	9.5	3.0

MW target hoki tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	69	149 263	6 736	4.2	10.3	2.6
1991	66	118 202	6 727	4.0	10.2	2.6
1992	60	91 904	5 141	3.6	12.4	3.6
1993	56	82 086	5 025	3.1	10.6	4.1
1994	62	105 007	6 978	3.0	9.5	3.3
1995	59	74 701	7 129	3.5	4.9	1.5
1996	59	64 734	5 113	3.5	6.8	1.9
1997	76	82 219	6 503	3.8	7.9	2.1
1998	66	95 572	6 612	3.5	10.4	2.8
1999	56	76 532	5 141	3.1	10.3	3.4
2000	51	79 269	5 193	2.7	12.0	4.6
2001	62	78 512	5 726	2.6	9.3	3.6
2002	56	61 336	4 579	2.3	9.8	4.3
2003	51	51 466	4 208	3.0	8.1	2.5
2004	51	31 874	4 150	2.3	4.9	1.6
2005	37	19 620	2 266	2.4	5.7	2.0
2006	34	20 729	1 734	2.6	8.5	3.2
2007	31	20 786	1 136	2.8	15.0	5.5
2008	13	11 841	806	1.7	7.3	4.7
2009	15	12 363	679	2.7	14.5	5.1
2010	23	22 884	1 172	2.5	17.1	5.5
2011	24	29 468	1 495	2.0	17.4	8.5
2012	27	30 071	1 559	2.1	16.3	7.9
2013	24	33 697	1 793	2.6	15.4	6.2
2014	26	43 770	2 298	2.8	15.2	6.0
2015	27	50 906	2 649	2.7	15.5	6.1
2016	24	38 311	2 639	2.2	11.7	5.0
2017	24	35 227	2 307	2.2	11.8	5.5
All years	242	1 612 351	107 494	3.2	9.9	3.2

Table A2b: Number of vessels, total hoki catch, number of tows, median tow duration, median catch per tow, and median catch per hour for all WCSI vessels by year. Year defined as June to September. Data are non-zero catches for TCEPR bottom tows, and excludes MHS tows.

BT all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	41	10 737	1 292	4.0	3.2	0.8
1991	36	10 951	1 458	4.0	3.6	0.9
1992	37	9 332	1 025	4.1	4.1	1.0
1993	33	13 655	1 725	3.8	5.2	1.4
1994	32	9 700	1 454	4.2	4.0	0.8
1995	27	5 797	1 304	4.5	2.5	0.5
1996	37	4 911	1 576	4.7	2.1	0.4
1997	47	5 139	1 416	5.0	2.3	0.5
1998	40	5 891	1 271	5.2	3.1	0.5
1999	38	12 881	1 803	4.7	4.4	0.9
2000	34	17 443	2 002	4.5	6.0	1.3
2001	40	18 238	2 397	4.5	5.0	0.9
2002	35	26 991	2 998	5.0	5.3	1.0
2003	39	17 044	3 146	5.3	2.4	0.4
2004	35	8 158	2 113	6.0	1.6	0.3
2005	30	10 683	1 741	6.2	2.7	0.4
2006	25	14 719	2 127	8.3	2.8	0.4
2007	22	10 223	1 316	7.0	3.1	0.4
2008	17	8 177	1 468	9.0	2.4	0.3
2009	18	6 732	1 079	9.2	3.0	0.3
2010	21	11 089	1 146	6.8	5.1	0.9
2011	21	15 071	1 561	6.1	6.3	1.0
2012	23	20 353	1 656	5.2	9.9	1.9
2013	18	17 773	1 427	5.1	10.8	2.3
2014	17	19 316	1 523	5.2	10.2	1.8
2015	19	20 997	1 795	5.2	8.4	1.5
2016	21	24 076	1 785	3.7	12.6	3.4
2017	18	23 374	2 257	4.8	6.4	1.3
All years	146	379 454	47 861	5.0	4.1	0.7

BT target hoki tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	34	10 597	1 129	4.2	4.1	1.1
1991	31	10 877	1 321	4.0	4.1	1.1
1992	28	9 152	791	4.0	7.0	1.7
1993	29	13 611	1 588	3.8	5.9	1.6
1994	29	9 676	1 361	4.3	4.2	0.9
1995	24	5 782	1 271	4.5	2.6	0.5
1996	37	4 883	1 536	4.7	2.1	0.4
1997	42	5 112	1 341	5.0	2.5	0.5
1998	34	5 856	1 190	5.2	3.1	0.6
1999	34	12 849	1 669	4.7	5.1	1.0
2000	32	17 385	1 859	4.3	6.6	1.4
2001	37	18 216	2 314	4.6	5.0	1.0
2002	34	26 722	2 832	5.0	5.9	1.1
2003	39	16 793	2 789	5.1	3.0	0.6
2004	34	7 911	1 797	5.7	2.0	0.4
2005	27	9 732	1 240	5.6	4.5	0.8
2006	24	13 087	1 405	7.0	5.0	0.8
2007	20	8 874	731	4.8	9.3	1.7
2008	13	5 246	480	5.0	8.6	1.7
2009	13	4 460	348	4.5	11.3	2.6
2010	19	9 214	611	3.2	13.5	4.7
2011	17	11 707	908	4.1	11.4	2.9
2012	20	18 853	1 184	3.8	15.0	4.1
2013	16	16 060	996	3.5	15.6	4.8
2014	15	17 203	1 075	3.9	15.3	3.8
2015	17	18 209	1 216	3.6	14.3	4.0
2016	17	23 071	1 494	3.2	15.1	5.1
2017	16	22 134	1 874	4.4	8.7	1.8
All years	131	353 273	38 350	4.5	5.3	1.1

Table A2c: Number of vessels, total hoki catch, number of tows, median tow duration, median catch per tow, and median catch per hour for all Cook Strait vessels by year. Year defined as June to September. Data are non-zero catches for TCEPR midwater tows, and excludes MHS tows.

MW all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	17	11 888	1 045	1.2	9.1	7.4
1991	22	21 976	2 069	1.5	8.2	5.0
1992	22	19 345	1 642	1.2	8.3	6.5
1993	20	16 977	1 499	1.0	8.3	7.0
1994	29	24 796	1 774	1.0	12.1	12.1
1995	24	23 683	1 964	1.0	9.4	11.9
1996	36	41 587	3 026	0.8	11.5	17.1
1997	34	42 689	3 481	0.9	10.6	12.0
1998	28	30 208	2 246	1.0	12.5	12.8
1999	21	27 852	1 930	1.0	14.4	15.9
2000	21	27 550	1 893	0.7	12.9	20.9
2001	25	23 478	1 807	0.8	11.6	14.5
2002	15	16 911	989	1.0	15.9	19.5
2003	20	26 795	1 758	0.9	13.7	17.9
2004	19	27 603	1 732	1.0	13.2	15.1
2005	13	18 037	1 310	1.0	13.5	17.7
2006	11	16 145	977	0.8	15.3	21.4
2007	7	12 181	895	0.9	11.9	15.5
2008	6	7 350	375	0.8	19.3	26.0
2009	7	9 040	727	0.6	10.1	18.4
2010	8	10 662	794	0.8	11.2	15.3
2011	6	7 070	482	0.7	12.3	20.1
2012	9	9 656	719	0.9	11.5	15.1
2013	9	11 483	827	0.7	12.3	18.0
2014	9	11 163	871	1.0	11.2	12.3
2015	9	11 967	768	0.6	15.0	22.3
2016	9	10 805	630	0.7	16.9	26.2
2017	9	9 056	555	0.9	14.7	17.0
All years	72	527 954	38 785	1.0	11.7	13.7

MW target hoki tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	17	11 888	1 045	1.2	9.1	7.4
1991	22	21 976	2 069	1.5	8.2	5.0
1992	22	19 345	1 642	1.2	8.3	6.5
1993	18	16 957	1 493	1.0	8.3	7.0
1994	29	24 755	1 768	1.0	12.1	12.1
1995	24	23 627	1 960	1.0	9.4	11.9
1996	36	41 511	3 017	0.8	11.5	17.3
1997	34	42 620	3 474	0.9	10.6	12.0
1998	28	30 171	2 244	1.0	12.5	12.8
1999	21	27 852	1 930	1.0	14.4	15.9
2000	21	27 550	1 893	0.7	12.9	20.9
2001	25	23 450	1 804	0.8	11.6	14.5
2002	15	16 911	989	1.0	15.9	19.5
2003	20	26 795	1 758	0.9	13.7	17.9
2004	19	27 603	1 730	1.0	13.2	15.2
2005	13	18 033	1 309	1.0	13.5	17.7
2006	11	16 145	976	0.8	15.3	21.4
2007	7	12 133	892	0.9	11.8	15.5
2008	5	7 347	368	0.8	19.8	26.8
2009	7	9 028	726	0.6	10.1	18.4
2010	8	10 606	792	0.8	11.2	15.3
2011	6	7 070	482	0.7	12.3	20.1
2012	9	9 656	719	0.9	11.5	15.1
2013	9	11 483	827	0.7	12.3	18.0
2014	9	11 163	871	1.0	11.2	12.3
2015	9	11 964	767	0.6	15.1	22.4
2016	9	10 805	630	0.7	16.9	26.2
2017	9	9 047	550	0.9	15.1	17.5
All years	72	527 492	38 725	1.0	11.7	13.7

Table A2d: Number of Chatham Rise and ECSI non-zero hoki bottom tows and vessels, total catches, median tow duration, median catch per tow, and median catch per hour by fishing year. Data source is un-groomed bottom non-zero TCEPR tows catching hoki. Chatham Rise data includes data from October to September, and ECSI data includes non-spawning data from November to May, and excludes MHS tows. Fishing year: “1990” = 1989–90.

BT all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	47	12 998	3 277	4.0	1.5	0.5
1991	59	18 078	4 774	4.0	2.0	0.5
1992	72	43 438	8 142	4.0	3.1	0.8
1993	61	39 231	7 513	3.9	3.4	1.0
1994	64	18 121	5 285	3.5	2.1	0.7
1995	70	30 582	7 903	3.8	3.0	0.9
1996	84	37 618	9 289	3.6	3.0	0.9
1997	96	42 749	10 281	3.7	3.2	0.9
1998	82	55 776	12 457	4.0	3.3	0.9
1999	76	61 420	12 580	4.0	4.1	1.0
2000	60	44 683	10 704	4.1	3.0	0.8
2001	60	46 140	11 419	4.5	3.0	0.7
2002	55	36 215	9 470	4.5	2.9	0.7
2003	62	37 381	10 889	4.7	2.5	0.5
2004	57	31 498	9 094	5.0	2.3	0.5
2005	50	28 822	7 024	5.0	2.8	0.6
2006	50	33 939	7 109	4.8	3.5	0.8
2007	46	37 612	7 255	4.6	3.5	0.8
2008	38	37 366	6 879	4.8	3.6	0.8
2009	37	38 863	6 166	4.3	4.6	1.1
2010	38	38 378	5 814	4.5	5.3	1.2
2011	37	38 118	5 273	4.7	6.0	1.3
2012	35	38 814	5 426	4.8	5.7	1.3
2013	35	35 028	5 166	4.8	5.6	1.2
2014	32	32 570	5 153	4.8	5.1	1.1
2015	35	38 315	5 444	5.0	5.7	1.2
2016	32	35 067	5 243	4.7	5.5	1.2
2017	31	38 802	5 210	4.8	6.1	1.4
All years	201	1 027 624	210 239	4.2	3.3	0.8

BT target hoki tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	31	11 787	1 894	4.0	3.9	1.0
1991	41	16 760	3 279	4.0	3.5	0.9
1992	47	42 305	5 408	3.8	5.7	1.6
1993	40	38 348	5 168	3.5	5.7	1.6
1994	36	17 525	3 370	3.2	4.2	1.3
1995	42	30 095	6 478	3.5	3.9	1.1
1996	58	37 176	7 968	3.5	3.2	1.0
1997	73	42 231	8 940	3.6	3.7	1.1
1998	63	55 267	11 137	4.0	4.2	1.0
1999	45	60 732	11 209	4.0	4.4	1.1
2000	34	44 043	9 377	4.1	3.7	0.9
2001	40	44 918	9 753	4.5	3.5	0.8
2002	31	35 031	7 753	4.4	3.4	0.8
2003	32	36 017	9 174	4.8	3.0	0.6
2004	28	30 050	7 108	4.9	3.0	0.6
2005	21	27 380	4 951	5.0	4.1	0.8
2006	20	32 193	4 962	4.9	5.0	1.0
2007	21	34 743	4 729	4.5	5.8	1.2
2008	22	33 519	4 182	4.8	6.6	1.4
2009	21	33 623	3 890	4.2	7.3	1.7
2010	21	35 075	4 332	4.6	6.9	1.5
2011	23	34 801	4 049	4.8	7.2	1.5
2012	24	37 635	4 378	4.8	7.2	1.6
2013	22	33 868	4 146	4.8	6.7	1.4
2014	18	31 864	3 946	4.9	6.6	1.4
2015	21	37 368	4 295	5.0	7.2	1.4
2016	14	32 653	4 048	4.8	6.8	1.5
2017	16	37 100	4 176	4.8	7.7	1.6
All years	166	984 107	164 100	4.2	4.5	1.1

Table A2e: Number of ECSI non-zero hoki midwater or bottom tows and vessels, total catches, median tow duration, median catch per tow, and median catch per hour by year. Data source is un-groomed midwater or bottom non-zero TCEPR tows catching hoki. Year defined as June to October. No October data in 2017. Data not shown where there are less than 3 vessels, and excludes MHS tows.

MW all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
2000	7	289	24	2.7	7.5	2.4
2001	15	1 264	123	2.4	6.0	2.2
2002	10	2 003	145	2.2	10.9	4.2
2003	18	4 453	301	2.1	13.1	5.2
2004	5	1 438	85	2.2	10.4	6.0
2005	6	4 037	221	2.0	15.0	8.4
2006	4	485	41	1.5	10.0	5.7
2007	4	299	26	1.1	8.7	8.8
2008	3	263	28	3.0	8.1	2.7
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	4	879	57	1.0	14.7	10.8
2012	8	1 686	117	1.6	10.3	5.2
2013	10	2 945	191	2.0	14.2	6.6
2014	12	2 586	134	2.2	16.5	7.9
2015	8	3 345	189	2.3	17.3	6.9
2016	8	3 560	207	2.2	15.1	5.2
2017	9	3 680	182	2.6	18.4	6.4
All years	34	33 703	2 105	2.0	14.0	5.9

MW target hoki tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
2000	7	289	24	2.7	7.5	2.4
2001	15	1 264	123	2.4	6.0	2.2
2002	10	2 003	145	2.2	10.9	4.2
2003	18	4 453	301	2.1	13.1	5.2
2004	5	1 438	85	2.2	10.4	6.0
2005	6	4 037	221	2.0	15.0	8.4
2006	4	485	41	1.5	10.0	5.7
2007	4	299	26	1.1	8.7	8.8
2008	3	263	28	3.0	8.1	2.7
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	4	879	57	1.0	14.7	10.8
2012	8	1 686	117	1.6	10.3	5.2
2013	10	2 945	191	2.0	14.2	6.6
2014	12	2 586	134	2.2	16.5	7.9
2015	8	3 345	189	2.3	17.3	6.9
2016	8	3 560	207	2.2	15.1	5.2
2017	9	3 680	182	2.6	18.4	6.4
All years	34	32 699	2 066	2.1	13.8	5.8

Table A2e: ECSI continued.

BT all target tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
2000	10	250	69	2.5	2.5	1.0
2001	13	441	85	2.7	3.5	1.2
2002	16	828	126	2.6	3.9	1.5
2003	16	2 081	255	2.9	5.4	1.9
2004	7	250	44	2.4	3.1	1.0
2005	8	717	98	3.0	4.1	1.8
2006	7	163	31	2.1	2.1	1.6
2007	11	666	81	2.0	6.2	2.9
2008	12	2 112	215	2.8	7.5	2.5
2009	8	635	76	2.8	6.2	2.4
2010	8	533	70	2.8	7.3	2.1
2011	6	592	56	3.5	10.8	3.0
2012	9	753	89	2.5	7.2	2.4
2013	10	302	48	2.9	3.6	1.4
2014	12	227	55	2.5	2.5	1.0
2015	7	257	42	2.8	3.7	1.3
2016	10	565	106	3.0	3.1	1.0
2017	8	655	84	2.1	5.1	2.9
All years	39	12 099	1 672	2.8	4.7	1.8

BT target hoki tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
2000	10	250	69	2.5	2.5	1.0
2001	13	441	85	2.7	3.5	1.2
2002	16	828	126	2.6	3.9	1.5
2003	16	2 081	255	2.9	5.4	1.9
2004	7	250	44	2.4	3.1	1.0
2005	8	717	98	3.0	4.1	1.8
2006	7	163	31	2.1	2.1	1.6
2007	11	666	81	2.0	6.2	2.9
2008	12	2 112	215	2.8	7.5	2.5
2009	8	635	76	2.8	6.2	2.4
2010	8	533	70	2.8	7.3	2.1
2011	6	592	56	3.5	10.8	3.0
2012	9	753	89	2.5	7.2	2.4
2013	10	302	48	2.9	3.6	1.4
2014	12	227	55	2.5	2.5	1.0
2015	7	257	42	2.8	3.7	1.3
2016	10	565	106	3.0	3.1	1.0
2017	8	655	84	2.1	5.1	2.9
All years	28	11 522	1 524	2.8	5.0	1.9

Table A2f: Number of Sub-Antarctic non-zero hoki bottom tows and vessels, total catches, median tow duration, median catch per tow, and median catch per hour for all vessels by fishing year. Data source is ungrouped bottom non-zero TCEPR tows catching hoki, and excludes MHS tows. Fishing year: “1990” = 1989–90.

BT all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	36	11 542	2 589	4.0	2.6	0.6
1991	43	16 177	4 420	4.3	2.6	0.6
1992	58	29 688	6 877	4.2	3.1	0.8
1993	39	22 304	5 647	4.0	3.1	0.8
1994	45	9 051	3 163	4.2	1.6	0.4
1995	42	11 716	3 223	4.3	2.2	0.6
1996	46	10 889	3 483	4.2	1.9	0.5
1997	58	19 288	4 522	4.5	3.2	0.7
1998	49	24 217	5 192	4.3	3.3	0.8
1999	49	20 966	4 673	4.5	2.9	0.7
2000	43	31 576	7 155	4.2	3.0	0.8
2001	46	26 222	6 669	4.5	2.7	0.6
2002	47	29 568	8 093	4.4	2.1	0.6
2003	44	19 870	5 556	4.9	2.4	0.5
2004	41	11 168	3 728	5.0	2.0	0.4
2005	40	6 148	2 542	5.3	1.0	0.2
2006	34	6 491	2 360	5.3	0.7	0.1
2007	31	7 420	2 878	5.2	0.8	0.2
2008	29	8 015	2 625	5.5	1.0	0.2
2009	25	9 195	2 807	5.0	1.0	0.2
2010	29	11 551	3 023	5.4	1.0	0.2
2011	28	10 973	2 689	5.0	1.5	0.3
2012	28	13 665	2 580	5.0	2.2	0.5
2013	29	14 050	2 773	4.8	2.6	0.5
2014	22	19 786	3 211	5.0	3.6	0.7
2015	25	15 606	2 835	5.1	3.3	0.7
2016	25	6 550	1 787	5.1	1.5	0.3
2017	27	12 939	2 413	5.3	2.0	0.5
All years	168	436 629	109 513	4.5	2.3	0.5

BT hoki target tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	20	10 922	2 048	4.0	3.6	0.9
1991	30	15 229	3 862	4.4	2.8	0.6
1992	33	28 278	5 314	4.1	4.1	1.0
1993	24	21 359	4 817	3.8	3.6	0.9
1994	22	8 748	1 977	4.0	3.2	0.9
1995	25	11 453	2 297	4.0	3.9	1.0
1996	25	10 628	2 437	4.0	3.1	0.9
1997	42	18 919	3 293	4.2	4.6	1.1
1998	34	23 669	4 267	4.2	4.2	1.0
1999	33	20 391	3 563	4.2	4.1	1.1
2000	30	30 884	5 806	4.0	3.9	1.0
2001	31	25 397	5 324	4.2	3.5	0.8
2002	33	28 612	6 253	4.2	2.9	0.8
2003	33	19 101	4 322	4.8	3.0	0.7
2004	26	10 815	2 864	4.9	3.0	0.6
2005	25	5 151	1 351	5.1	2.5	0.5
2006	16	4 636	720	5.0	4.0	0.8
2007	20	5 143	1 136	4.5	2.2	0.5
2008	13	5 828	909	4.8	4.5	0.9
2009	12	6 883	918	4.4	5.1	1.2
2010	12	9 687	1 231	4.5	6.1	1.3
2011	15	9 210	1 237	4.5	5.5	1.2
2012	17	11 538	1 193	4.6	7.6	1.6
2013	16	11 703	1 363	4.3	6.2	1.5
2014	13	17 217	1 864	4.5	7.1	1.6
2015	15	13 052	1 610	4.9	6.2	1.3
2016	9	5 651	824	4.9	5.2	1.1
2017	15	11 063	1 257	4.8	6.1	1.3
All years	111	401 166	74 057	4.2	3.9	0.9

Table A2g: Number of Puysegur non-zero hoki bottom and midwater median tow duration, median catch per tow, and median catch per hour for all vessels by year. Data source is un-groomed midwater or bottom non-zero TCEPR tows catching hoki. Year defined as June to December. No October to December data in 2017. Data not shown where there are less than 3 vessels, and excludes MHS tows.

MW all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	25	7 154	759	2.5	7.9	3.2
1991	16	3 188	269	2.4	10.2	4.1
1992	13	1 079	146	3.0	5.2	1.9
1993	10	663	75	2.0	6.1	2.5
1994	17	2 209	266	3.0	3.9	1.1
1995	15	1 015	163	2.3	3.0	1.4
1996	12	1 447	155	2.7	7.1	2.9
1997	20	4 742	410	3.5	8.5	2.5
1998	8	886	97	3.0	7.3	2.4
1999	16	1 416	141	3.4	4.8	1.3
2000	13	2 071	173	4.2	6.0	1.6
2001	22	5 213	373	4.3	10.0	2.2
2002	19	3 129	262	3.6	6.7	1.5
2003	20	5 137	309	2.8	12.1	3.6
2004	5	576	43	3.7	2.9	0.7
2005	9	4 953	220	2.1	22.0	9.6
2006	4	236	16	2.8	14.8	5.0
2007	1	-	-	-	-	-
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	2	-	-	-	-	-
2012	2	-	-	-	-	-
2013	2	-	-	-	-	-
2014	3	9	4	3.5	2.2	0.8
2015	3	864	50	2.5	16.4	3.7
2016	3	411	36	3.5	6.6	1.6
2017	5	504	37	3.2	12.3	3.1
All years	109	49 113	4 187	3.0	7.9	2.6

MW hoki target tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	25	7 149	758	2.5	7.9	3.2
1991	16	3 173	268	2.4	10.2	4.1
1992	12	1 048	134	3.0	5.2	2.0
1993	9	663	74	2.0	6.2	2.6
1994	17	2 189	264	3.0	3.9	1.1
1995	15	1 015	163	2.3	3.0	1.4
1996	12	1 447	155	2.7	7.1	2.9
1997	20	4 742	410	3.5	8.5	2.5
1998	8	885	96	3.0	7.7	2.4
1999	16	1 416	141	3.4	4.8	1.3
2000	13	2 071	173	4.2	6.0	1.6
2001	22	5 206	372	4.3	10.0	2.2
2002	19	3 129	262	3.6	6.7	1.5
2003	20	5 137	309	2.8	12.1	3.6
2004	3	571	29	3.5	13.2	5.1
2005	8	4 942	216	2.1	22.0	10.0
2006	4	236	16	2.8	14.8	5.0
2007	1	-	-	-	-	-
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	2	-	-	-	-	-
2012	2	-	-	-	-	-
2013	2	-	-	-	-	-
2014	3	9	4	3.5	2.2	0.8
2015	3	864	50	2.5	16.4	3.7
2016	3	411	36	3.5	6.6	1.6
2017	5	504	37	3.2	12.3	3.1
All years	106	49 018	4 150	3.0	8.0	2.6

Table A2g continued.: Puysegur continued.

BT all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	18	116	276	3.2	0.1	-
1991	26	1 664	380	4.3	3.1	0.7
1992	32	4 019	864	4.3	2.6	0.6
1993	15	1 052	241	4.2	3.0	0.7
1994	22	424	255	5.0	0.7	0.1
1995	16	339	322	6.1	0.4	0.1
1996	18	1 021	468	4.8	0.6	0.1
1997	27	1 247	487	5.9	0.5	0.1
1998	22	1 443	379	5.6	1.1	0.2
1999	23	1 111	436	5.5	1.0	0.2
2000	23	1 231	453	5.8	1.0	0.2
2001	26	953	277	4.4	1.0	0.3
2002	19	1 930	230	3.8	5.5	1.2
2003	20	839	227	4.5	1.3	0.3
2004	17	224	112	4.4	0.5	0.1
2005	21	587	316	5.9	0.8	0.1
2006	20	1 081	330	4.2	1.0	0.2
2007	16	370	251	4.7	0.5	0.1
2008	6	155	126	4.6	0.4	0.1
2009	9	163	80	4.2	1.0	0.2
2010	11	150	133	5.0	0.5	0.1
2011	13	299	141	4.5	1.0	0.2
2012	10	264	103	4.1	1.0	0.3
2013	10	528	114	4.4	3.1	0.6
2014	12	888	148	3.9	4.1	1.0
2015	12	559	166	4.9	1.0	0.2
2016	11	631	126	5.0	2.0	0.4
2017	11	421	58	4.4	3.7	1.0
All years	98	23 708	7 499	4.7	1.0	0.2

BT hoki target tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	8	24	24	2.9	0.5	0.3
1991	21	1 541	312	4.1	4.1	0.9
1992	26	3 783	712	4.2	3.1	0.8
1993	12	1 019	202	4.0	3.9	0.9
1994	17	380	195	5.2	1.0	0.2
1995	11	293	227	6.1	0.5	0.1
1996	18	945	361	4.5	1.0	0.2
1997	25	1 062	427	5.8	0.5	0.1
1998	20	1 371	303	5.2	2.1	0.4
1999	22	1 060	387	5.5	1.0	0.2
2000	21	1 190	381	5.7	1.2	0.2
2001	23	919	210	4.3	2.2	0.5
2002	17	1 907	209	3.8	5.9	1.4
2003	14	810	151	4.6	3.0	0.6
2004	7	166	31	3.7	3.0	0.9
2005	8	240	51	3.2	2.2	0.9
2006	6	725	90	3.5	6.0	2.0
2007	2	-	-	-	-	-
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	1	-	-	-	-	-
2012	1	-	-	-	-	-
2013	4	221	21	3.9	11.5	2.7
2014	4	254	34	3.5	4.1	1.1
2015	4	371	26	3.2	16.0	4.5
2016	4	309	31	3.6	10.0	2.4
2017	4	320	24	3.9	11.6	3.3
All years	78	19 064	4 436	4.6	1.9	0.4

Table A2h: Number of ECNI non-zero hoki bottom and midwater median tow duration, median catch per tow, and median catch per hour for all vessels by fishing year. Data source is un-groomed midwater or bottom non-zero TCEPR tows catching hoki. Year defined as October to September. Data not shown where there are less than 3 vessels. Fishing year: “1990” = 1989–90.

MW all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	6	155	114	1.0	0.5	0.5
1991	7	58	71	1.2	0.3	0.3
1992	7	93	110	1.0	0.2	0.1
1993	7	180	166	1.5	0.5	0.3
1994	10	186	198	1.2	0.2	0.2
1995	9	51	91	0.8	0.1	0.2
1996	17	113	161	1.8	0.1	0.1
1997	19	108	85	1.5	0.4	0.3
1998	13	699	252	1.5	1.7	1.0
1999	11	368	226	2.1	0.4	0.3
2000	8	288	187	1.3	1.0	0.7
2001	9	643	234	1.2	1.7	1.2
2002	7	285	156	1.0	0.8	0.7
2003	8	161	175	0.9	0.4	0.3
2004	7	239	195	1.0	0.4	0.4
2005	6	97	147	1.1	0.2	0.2
2006	5	314	99	1.2	0.6	0.4
2007	5	131	67	1.0	0.3	0.4
2008	6	197	119	1.2	0.3	0.3
2009	5	190	99	0.8	0.9	1.0
2010	7	105	114	1.0	0.4	0.3
2011	6	628	138	1.0	2.8	2.4
2012	6	249	92	1.0	1.0	1.1
2013	5	175	85	1.0	0.4	0.6
2014	6	114	90	1.0	0.4	0.4
2015	6	274	98	1.1	1.5	0.9
2016	6	125	74	1.0	0.8	0.9
2017	5	90	34	1.0	2.0	2.3
All years	49	6 315	3 677	1.2	0.5	0.4

MW hoki target tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	3	33	3	0.8	11.7	15.6
1991	6	45	42	1.4	0.6	0.4
1992	4	63	39	1.4	1.2	0.8
1993	5	66	43	1.4	1.0	0.6
1994	7	89	33	1.8	0.3	0.3
1995	4	11	12	1.5	0.4	0.4
1996	14	88	45	2.7	0.8	0.2
1997	14	95	43	1.7	1.1	0.6
1998	11	666	183	1.7	2.3	1.4
1999	4	332	121	1.4	1.5	0.9
2000	4	233	112	2.0	1.5	0.8
2001	5	623	194	1.4	2.0	1.6
2002	4	261	107	1.2	1.2	1.0
2003	2	-	-	-	-	-
2004	3	215	140	1.4	0.7	0.4
2005	2	-	-	-	-	-
2006	2	-	-	-	-	-
2007	2	-	-	-	-	-
2008	2	-	-	-	-	-
2009	1	-	-	-	-	-
2010	2	-	-	-	-	-
2011	3	519	74	0.9	6.2	5.7
2012	3	218	47	1.3	4.1	2.6
2013	3	98	25	2.1	2.3	0.8
2014	5	47	22	1.2	2.0	1.0
2015	4	234	57	0.9	3.7	4.7
2016	4	71	35	1.0	1.1	1.0
2017	1	-	-	-	-	-
All years	40	4 970	1 767	1.4	1.5	0.9

Table A2h: ECNI continued.

BT all target species tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	14	127	1 675	3.9	0.1	-
1991	27	322	3 244	4.5	0.1	-
1992	26	273	2 520	5.2	0.1	-
1993	30	568	2 320	5.2	0.1	-
1994	45	960	2 997	5.3	0.1	-
1995	49	1 068	2 379	5.0	0.1	-
1996	70	1 886	3 355	4.2	0.2	-
1997	67	2 734	3 722	4.1	0.2	-
1998	58	1 936	3 386	4.5	0.2	-
1999	48	1 065	2 993	4.9	0.1	-
2000	40	754	3 041	5.5	0.1	-
2001	37	987	3 006	6.5	0.1	-
2002	40	838	4 249	7.0	0.1	-
2003	43	718	2 528	7.0	0.1	-
2004	39	612	2 067	6.5	0.1	-
2005	36	403	1 483	6.2	0.1	-
2006	35	350	1 176	5.8	0.1	-
2007	29	440	1 622	5.0	0.1	-
2008	26	317	1 288	5.8	0.1	-
2009	20	300	1 120	4.4	-	-
2010	22	283	1 655	6.2	-	-
2011	23	802	1 793	5.0	0.1	-
2012	24	442	1 489	5.7	0.1	-
2013	23	623	1 356	6.9	0.1	-
2014	25	795	1 269	4.4	0.1	-
2015	21	208	922	5.0	0.1	-
2016	18	305	867	6.8	0.1	-
2017	19	218	1 000	6.9	0.1	-
All years	119	20 334	60 522	5.2	0.1	-

BT hoki target tows:

Fishing year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1990	4	16	24	0.7	0.2	0.3
1991	4	10	16	3.2	0.4	0.1
1992	9	75	77	5.0	0.7	0.1
1993	14	401	248	5.5	0.8	0.1
1994	18	553	156	2.2	1.3	0.5
1995	33	1 248	836	2.8	0.8	0.3
1996	46	2 150	1 396	3.0	0.8	0.3
1997	38	1 273	1 125	3.5	0.5	0.1
1998	23	656	528	3.0	0.8	0.3
1999	15	405	402	2.8	0.7	0.2
2000	18	566	324	2.7	1.0	0.4
2001	16	294	305	3.3	0.5	0.2
2002	14	379	283	2.5	0.8	0.3
2003	17	345	364	3.0	0.4	0.2
2004	10	239	252	3.0	0.5	0.1
2005	14	242	154	3.4	0.8	0.3
2006	13	232	150	4.0	0.6	0.1
2007	6	185	87	3.0	1.1	0.4
2008	6	146	74	3.5	1.2	0.3
2009	8	86	78	4.0	0.7	0.2
2010	9	547	157	3.7	2.1	0.7
2011	7	270	140	3.6	1.0	0.3
2012	6	472	137	4.0	2.1	0.6
2013	8	584	205	2.8	1.3	0.5
2014	6	110	118	4.3	0.4	0.1
2015	4	203	82	5.0	0.5	0.1
2016	4	74	115	4.8	0.5	0.1
2017	84	11 757	7 833	3.1	0.7	0.2
All years						

Table A3: Summary of data used in the analyses of CPUE for all vessels and for core vessels for each fishing year. Vessels, number of unique vessels fishing; Tows, number of tow records; Zeros, proportion of tows (estimated) that caught zero catch; Catch, estimated; CPUE, unstandardised CPUE from the non-zero tow-by-tow. Fishing year: “1991” = 1990–91.

WCSI: TCEPR tow-by-tow, BT and MW, target hoki

Year	All vessels					Core vessels				
	No. vessels	Catch	Effort	Prop. zeros	CPUE	No. vessels	Catch	Effort	Prop. zeros	CPUE
1991	73	102 676.0	7 632	0.04	13.45	25	46 571.4	2 429	0.03	19.17
1992	66	87 487.1	5 747	0.06	15.22	25	37 536.2	2 259	0.03	16.62
1993	60	85 085.3	6 390	0.06	13.32	30	48 282.3	3 490	0.06	13.83
1994	66	98 820.5	8 139	0.08	12.14	40	69 098.8	5 377	0.08	12.85
1995	62	67 484.7	8 132	0.10	8.30	43	51 610.6	6 040	0.09	8.54
1996	61	59 237.8	6 440	0.07	9.20	42	53 128.6	5 298	0.07	10.03
1997	76	78 693.2	7 635	0.07	10.31	50	67 410.8	6 186	0.07	10.90
1998	68	91 280.9	7 631	0.04	11.96	55	85 570.9	7 093	0.04	12.06
1999	58	82 900.7	6 690	0.03	12.39	51	82 522.6	6 638	0.03	12.43
2000	51	93 665.7	6 956	0.02	13.47	44	92 844.5	6 865	0.02	13.52
2001	63	93 718.9	7 969	0.02	11.76	48	89 975.2	7 494	0.02	12.01
2002	56	85 314.7	7 270	0.02	11.74	47	82 108.5	6 956	0.02	11.80
2003	51	68 095.9	6 957	0.02	9.79	45	67 822.8	6 900	0.02	9.83
2004	51	39 627.7	5 908	0.02	6.71	41	35 211.1	5 406	0.02	6.51
2005	37	28 969.9	3 458	0.02	8.38	36	28 714.9	3 439	0.02	8.35
2006	36	33 620.2	3 113	0.01	10.80	31	32 916.3	3 018	0.01	10.91
2007	32	29 194.3	1 818	0.01	16.06	28	28 401.8	1 776	0.01	15.99
2008	22	16 956.9	1 277	0.01	13.28	15	16 126.4	1 213	0.01	13.29
2009	20	16 781.8	1 022	0.01	16.42	13	15 781.6	960	0.01	16.44
2010	27	31 982.6	1 774	0.01	18.03	24	31 674.0	1 760	0.01	18.00
2011	27	41 002.0	2 390	0.01	17.16	24	40 564.6	2 356	0.01	17.22
2012	30	48 759.8	2 731	0.01	17.85	29	48 701.2	2 723	0.01	17.89
2013	26	49 485.3	2 770	0.01	17.86	23	49 015.9	2 741	0.01	17.88
2014	26	60 570.6	3 343	-	18.12	24	60 171.6	3 310	-	18.18
2015	28	68 779.5	3 835	-	17.93	24	68 182.2	3 779	-	18.04
2016	25	60 946.6	4 121	0.01	14.79	22	59 846.0	4 000	0.01	14.96
2017	27	56 931.3	4 174	0.01	13.64	22	48 130.5	3 517	0.01	13.69

WCSI: Observer target hoki catch

Fishing year	All vessels					Core vessels				
	No. vessels	Catch	Tows	Prop. zeros	CPUE	No. vessels	Catch	Tows	Prop. zeros	CPUE
1990	14	27 415.7	1 353	0.02	20.26	5	9 069.6	476	0.02	19.05
1991	14	19 416.0	1 149	0.02	16.90	5	11 045.3	484	0.02	22.82
1992	10	13 492.3	712	0.04	18.95	3	4 554.7	185	0.01	24.62
1993	15	12 936.1	981	0.02	13.19	8	6 878.9	637	0.01	10.80
1994	15	21 979.5	1 437	0.02	15.30	8	12 035.9	864	0.01	13.93
1995	9	13 121.1	700	0.02	18.74	6	6 359.1	395	0.01	16.10
1996	15	11 517.1	981	0.03	11.74	10	9 906.7	766	0.02	12.93
1997	12	10 317.3	644	0.02	16.02	10	8 766.6	583	0.02	15.04
1998	16	13 969.5	845	0.01	16.53	11	13 072.5	760	0.01	17.20
1999	14	14 151.4	1 048	0.02	13.50	11	13 344.0	912	0.02	14.63
2000	17	17 566.9	1 138	-	15.44	12	16 221.4	1 095	-	14.81
2001	21	14 250.9	979	0.01	14.56	15	12 871.4	904	0.01	14.24
2002	16	16 306.8	1 287	0.01	12.67	14	16 073.6	1 271	0.01	12.65
2003	13	10 085.7	908	0.01	11.11	13	10 085.7	908	0.01	11.11
2004	16	8 358.6	1 292	0.01	6.47	13	7 452.7	1 166	0.01	6.39
2005	13	7 165.4	971	-	7.38	11	7 094.2	958	-	7.41
2006	13	9 519.6	778	-	12.24	9	9 328.1	750	-	12.44
2007	16	9 203.3	457	-	20.14	10	8 079.1	399	-	20.25
2008	11	6 977.9	419	-	16.65	7	6 283.8	383	0.01	16.41
2009	12	7 231.2	361	-	20.03	6	6 956.3	327	-	21.27
2010	14	8 122.9	469	0.02	17.32	6	7 188.8	420	0.02	17.12
2011	11	8 601.3	489	0.01	17.59	8	7 994.8	466	0.01	17.16
2012	15	16 102.3	839	0.01	19.19	12	15 465.7	807	0.01	19.16
2013	17	29 069.5	1 600	-	18.17	16	28 933.2	1 590	-	18.20
2014	17	27 060.3	1 477	0.01	18.32	15	26 496.8	1 452	0.01	18.25
2015	20	34 027.8	1 644	0.01	20.70	17	33 582.1	1 613	0.01	20.82
2016	16	25 994.0	1 582	-	16.43	15	25 695.4	1 537	-	16.72
2017	20	19 652.4	1 361	0.01	14.44	17	17 666.8	1 205	0.01	14.66

Table A3: continued.

Cook Strait: TCEPR tow-by-tow, MW, target hoki

Year	All vessels					Core vessels				
	No. vessels	Catch	Effort	Prop. zeros	CPUE	No. vessels	Catch	Effort	Prop. zeros	CPUE
1991	22	21 710.3	2 041	0.02	10.64	17	19 125.3	1 794	0.02	10.66
1992	22	17 839.8	1 567	0.03	11.38	16	15 069.1	1 307	0.03	11.53
1993	18	16 317.6	1 430	0.04	11.41	14	15 547.5	1 336	0.04	11.64
1994	28	23 561.4	1 686	0.04	13.97	15	18 851.0	1 275	0.03	14.79
1995	24	20 992.6	1 753	0.03	11.98	16	17 542.1	1 220	0.02	14.38
1996	36	34 543.0	2 554	0.03	13.53	22	27 354.3	1 900	0.03	14.40
1997	33	36 765.7	2 934	0.04	12.53	23	30 107.3	2 416	0.03	12.46
1998	28	26 083.6	1 934	0.03	13.49	19	23 395.7	1 715	0.02	13.64
1999	20	25 626.8	1 748	0.02	14.66	19	25 375.2	1 736	0.02	14.62
2000	21	21 970.7	1 531	0.01	14.35	19	21 672.7	1 500	0.01	14.45
2001	25	20 180.6	1 569	0.02	12.86	20	19 163.6	1 480	0.02	12.95
2002	15	15 143.1	866	0.01	17.49	10	14 408.1	815	0.01	17.68
2003	19	22 906.1	1 510	0.03	15.17	13	22 271.6	1 437	0.03	15.50
2004	19	25 215.9	1 589	0.01	15.87	15	24 255.4	1 537	0.01	15.78
2005	12	15 476.1	1 115	0.01	13.88	9	15 103.8	1 092	0.01	13.83
2006	11	13 770.6	850	0.01	16.20	9	13 551.8	832	0.01	16.29
2007	7	10 526.1	794	0.01	13.26	6	10 364.1	783	0.01	13.24
2008	5	6 164.3	310	0.01	19.88	3	6 072.4	301	0.01	20.17
2009	7	6 814.9	579	0.01	11.77	6	6 469.2	551	0.01	11.74
2010	8	9 325.5	713	0.01	13.08	5	9 203.0	703	0.01	13.09
2011	6	5 998.2	418	0.01	14.35	5	5 980.6	415	0.01	14.41
2012	9	8 721.6	658	0.01	13.25	6	8 553.7	646	0.02	13.24
2013	9	8 915.0	687	-	12.98	5	8 664.6	652	-	13.29
2014	9	9 361.6	780	0.01	12.00	8	8 971.8	750	0.01	11.96
2015	9	9 726.2	663	-	14.67	8	9 661.7	660	-	14.64
2016	9	9 069.8	541	0.01	16.76	6	8 752.8	515	-	17.00
2017	9	8 718.4	523	-	16.67	7	7 742.1	439	-	17.64

Cook Strait: Observer target hoki catch

Year	All vessels					Core vessels				
	No. vessels	Catch	Tows	Prop. zeros	CPUE	No. vessels	Catch	Tows	Prop. zeros	CPUE
1998	11	2 816.7	170	0.05	16.57	9	2 670.3	153	0.04	17.45
1999	10	2 724.7	173	0.01	15.75	7	2 149.0	125	0.02	17.19
2000	7	2 236.5	111	-	20.15	7	2 236.5	111	-	20.15
2001	9	2 670.2	166	-	16.09	5	2 044.2	113	-	18.09
2002	9	1 467.3	106	0.03	13.84	5	1 133.9	81	-	14.00
2003	5	1 599.0	95	-	16.83	4	1 497.9	88	-	17.02
2004	7	2 123.9	107	0.02	19.85	5	1 667.8	75	0.01	22.24
2005	9	1 752.2	100	-	17.52	4	1 391.0	66	-	21.08
2006	4	837.2	48	-	17.44	4	837.2	48	-	17.44
2007	7	1 615.0	137	0.01	11.79	7	1 615.0	137	0.01	11.79
2008	6	2 842.7	165	0.01	17.23	4	2 420.0	128	0.01	18.91
2009	4	1 409.5	108	-	13.05	3	1 344.4	103	-	13.05
2010	9	2 673.5	201	-	13.30	6	2 257.2	167	0.01	13.52
2011	5	1 395.1	75	-	18.60	5	1 387.1	74	-	18.74
2012	7	1 306.7	124	0.04	10.54	6	1 100.5	94	0.02	11.71
2013	4	827.3	74	-	11.18	4	827.3	74	-	11.18
2014	4	2 075.5	182	0.01	11.40	3	1 928.6	160	0.01	12.05
2015	2	303.4	19	-	15.97	2	303.4	19	-	15.97
2016	4	1 933.8	123	0.01	15.72	4	1 933.8	123	0.01	15.72
2017	4	1 760.2	99	-	17.78	3	1 505.5	77	-	19.55

Table A3: continued.

Chatham Rise (Year Oct–Sep) and ECSI non-spawning (Nov–May): TCEPR tow-by-tow, BT, target hoki

Year	All vessels					Core vessels				
	No. vessels	Catch	Effort	Prop. zeros	CPUE	No. vessels	Catch	Effort	Prop. zeros	CPUE
1992	41	27 614.3	3 694	0.02	7.48	7	6 419.1	944	0.01	6.80
1993	40	33 414.3	4 752	0.02	7.03	6	12 472.6	2 259	0.02	5.52
1994	36	16 861.8	3 327	0.02	5.07	6	10 229.3	2 134	0.02	4.79
1995	41	28 416.1	6 174	0.03	4.60	11	20 513.7	4 295	0.02	4.78
1996	53	36 012.7	7 795	0.04	4.62	13	24 823.4	4 562	0.02	5.44
1997	70	41 418.9	8 729	0.03	4.74	19	30 336.6	5 827	0.02	5.21
1998	61	53 600.6	10 880	0.02	4.93	23	44 033.6	8 703	0.02	5.06
1999	47	59 497.3	11 057	0.02	5.38	24	52 789.8	9 686	0.01	5.45
2000	34	43 564.8	9 262	0.01	4.70	22	43 341.8	9 145	0.01	4.74
2001	40	44 492.7	9 653	0.01	4.61	24	42 792.7	9 218	0.01	4.64
2002	31	34 816.4	7 706	0.01	4.52	17	33 619.5	7 332	-	4.59
2003	31	35 848.6	9 111	0.01	3.93	21	33 247.6	8 522	0.01	3.90
2004	28	29 829.1	6 997	0.01	4.26	20	27 404.9	6 568	0.01	4.17
2005	23	27 073.0	4 876	0.01	5.55	17	24 258.0	4 372	0.01	5.55
2006	19	32 074.1	4 923	-	6.52	12	28 888.3	4 416	-	6.54
2007	20	34 415.5	4 675	0.01	7.36	10	29 181.1	3 907	0.01	7.47
2008	22	33 210.3	4 123	-	8.05	14	31 771.5	3 904	-	8.14
2009	20	33 207.1	3 820	-	8.69	13	31 643.4	3 618	-	8.75
2010	20	34 823.4	4 282	-	8.13	12	33 499.4	4 114	-	8.14
2011	23	34 507.7	4 021	-	8.58	14	33 687.9	3 889	-	8.66
2012	24	37 242.6	4 320	-	8.62	15	36 371.1	4 212	-	8.64
2013	22	33 350.6	4 102	-	8.13	14	33 027.2	4 033	-	8.19
2014	18	31 676.3	3 912	-	8.10	10	30 949.6	3 645	-	8.49
2015	20	37 171.5	4 258	-	8.73	12	36 140.0	4 078	-	8.86
2016	14	32 422.6	3 995	-	8.12	10	32 142.5	3 961	-	8.11
2017	16	36 734.6	4 132	-	8.89	9	32 968.3	3 702	-	8.91

Chatham Rise (Year Oct–Sep) and ECSI non-spawning (Nov–May): Observer tow-by-tow, BT, target hoki

Fishing year	All vessels					Core vessels				
	No. vessels	Catch	Tows	Prop. zeros	CPUE	No. vessels	Catch	Tows	Prop. zeros	CPUE
1994	7	1 910.6	327	0.01	5.84	2	649.4	153	0.01	4.24
1995	4	1 460.1	325	0.01	4.49	2	1 231.2	304	0.01	4.05
1996	8	3 454.9	485	-	7.12	4	1 790.9	321	-	5.58
1997	7	1 017.3	217	0.01	4.69	4	539.4	110	0.02	4.90
1998	17	5 322.4	1 054	0.01	5.05	15	5 279.8	1 045	0.01	5.05
1999	14	7 607.8	1 184	0.01	6.43	12	7 025.0	1 097	0.01	6.40
2000	10	3 410.4	672	0.01	5.08	8	3 396.2	658	0.01	5.16
2001	15	4 207.2	922	0.08	4.56	13	4 193.6	915	-	4.58
2002	10	4 601.0	955	-	4.82	10	4 601.0	955	-	4.82
2003	13	2 204.0	728	-	3.03	13	2 204.0	728	-	3.03
2004	10	2 368.5	489	0.04	4.84	5	455.0	137	0.01	3.32
2005	9	4 743.2	756	-	6.27	7	4 696.5	744	-	6.31
2006	9	5 163.2	702	-	7.35	7	4 404.3	562	-	7.84
2007	10	5 486.9	788	-	6.96	9	5 408.8	782	-	6.92
2008	10	5 436.2	706	-	7.70	10	5 436.2	706	-	7.70
2009	11	4 190.4	487	0.02	8.60	11	4 190.4	487	0.02	8.60
2010	12	3 024.4	364	0.01	8.31	11	2 996.2	360	0.01	8.32
2011	10	4 547.9	557	-	8.16	9	4 527.0	553	-	8.19
2012	11	6 460.6	773	0.01	8.36	10	6 311.0	758	0.01	8.33
2013	15	9 292.8	1 311	0.01	7.09	14	8 751.7	1 242	0.01	7.05
2014	10	7 663.3	959	0.01	7.99	10	7 663.3	959	0.01	7.99
2015	14	3 703.9	418	-	8.86	13	3 680.1	415	-	8.87
2016	12	6 366.7	899	-	7.08	11	6 352.7	892	-	7.12
2017	10	6 513.5	790	-	8.24	9	5 616.8	672	-	8.36

Table A3: continued.

Sub-Antarctic: TCEPR tow-by-tow, BT, target hoki (Year as Oct–Sep)

Year	All vessels					Core vessels				
	No. vessels	Catch	Effort	Prop. zeros	CPUE	No. vessels	Catch	Effort	Prop. zeros	CPUE
1992	34	27 491.2	5 217	0.02	5.27	5	9 846.5	1 794	0.02	5.49
1993	24	21 238.1	4 786	0.02	4.44	6	9 563.5	2 075	0.01	4.61
1994	24	8 739.1	1 973	0.03	4.43	6	5 451.7	1 296	0.02	4.21
1995	24	11 432.7	2 286	0.03	5	6	7 388.2	1 618	0.02	4.57
1996	25	10 577.7	2 421	0.06	4.37	7	7 225.4	1 591	0.02	4.54
1997	42	18 508.9	3 180	0.04	5.82	14	17 041.4	2 732	0.03	6.24
1998	35	23 349.3	4 219	0.02	5.53	14	22 215.5	3 877	0.02	5.73
1999	34	20 005.0	3 525	0.03	5.68	14	17 876.5	3 082	0.02	5.80
2000	29	30 540.8	5 713	0.02	5.35	19	30 133.8	5 520	0.02	5.46
2001	32	25 190.0	5 286	0.02	4.77	20	24 162.6	4 997	0.02	4.84
2002	33	28 411.3	6 187	0.03	4.59	17	27 141.4	5 724	0.02	4.74
2003	32	19 057.3	4 308	0.02	4.42	18	18 588.7	4 100	0.01	4.53
2004	27	10 789.1	2 855	0.05	3.78	13	10 442.9	2 713	0.05	3.85
2005	25	5 085.1	1 332	0.06	3.82	10	4 775.2	1 191	0.05	4.01
2006	16	4 635.6	717	0.02	6.47	8	4 415.6	641	0.02	6.89
2007	20	5 134.9	1 132	0.05	4.54	10	4 740.3	1 031	0.03	4.60
2008	14	5 820.2	905	0.02	6.43	5	5 737.4	872	0.02	6.58
2009	13	6 874.3	917	0.01	7.50	4	6 776.5	890	0.01	7.61
2010	12	9 686.7	1 231	0.02	7.87	6	9 425.5	1 184	0.01	7.96
2011	15	9 201.5	1 235	0.01	7.45	5	8 451.6	1 131	0.01	7.47
2012	17	11 474.1	1 191	0.01	9.63	7	10 454.8	1 107	0.01	9.44
2013	16	11 643.3	1 362	0.01	8.55	7	11 451.3	1 321	0.01	8.67
2014	13	16 964.0	1 856	-	9.14	6	16 183.8	1 674	-	9.67
2015	15	13 022.8	1 606	0.01	8.11	9	12 226.4	1 444	-	8.47
2016	10	5 643.9	823	0.01	6.86	6	5 608.0	806	0.01	6.96
2017	15	10 899.8	1 248	0.02	8.73	6	10 514.9	1 181	0.01	8.90

Sub-Antarctic: Observer tow-by-tow, BT, for target hoki (Year as Oct–Sep)

Fishing year	All vessels					Core vessels				
	No. vessels	Catch	Tows	Prop. zeros	CPUE	No. vessels	Catch	Tows	Prop. zeros	CPUE
1998	4	1 449.4	231	-	6.27	3	1 123.2	174	-	6.46
1999	10	4 686.2	726	0.01	6.45	8	4 473.5	664	0.01	6.74
2000	10	4 956.4	1 023	0.01	4.84	9	4 955.5	1 020	0.01	4.86
2001	15	2 724.0	501	0.01	5.44	11	2 296.6	395	0.01	5.81
2002	7	3 601.1	692	-	5.20	7	3 601.1	692	-	5.20
2003	11	1 971.5	517	0.01	3.81	8	1 893.2	488	0.01	3.88
2004	7	548.0	191	0.14	2.87	5	546.9	187	0.12	2.92
2005	4	373.2	91	0.03	4.10	4	373.2	91	0.03	4.10
2006	5	1 169.6	147	-	7.96	5	1 169.6	147	-	7.96
2007	7	1 121.9	177	-	6.34	6	1 121.9	176	-	6.37
2008	5	2 384.8	314	-	7.59	5	2 384.8	314	-	7.59
2009	5	2 858.4	396	0.02	7.22	5	2 858.4	396	0.02	7.22
2010	6	2 678.3	313	0.02	8.56	6	2 678.3	313	0.02	8.56
2011	7	1 627.2	218	0.02	7.46	7	1 627.2	218	0.02	7.46
2012	8	1 700.3	196	-	8.67	8	1 700.3	196	-	8.67
2013	14	5 826.0	754	-	7.73	14	5 826.0	754	-	7.73
2014	12	4 318.1	556	-	7.77	12	4 318.1	556	-	7.77
2015	12	2 189.7	300	-	7.30	11	2 173.8	297	-	7.32
2016	5	879.8	141	0.02	6.24	4	861.2	133	0.02	6.48
2017	8	801.8	111	0.03	7.22	7	800.9	110	0.03	7.28

Table A4: Lognormal CPUE standardised indices (with 95% confidence intervals).

WCSI: TCEPR tow-by-tow, target hoki

Year	Index	CI
1990	1.03	0.89 – 1.19
1991	1.05	0.93 – 1.18
1992	1.18	0.98 – 1.43
1993	0.99	0.88 – 1.11
1994	0.97	0.90 – 1.06
1995	0.72	0.64 – 0.82
1996	0.72	0.66 – 0.79
1997	0.81	0.73 – 0.89
1998	0.94	0.87 – 1.02
1999	0.83	0.76 – 0.90
2000	1.04	0.97 – 1.11
2001	0.70	0.65 – 0.75
2002	0.77	0.72 – 0.82
2003	0.48	0.45 – 0.52
2004	0.30	0.28 – 0.32
2005	0.44	0.41 – 0.47
2006	0.82	0.76 – 0.89
2007	1.24	1.12 – 1.38
2008	1.06	0.95 – 1.17
2009	1.56	1.39 – 1.74
2010	1.49	1.34 – 1.65
2011	1.68	1.53 – 1.86
2012	1.85	1.71 – 2.00
2013	1.84	1.74 – 1.95
2014	1.66	1.56 – 1.76
2015	1.81	1.71 – 1.91
2016	1.27	1.19 – 1.35
2017	1.28	1.20 – 1.37

WCSI: Observer catch, target hoki

Year	Index	CI
1991	1.13	1.08 – 1.18
1992	1.17	1.12 – 1.22
1993	1.02	0.98 – 1.05
1994	0.94	0.91 – 0.97
1995	0.62	0.60 – 0.64
1996	0.73	0.71 – 0.75
1997	0.73	0.71 – 0.75
1998	0.88	0.86 – 0.91
1999	0.93	0.91 – 0.96
2000	1.06	1.03 – 1.09
2001	0.78	0.76 – 0.80
2002	0.77	0.75 – 0.79
2003	0.60	0.58 – 0.61
2004	0.39	0.38 – 0.40
2005	0.47	0.45 – 0.48
2006	0.69	0.67 – 0.72
2007	1.17	1.11 – 1.22
2008	1.08	1.02 – 1.14
2009	1.53	1.43 – 1.62
2010	1.44	1.38 – 1.51
2011	1.48	1.42 – 1.54
2012	1.72	1.65 – 1.79
2013	1.84	1.77 – 1.91
2014	1.66	1.60 – 1.72
2015	1.76	1.70 – 1.82
2016	1.37	1.33 – 1.42
2017	1.18	1.14 – 1.23

Cook Strait: TCEPR MW tow-by-tow, target hoki

Year	Index	CI
1991	0.99	0.93 – 1.04
1992	1.13	1.06 – 1.21
1993	1.05	0.99 – 1.12
1994	1.28	1.20 – 1.36
1995	1.30	1.23 – 1.38
1996	1.16	1.11 – 1.22
1997	0.92	0.88 – 0.96
1998	1.01	0.96 – 1.06
1999	1.01	0.96 – 1.07
2000	1.03	0.97 – 1.08
2001	0.85	0.80 – 0.90
2002	1.29	1.20 – 1.38
2003	1.05	0.99 – 1.11
2004	0.95	0.90 – 1.00
2005	0.84	0.79 – 0.89
2006	0.99	0.92 – 1.06
2007	0.72	0.67 – 0.77
2008	1.13	1.01 – 1.27
2009	0.74	0.68 – 0.80
2010	0.92	0.85 – 1.00
2011	1.09	0.99 – 1.20
2012	0.85	0.79 – 0.92
2013	0.92	0.85 – 0.99
2014	0.90	0.83 – 0.97
2015	0.95	0.88 – 1.03
2016	1.11	1.02 – 1.22
2017	1.12	1.02 – 1.23

Cook Strait: Observer catch, target hoki

Year	Index	CI
1998	0.88	0.66 – 1.16
1999	1.10	0.84 – 1.44
2000	1.12	0.84 – 1.49
2001	0.73	0.56 – 0.96
2002	0.77	0.53 – 1.13
2003	0.55	0.38 – 0.79
2004	0.98	0.70 – 1.39
2005	1.65	1.13 – 2.42
2006	1.14	0.79 – 1.65
2007	0.55	0.42 – 0.72
2008	1.17	0.91 – 1.49
2009	0.83	0.62 – 1.10
2010	1.09	0.84 – 1.41
2011	1.24	0.91 – 1.70
2012	1.06	0.78 – 1.45
2013	1.24	0.88 – 1.74
2014	0.95	0.73 – 1.25
2015	0.75	0.37 – 1.49
2016	1.87	1.43 – 2.44
2017	1.28	0.93 – 1.74

Table A4: continued.

Chatham Rise: TCEPR tow-by-tow, target hoki

Year	Index		CI
1992	1.16	1.09	– 1.24
1993	1.00	0.96	– 1.05
1994	0.92	0.88	– 0.97
1995	0.82	0.80	– 0.85
1996	0.90	0.87	– 0.93
1997	0.89	0.86	– 0.91
1998	0.80	0.78	– 0.82
1999	0.89	0.87	– 0.91
2000	0.77	0.75	– 0.78
2001	0.74	0.72	– 0.75
2002	0.73	0.71	– 0.75
2003	0.57	0.56	– 0.58
2004	0.58	0.57	– 0.60
2005	0.77	0.75	– 0.79
2006	0.97	0.94	– 1.00
2007	1.06	1.03	– 1.10
2008	1.24	1.20	– 1.28
2009	1.39	1.34	– 1.43
2010	1.25	1.21	– 1.29
2011	1.39	1.35	– 1.44
2012	1.43	1.38	– 1.47
2013	1.32	1.28	– 1.36
2014	1.33	1.28	– 1.37
2015	1.39	1.34	– 1.43
2016	1.25	1.21	– 1.29
2017	1.43	1.39	– 1.48

Chatham Rise: Observer catch, target hoki

Year	Index		CI
1994	1.10	0.91	– 1.32
1995	0.77	0.67	– 0.89
1996	0.93	0.82	– 1.06
1997	0.68	0.55	– 0.84
1998	0.77	0.72	– 0.83
1999	0.97	0.90	– 1.05
2000	0.81	0.74	– 0.88
2001	0.70	0.65	– 0.77
2002	0.73	0.68	– 0.79
2003	0.54	0.50	– 0.59
2004	0.60	0.49	– 0.72
2005	0.88	0.81	– 0.96
2006	1.03	0.94	– 1.13
2007	1.14	1.05	– 1.23
2008	1.27	1.17	– 1.38
2009	1.39	1.26	– 1.53
2010	1.45	1.29	– 1.62
2011	1.30	1.18	– 1.43
2012	1.35	1.24	– 1.46
2013	1.20	1.12	– 1.28
2014	1.44	1.33	– 1.55
2015	1.41	1.26	– 1.57
2016	1.21	1.13	– 1.31
2017	1.38	1.27	– 1.50

Sub-Antarctic: TCEPR tow-by-tow, target hoki

Year	Index		CI
1992	0.94	0.89	– 1.00
1993	0.85	0.81	– 0.90
1994	0.91	0.85	– 0.97
1995	0.83	0.78	– 0.88
1996	0.87	0.82	– 0.92
1997	1.09	1.05	– 1.14
1998	0.97	0.94	– 1.00
1999	0.89	0.86	– 0.93
2000	0.91	0.88	– 0.94
2001	0.81	0.78	– 0.84
2002	0.77	0.75	– 0.80
2003	0.74	0.71	– 0.77
2004	0.57	0.54	– 0.59
2005	0.58	0.55	– 0.61
2006	0.82	0.76	– 0.89
2007	0.76	0.71	– 0.81
2008	1.16	1.08	– 1.24
2009	1.33	1.24	– 1.42
2010	1.38	1.30	– 1.47
2011	1.38	1.30	– 1.46
2012	1.66	1.56	– 1.77
2013	1.43	1.35	– 1.51
2014	1.54	1.46	– 1.62
2015	1.46	1.39	– 1.54
2016	1.20	1.12	– 1.29
2017	1.25	1.18	– 1.33

Sub-Antarctic: Observer catch, target hoki

Year	Index		CI
1998	1.15	0.93	– 1.42
1999	1.05	0.94	– 1.17
2000	0.77	0.70	– 0.85
2001	1.02	0.90	– 1.16
2002	0.69	0.62	– 0.76
2003	0.59	0.52	– 0.67
2004	0.62	0.52	– 0.75
2005	0.44	0.36	– 0.56
2006	0.86	0.70	– 1.06
2007	1.18	0.97	– 1.43
2008	1.28	1.13	– 1.45
2009	1.16	1.03	– 1.31
2010	1.34	1.18	– 1.52
2011	1.40	1.20	– 1.65
2012	1.25	1.08	– 1.46
2013	1.25	1.14	– 1.37
2014	1.39	1.26	– 1.54
2015	1.38	1.22	– 1.57
2016	1.02	0.86	– 1.23
2017	1.07	0.86	– 1.32